Climate Change Mitigation

Basic Approach

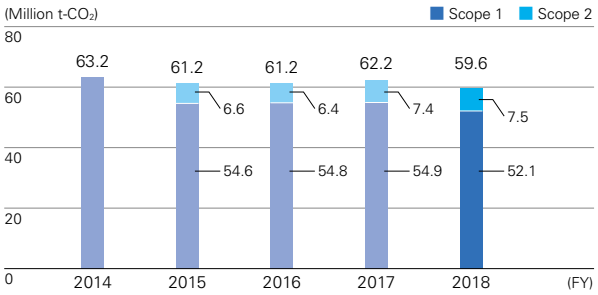
The JFE Group's business involves steel manufacturing, which emits large amounts of CO_2. Therefore, climate change is a serious management concern from the viewpoint of the Group's business continuity. The steel business, which accounts for 99.9% of the Group's CO_2 emissions, has developed many technologies for saving energy and reducing CO_2 emissions and has adopted them in its steel manufacturing process. As a result, CO_2 emission intensity in its steel manufacturing process is the lowest in the world. The JFE Group also develops and possesses many other eco-friendly products and technologies such as high-performance steel materials that contribute to the customer's energy saving and power generation using renewable energy.

Going forward, the Group will continue to achieve technical advances in products and services while at the same time expanding the uses of technologies it has accumulated over many years throughout its global operations, all part of its contribution toward mitigating climate change.

CO_2 Emissions of the JFE Group

JFE's CO_2 emissions are mainly generated by its steel business. However, beyond reducing CO_2 emissions from steel production process, each company sets specific targets corresponding with their operations to further save energy and reduce CO_2 emissions.

■ CO_2 Emissions of the JFE Group



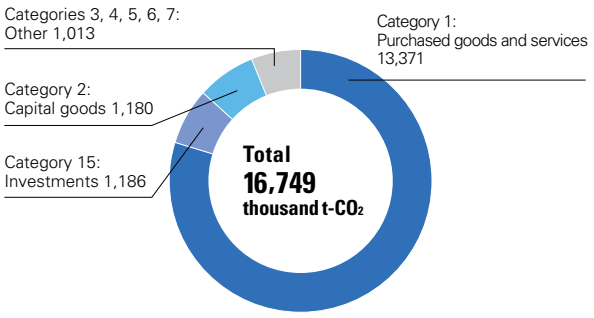
Data cover 76 companies, including JFE Steel and 30 major domestic and overseas subsidiaries, JFE Engineering and 10 major domestic subsidiaries, and JFE Shoji Trade and 33 major domestic and overseas subsidiaries.

Notes: Data for JFE Steel include CO_2 emissions from non-energy sources. Starting with FY2018, data for JFE Steel's subsidiaries and JFE Engineering's subsidiary include CO_2 emissions from non-energy sources.

■ CO_2 Emissions by Operating Company (FY2018)

JFE Steel	JFE Engineering	JFE Shoji Trade
59,357 thousand t-CO_2	212 thousand t-CO_2	36 thousand t-CO_2
99.58%	0.36%	0.06%

■ Scope 3 Emissions of the JFE Group (FY2018)



Coverage: (Categories 1, 2, 3, 4, 5) JFE Steel, 25 JFE Steel domestic subsidiaries, JFE Engineering, and JFE Shoji Trade
(Category 6, 7) JFE Steel, 25 JFE Steel domestic subsidiaries, JFE Engineering, 10 JFE Engineering domestic subsidiaries, and JFE Shoji Trade
(Category 15) Japan Marine United, and 9 JFE Steel equity-method affiliates (7 domestic and 2 overseas)
Sources: Green Value Chain Platform (Ministry of the Environment) and others

Energy Savings and CO_2 Reduction in Iron and Steelmaking

Initiatives to Save Energy and Reduce CO_2

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

Energy Consumption and CO_2 Emissions in FY2018

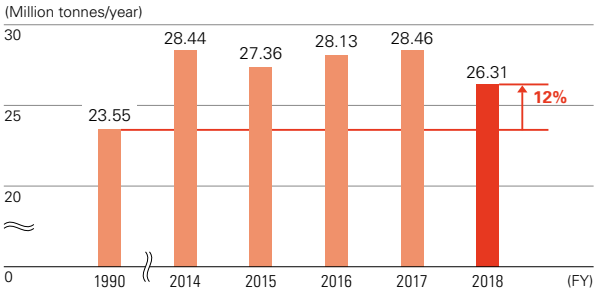
Energy consumption and CO_2 emissions in iron and steelmaking are greatly influenced by production volume. To accurately assess the effects of improvements due to operational technologies and capital investments, JFE Steel is working to reduce its intensity (energy consumption and CO_2 emissions per unit of production) and related energy-conservation activities.

JFE Steel's crude steel production was 26.31 million tonnes in FY2018, down 8% from FY2017 and up 12% from FY1990. However, thanks to ongoing energy-saving activities, energy consumption was down 9% and CO_2 emissions were down 9% from FY1990.

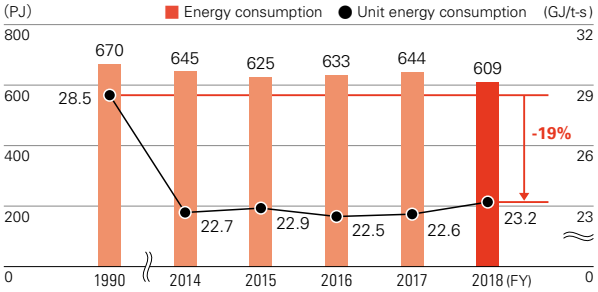
The company's energy consumption intensity in FY2018 was 19% below the FY1990 level at 23.2 GJ/

t-steel, while CO_2 emission intensity was down 18% to 2.02 t-CO_2/t-steel. The results prove the success of JFE Steel's energy-saving activities in recent years, including capital investments in energy conservation and promotion of energy conservation through the visualization of the reheat furnace fuel basic unit.

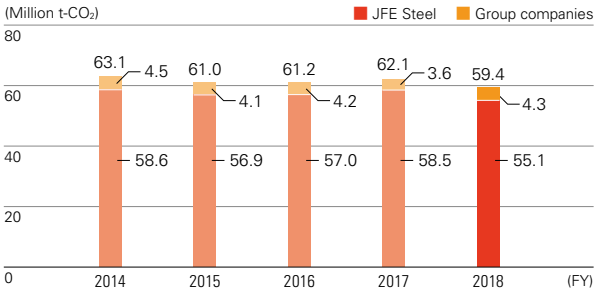
■ Production of Crude Steel of JFE Steel



■ Energy Consumption and Unit Energy Consumption of JFE Steel

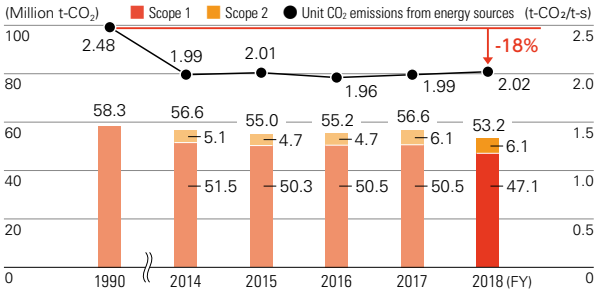


■ CO_2 Emissions of JFE Steel Group



Data cover JFE Steel and 30 consolidated subsidiaries in Japan and overseas.
Note: Data for FY2018 include CO_2 emissions from non-energy sources at the subsidiaries.

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

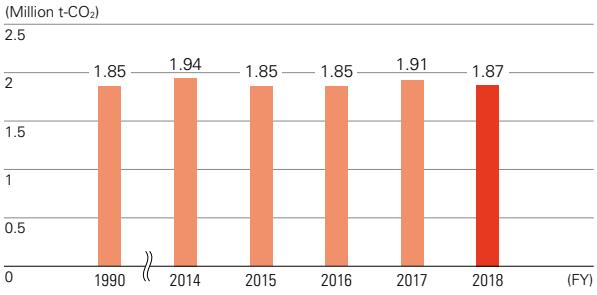


Note: The CO_2 emissions and emission intensity in FY2018 are calculated using the CO_2 emission factor for electricity purchased in FY2017 on the Japan Iron and Steel Federation's Commitment to a Low Carbon Society.

CO_2 Emissions from Non-energy Sources

Lime and dolomite, which are used as auxiliary materials in blast furnaces and converters, emit CO_2 in decomposition.

■ CO_2 Emissions from Non-energy Sources of JFE Steel



Data cover JFE Steel

Steel Industry Initiatives

Japan Iron and Steel Federation (JISF) Initiatives

Long-term Vision for Climate Change Mitigation

In addition to ongoing efforts to achieve the Commitment to a Low Carbon Society, 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 an important role in formulating this vision.

Mid-term (–2030) Initiatives	• Promotion and expansion of The Three Ecos Initiatives • Development and implementation of innovative new iron and steelmaking processes
Long-term (–2050) Initiatives	• Promotion of innovative new iron and steelmaking processes • Development of super innovative iron and steelmaking processes and CCS/CCU technologies
End (–2100) Vision	• Realization of zero-carbon steel • Implementation of super innovative iron and steelmaking processes

The Commitment to a Low Carbon Society

The Japan Iron and Steel Federation (JISF) is promoting its Commitment to a Low Carbon Society, which focuses on the Three Ecos initiatives and the development of innovative new iron and steelmaking processes. JFE Steel is actively implementing initiatives to help achieve the plan's targets.

Assessment of Commitment to a Low Carbon Society Results (JISF)

In FY2017 emissions by the Japanese steel industry decreased by 2.29 million t-CO_2 compared to the BAU emissions* benchmark. Various self-improvement efforts, such as raising the efficiency of coke ovens and generation facilities, are steadily contributing to this reduction. JFE Steel is actively working on these self-improvement efforts as well as investing in research and development for new energy-saving technologies.

*Business As Usual emissions: Estimated level of emissions in the absence of any special measure.

Revolutionary Iron and Steelmaking Process Development

COURSE50

About 30% of CO_2 emissions can be reduced through hydrogen reduction along with separation and capture of CO_2 from blast furnace gases. The first facility is expected to come online by 2030, followed by other plants by 2050.

Ferro Coke

The Japanese steel industry intends to develop ferro coke that accelerates and lowers the temperatures of the reduction reaction in a blast furnace as well as its operational processes to conserve energy further and

■ CO_2 Reduction Medium- to Long-Term Targets (Japan Iron and Steel Federation's "Commitment to a Low Carbon Society")

Three Ecos		Eco Processes	Eco Products	Eco Solutions
Goal		Further improve energy efficiency by taking full advantage of cutting-edge technologies	Provide high-performance steel materials that result in high performing end-products and thus reducing CO_2 emissions	Reduce CO_2 in developing countries through the transfer and application of world-leading, energy-saving Eco Process technologies
Targets	FY2020 (phase-I)	Reduce CO_2 emissions by 5 million t-CO_2 compared to the BAU benchmark • Energy conservation: 3 million t-CO_2 • Efficient use of waste plastics, etc.: 2 million t-CO_2	The use of major high-performance steel materials to contribute to a CO_2 reduction of approximately 34.0 million t-CO_2	Estimated CO_2 reduction impact of 70 million t-CO_2
	FY2030 (phase-II)	Reduce CO_2 emissions by 9 million t-CO_2 compared to the BAU benchmark	The use of major high-performance steel materials to contribute to a CO_2 reduction of approximately 42.0 million t-CO_2	Estimated CO_2 reduction impact of 80 million t-CO_2
Status as of FY2017 year-end		Reduced 2.29 million t-CO_2 emissions (energy conservation etc.), compared to the BAU benchmark	Domestic and international use contributed to a CO_2 reduction of 29.73 million t-CO_2	CO_2 reduction impact of 62.59 million t-CO_2

Source: Public data from the Japan Iron and Steel Federation

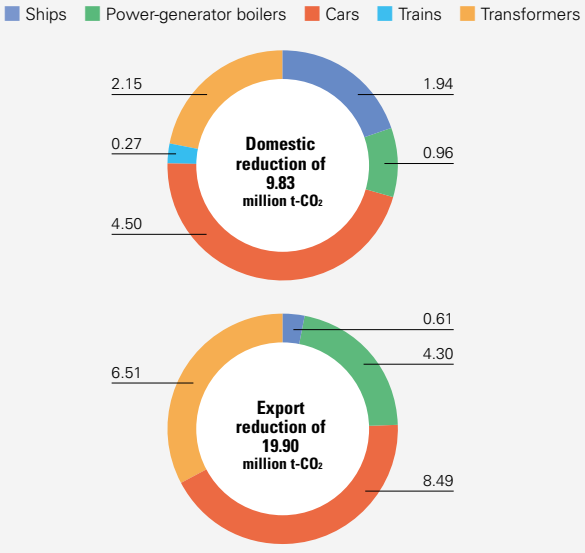
expand the use of low-rank materials. Currently, a medium-scale plant capable of producing 300 tonnes of ferro coke per day is being constructed in JFE Steel's West Japan Works (Fukuyama district) to establish the technology for producing and using the material.

Reduced CO_2 Emissions through High-performance Steel Materials (Effects of Eco Product)

The Japan Iron and Steel Federation expects the use of high-performance steel materials to reduce CO_2 emissions. It is estimated that the use of 5 major high-performance steel materials for cars, transformers, ships, power generator boilers, and trains in Japan and overseas (FY2017 production: 6.95 million tonnes, 6.6% of crude steel production) helped to reduce CO_2 emissions by 29.73 million tonnes in FY2017.

Notes: Estimates created by the Institute of Energy Economics, Japan.
Materials included are steel sheets for automobiles, directional electrical steel sheets, thick steel sheets for shipbuilding, steel tubes for boilers, stainless steel sheets.
For the domestic figures, the calculation includes data from FY1990 onward. For the export figures, the calculation includes data from FY2003 onward for automobile and shipbuilding, from FY1998 onward for steel pipes for boilers and from FY1996 onward for electrical steel sheets.

■ CO_2 Reduction Resulting from the Use of Five High-performance Steel Materials in Japan and Abroad (FY2017)



Global Scale Initiatives

Addressing Global Warming

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

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

Japan-ASEAN Steel Initiative

Climate Action Member Certification

Contribution to the Development of Life Cycle Inventory Calculation in LCA

In order to accurately evaluate the environmental impact of products, assessment and quantification is required over their entire life cycles, from raw resource mining to material production, product manufacture, use and final disposal. Life Cycle Assessment (LCA) is one method for conducting this evaluation.

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

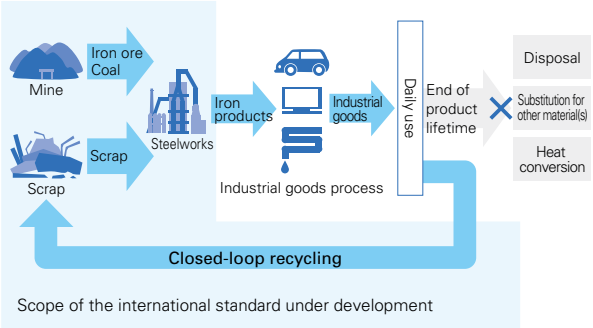
The standard for appropriately considering this ability of steel products to undergo closed-loop recycling was published in November 2018.

ISO 20915 (life cycle inventory calculation methodology for steel products) was developed by JISF with JFE Steel playing a major role, and provides a life cycle inventory (LCI) calculation method specific to steel products that takes into account the effects of recycling.

In addition, the Japan domestic version of this standard, JIS Q 20915 (life cycle inventory calculation methodology for steel products), was published in June 2019.

Notes: JFE Steel, together with the WSA (World Steel Association, comprising of approximately 170 steel manufacturers and steel-related organizations) and the Japan Iron and Steel Foundation (JISF), is working to establish LCA as an international standard methodology for calculating LCI for steel materials.

■Life Cycle of Steel Materials



CO_2 Reduction Initiatives

Initiatives towards CCU/CCS

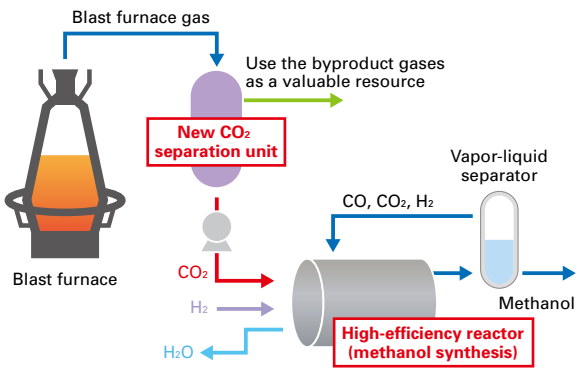
In order to reduce CO_2 emissions from the steel manufacturing process, JFE Steel is actively engaged in the development of new technologies to separate and recover CO_2 from blast furnace gas. This is in line with the JISF's COURSE50 project (CO_2 Ultimate Reduction in Steelmaking Process by Innovative Technology for Cool Earth 50), which focuses on hydrogen reduction of iron ore and separation and recovering of CO_2 from blast furnace gas. JFE Steel has been working on developing for practical use a physical adsorption technology for separating and capturing CO_2, which could then be fed to carbon capture and storage (CCS).

More recently, JFE Steel has also initiated R&D into the effective use of CO_2 separated and recovered from blast furnace gas and is one of the first domestic steel manufacturers to explore this field. JFE Steel is a participating member of NEDO*1 projects for the development of next-generation thermal power generation technologies / development of basic technologies for next-generation thermal power generation / development of CO_2 utilization technology project, and as such, it is working on an initiative together with RITE*2 to develop new technologies for separating and recovering CO_2 from blast furnace gas and utilizing it to synthesize methanol (CH_3OH).

In this project, JFE Steel is developing technologies that lower the cost of CO_2 separation and recovery that meets the objectives of CCU and process design for effective CO_2 utilization. The expertise in CO_2 separation and recovery technologies it has acquired through the COURSE50 project is applied to CCU.

*1 New Energy and Industrial Technology Development Organization
*2 Research Institute of Innovative Technology for the Earth

■CCU Technology



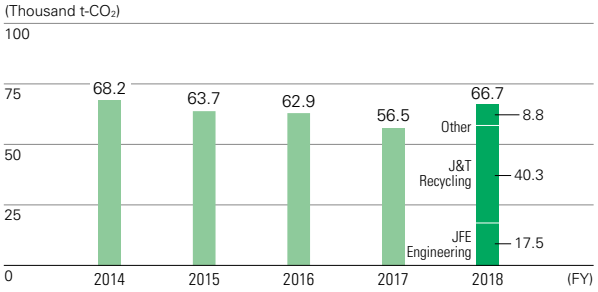
JFE Engineering strives to reduce CO_2 emissions in society through our clients and their daily operations by providing them with eco-friendly products and technologies, including those that harness renewable energy and energy-saving products.

For example, if all of the renewable energy-related plants that JFE Engineering has constructed by FY2018, including those currently under construction, were in operation, their estimated contribution* to CO_2 reduction would mount up to 4.12 million tonnes per year. Furthermore, JFE Engineering strives to reduce its own CO_2 emissions in accordance with the Energy Conservation Law, from its head office, branch offices, and works.

In FY2018, CO_2 emissions increased by approximately 120 thousand tonnes compared to the previous fiscal year due to the merger with Tokyo Waterfront Recycle Power. The JFE Engineering group has been achieving the reduction target set by the Energy Conservation Law every year since FY2015. Companies of the group each have their own energy saving initiatives that are appropriate for their businesses to make their contribution in reducing overall CO_2 emissions.

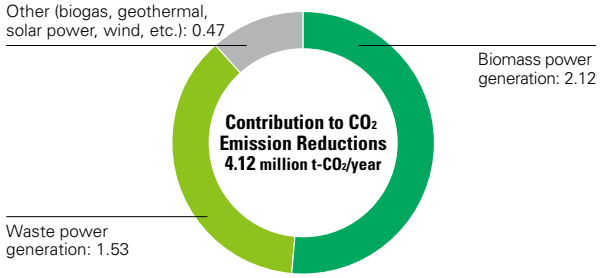
*For renewable energy power generation plants, the characteristics of each plant is taken into consideration while estimating their CO_2 emissions.

■JFE Engineering Group's CO_2 Emissions from Energy Sources



Data cover CO_2 emissions from energy sources by JFE Engineering and 10 consolidated subsidiaries in Japan.

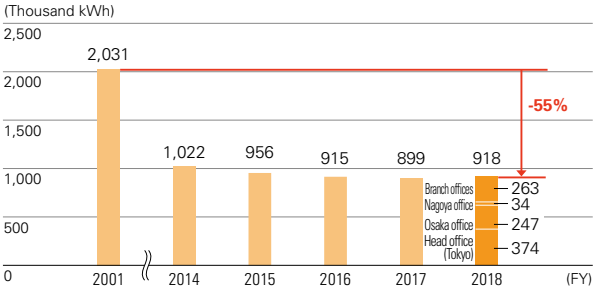
■Contribution to CO_2 Emission Reductions by Renewable Energy Plants (FY2018)



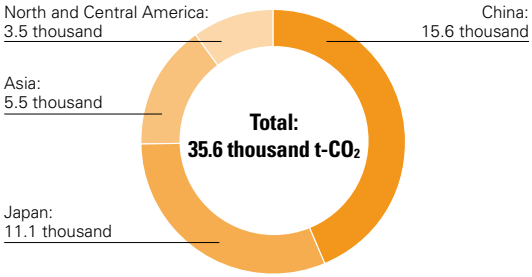
JFE Shoji Trade offices in Japan work to reduce their use of energy and paper as well as strictly manage waste separation. Energy consumption has been lowered significantly by observing days when employees are encouraged to leave work on time, prohibiting night work, and introducing pinpoint lighting. In FY2018, as in the previous year, the company has achieved more than a 50% reduction in energy consumption compared to FY2001.

In addition, the company has introduced video conferencing systems in offices worldwide to reduce printed reference materials and domestic and international business trips.

■Electric Power Consumption by JFE Shoji Trade



■CO_2 Emissions of the JFE Shoji Trade Group (FY2018)



The graph shows CO_2 emissions from electric power consumption by JFE Shoji Trade and 33 consolidated subsidiaries (steel-processing companies) in Japan and overseas.

Disclosure of CO_2 Reduction Initiatives

JFE Holdings is responding to requests to disclose its efforts to mitigate climate change and is providing inputs to the Carbon Disclosure Project (CDP)*.

*An international non-profit organization that works with institutional investors to collect and disclose information from corporations on their greenhouse gas emissions and other climate change risks.

Products and Technologies that Reduce CO_2 Emissions

JNSF Core™—an Electrical Steel Sheet that Improves the Efficiency of Electrical Equipment

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 such electrical equipment. JFE Steel has developed a proprietary technology to soak silicon (Si) into steel sheets by utilizing chemical vapor disposition (CVD). This led the company to successfully develop and commercialize a new steel sheet, JNSF Core™, which is a compact and highly magnetic material with lower energy loss when in use.

The steel sheet significantly contributes to improving the efficiency of electrical equipment and downsizing them. It is widely used in equipment surrounding solar power generation.

JFE Steel was awarded the chairman's prize of National Commendation for Invention Awards 2019 in recognition of this achievement.

Electrical equipment used in solar power generation (reactor)

Ultra-narrow-gap J-STAR™—a High-weldability CO_2 Arc-welding Technology

When assembling a box column using four steel plates, submerged arc welding*1 is typically used for welding the corners. However, the high heat input used can cause deformation.

On the other hand, CO_2 arc welding*2 uses a lower heat input and therefore causes less deformation. Nevertheless, it is less efficient. JFE Steel improved this CO_2 arc welding and developed the Ultra-narrow-gap J-STAR™ Welding method, which achieves both high efficiency and low deformation. Its improved efficiency means that the welding process applying the method takes less time to complete and thus uses less CO_2.

Characteristics of the welding method were considered highly suitable for the reconstruction of Kumamoto Castle, and Nagai Steel Co. used it to complete the assembly of the box columns then used to construct the six-story of the castle tower.

*1 A welding process that feeds the welding wire into areas spread with granular flux and generates an arc under the flux.
*2 The most widely used and inexpensive gas shield arc welding, which uses 100% CO_2 for the shielding gas.

Steel construction of the six-story of the castle tower of Kumamoto Castle

Use of Granulated Blast Furnace Slag to Reduce CO_2 Emissions

Granulated blast furnace slag in crushed and powdered form can be mixed with cement and used as a substitute for cement for making concrete. This leads to reducing the production of cement and hence lower CO_2 emissions. For example, producing one tonne of blast furnace slag cement with 45% of its content substituted with granulated blast furnace slag emits 41% less CO_2 than conventional cement. By FY2018, JFE Steel had supplied approximately 6.4 million tonnes of granulated blast furnace slag to cement production, equivalent to a reduction of approximately 4.5 million tonnes of CO_2 emissions.

In addition, studies have shown that using blast furnace slag as a substitute for the natural sand in concrete improves its mechanical property. There is a growing interest in the practical applications of this property as potential new technologies that strengthen the nation.

Example of precast, which uses granulated blast furnace slag cement

■ CO_2 Emission for Producing 1 Tonne of Cement (Unit: kg-CO_2)

CO_2 Emission Source	Regular Cement	Blast Furnace Slag Cement
Limestone	473	272
Electricity	311	190
Total	**784**	**463**

Regional Electricity Retail Businesses in Partnership with the Local Municipal Governments

JFE Engineering has established several regional electricity retail companies in partnership with local municipal governments. It is actively involved in the regional electricity business, with a particular focus on the distribution of renewable energy.

It sources its electricity from waste-fueled and other renewable-energy power generation plants that it has built and distributes the electricity to local areas and public facilities, thus promoting local production and consumption of electricity.

Through these regional electricity businesses, JFE Engineering intends to promote renewable energy, reduce electricity cost for public facilities, and expand the region's industrial infrastructure.

The regional electricity companies JFE Engineering has established in partnership with the municipal government are Smart Energy Iwata in Iwata city, Shizuoka Prefecture; Tokorozawa Mirai Electricity in Tokorozawa City, Saitama Prefecture; Fukuyama Mirai Energy in Fukuyama City, Hiroshima Prefecture; and Smart Energy Kumamoto in Kumamoto City, Kumamoto Prefecture. The company, through each regional electricity company, works on tailoring its electricity distribution business to the most suitable and effective level for every region, thereby creating sustainable regional societies.

Commencement of regional electricity business ceremony

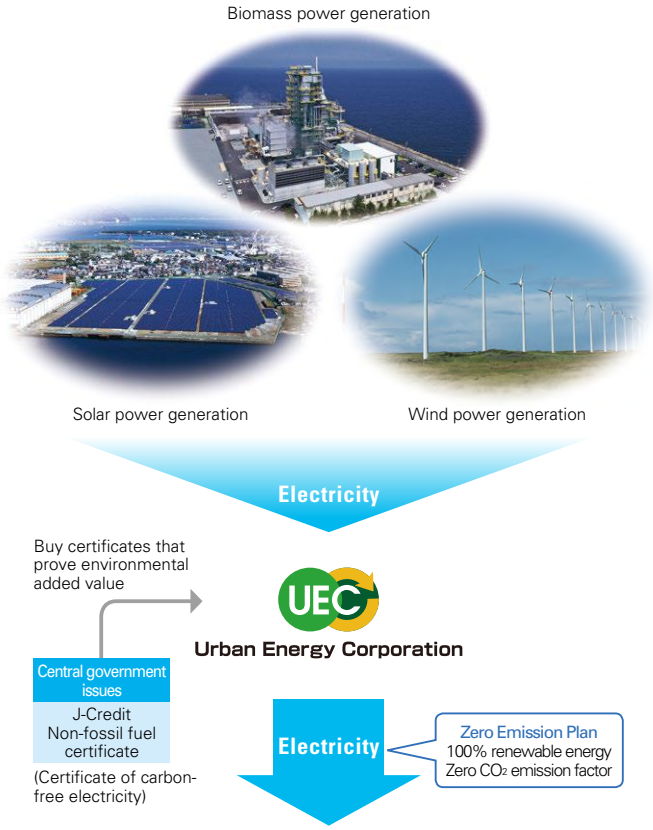

New West Environment Plan in Kumamoto

Promotion of Renewable Energy

JFE Engineering has established an array of electrical power generation plants that use renewable sources such as waste, biomass, solar, and geothermal and has been commissioned to manage their operations. Through its subsidiary Urban Energy Corporation, it is also involved in the retail electricity business using the electricity generated by these plants as the source.

More corporations have become more environmentally aware in recent years. In response, Urban Energy Corporation introduced the special electricity tariff Zero Emission Plan in July 2018 for corporations and organizations, which supplies them with 100% renewable energy.

■ Renewable Energy that the Urban Energy Corporation Supplies (Including Those within the Scope of the FIT Scheme)

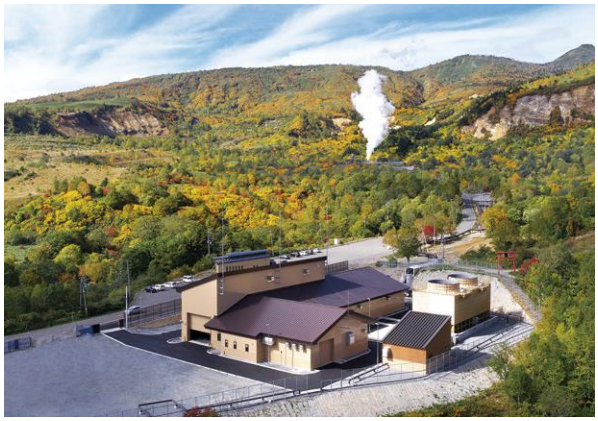


IKEA Tachikawa—a business that focuses on environmental added value

Matsuohachimantai Geothermal Power Plant Now in Operation

In January 2019, Iwate Geothermal Power Co., Ltd. began full operations of its geothermal power generation plant in Matsuohachimantai City, Iwate Prefecture. This was the first time in 22 years that a geothermal power plant with an output higher than 7,000 kW started operating in the country. Historically, steam production facilities and power generation facilities were constructed independently. However, for this plant, JFE Engineering was contracted to construct both facilities, considering the economic benefits and quicker turnaround time to production.

The generated electricity is sold to Tohoku Electricity under the FIT-scheme and resold to Urban Energy Corporation (100% subsidiary of JFE Engineering) as the agreed retailer for this source, which is actively involved in renewable energy and its promotion.



Matsuohachimantai Geothermal Power Plant operated by Iwate Geothermal Power Co., Ltd.

Biomass Fuel

In response to growing demand for biomass fuels by biomass power generation companies, JFE Shoji Trade imports palm kernel shells to Japan from Malaysia and India.

In addition, as the trend toward reducing CO_2 emissions accelerates, demand for renewable energy is rising, especially for biomass power generation not affected by weather conditions. We will respond to this demand by exploring other types of biomass fuels, such as wood pellets, to ensure a stable supply of biomass fuels.

Wood pellets are a biomass fuel that allows for the effective reuse of wood materials from thinning and pruning forests or waste materials from woodworking operations.

Wood pellets are considered to be ideal as a biomass fuel for renewable energy since the CO_2 emitted by burning them is offset by the CO_2 absorbed during tree growth.

We will continue to supply fuel to biomass power generation companies, including JFE Engineering, and do our part in the JFE Group's overall contribution toward realizing an eco-friendly society.

■ Shipping Bases for Palm Kernel Shells