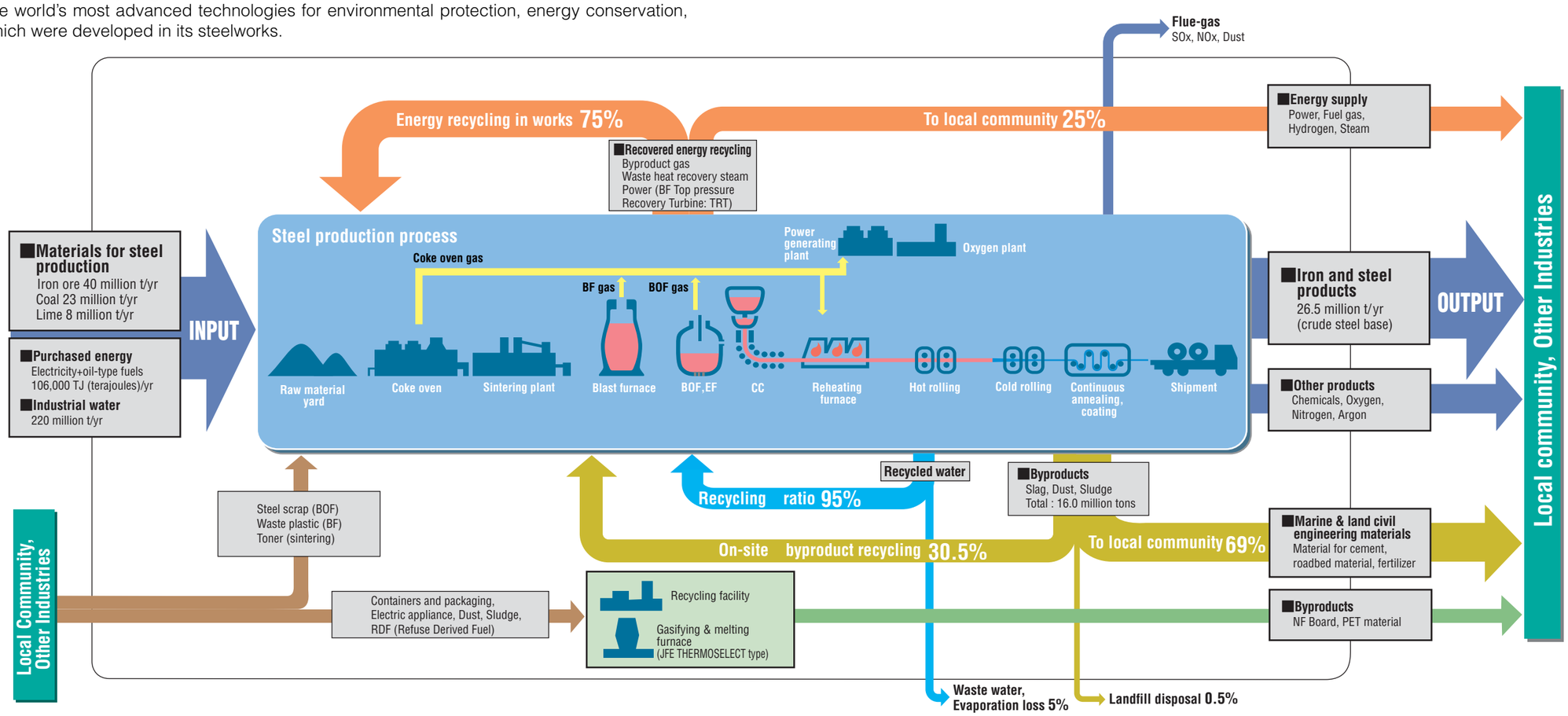
Reducing Environmental Loads in Business Operations

In responding to environmental problems, particularly in the steel division, JFE is reducing environmental loads by developing advanced technologies and implementing voluntary programs for energy conservation, air and water protection, and chemical substance control.

Efforts at JFE Steel

Resource and Energy Recycling in the Steel Production Process

JFE Steel is contributing to a recycling-oriented society in close cooperation with local community and other industries with the world's most advanced technologies for environmental protection, energy conservation, and recycling, which were developed in its steelworks.



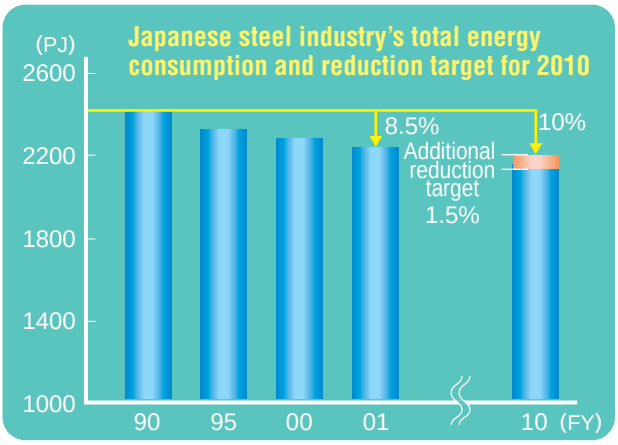
	Steel production process	Raw material yard	Coke oven	Sintering plant	Blast furnace	BOF, CC, EF	Reheating furnace	Hot rolling, cold rolling	Continuous annealing, coating	Shipment
Primary energy conservation measures for steel production	Counter-measures (facility)		Coke dry quenching (CDQ), coal moisture control (CMC), combustion control	Sintering cooler waste heat recovery, ignition furnace line burner	Waste plastics feeding, pulverized coal injection, top pressure recovery turbine, hot stove waste heat recovery, fuel gas preheating	Gas recovery, gas sensible heat recovery, nitrogen jet heater, ladle heating	Regenerative burner, direct charging, low-temperature extraction	Endless rolling, process coupling	Waste heat boiler, rotary regenerative heat exchanger	Selection of transportation mode, shortening of transportation distance, improvement of load efficiency, modal shift, application of IT
		Gas turbine combined cycle power plant Power plant fuel preheating device High efficiency air saparation equipment								
Primary environmental impact of steel production, and countermeasures	Generated substance	Dust	Flue gas, dust, wastewater (ammonia liquor)	Flue gas, dust, wastewater	Flue gas, slag, dust, wastewater	Flue gas, slag, dust, wastewater	Flue gas, dust	Rolling wastewater, pickling wastewater	Coating waste water	Exhaust gas
	Environmental impact	Dust	Dust, NOx, SOx, COD	Dust, NOx, SOx	Dust, SS	Dust, SS	NOx	SS, waste oil, waste acid, iron salt	Metallic ion, etc.	NOx, SPM (suspended particulate matter)
	Countermeasures (facility)	Yard water spraying, belt conveyor dust collection, laser dust monitoring	Coke oven gas desulfurization, waste ammonia liquor COD treatment, chemical by-product recovery	Flue gas desulfurization & denitrification	Gas recovery, dust collection, dust treatment, slag recycling	Gas recovery, dust collection, dust treatment, slag recycling	Low-NOx burner, use of cleaner fuel	Waste acid & waste alkali treatment, waste oil recycling, coagulating sedimentation	Wastewater treatment	Conversion to low-emission vehicles

Preventing Global Warming

Global warming requires a long-term solution involving every individual and business. JFE Steel already boasts the world's highest energy efficiency, but it has also set a high target for global warming prevention measures under the Voluntary Action of the Japan Iron and Steel Federation.

Voluntary Action Plan by Nippon Keidanren (Japan Business Federation)

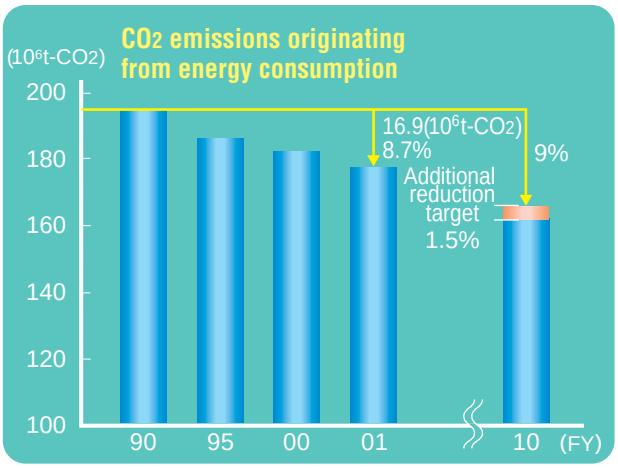
In anticipation of the Kyoto Protocol, Nippon Keidanren established a Voluntary Environmental Action Plan in July 1997, targeting voluntarily CO_2 reductions in the industrial and energy conversion sectors to 1990 levels by 2010. Under Japan's Guidelines for Measures to Prevent Global Warming, results are reviewed annually in the Industrial Structure Council.
In 2001, CO_2 emissions showed a 3.2% reduction from the 1990 baseline. Recognizing this achievement, a third party assessment report for 2002 praised participating businesses for "doing everything in their power, in the face of various difficult circumstances."



(Source: The Japan Iron and Steel Federation)

Voluntary Action Program for Environmental Protection by Japanese Steelmakers

One distinctive feature of Japan's steel industry, in comparison with the U.S. and Europe, is remarkably wide adoption of energy-saving equipment, giving Japanese mills the world's highest energy efficiency. Reflecting Japan's technical capabilities, in December 1996, the Japan Iron and Steel Federation established a Voluntary Action Plan, which targets a 10% reduction in energy consumption in 2010 against a 1990 baseline. As a supplementary goal, a 1.5% reduction by using waste plastic in blast furnaces (assuming creation of an adequate collection system) was later incorporated in the Plan. In 2001, energy consumption was 8.5% below the 1990 baseline, demonstrating the success of voluntary action.



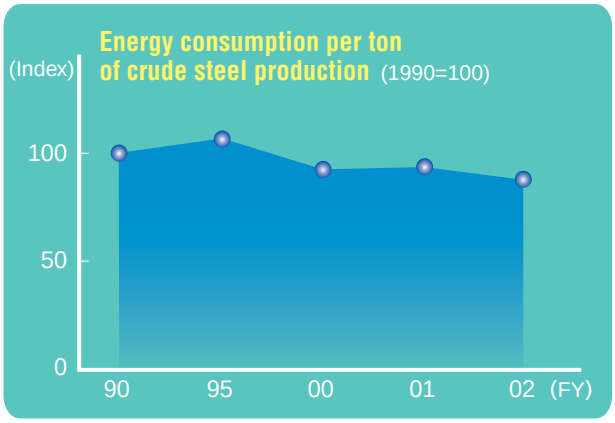
(Source: The Japan Iron and Steel Federation)

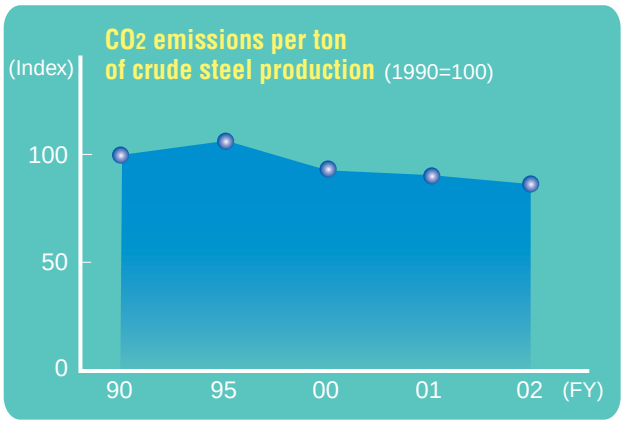
Terminology

PJ
Petajoule, joule (heat unit) x 10^{15} (1000 trillion)

Success of JFE Steel's Energy Conservation Measures

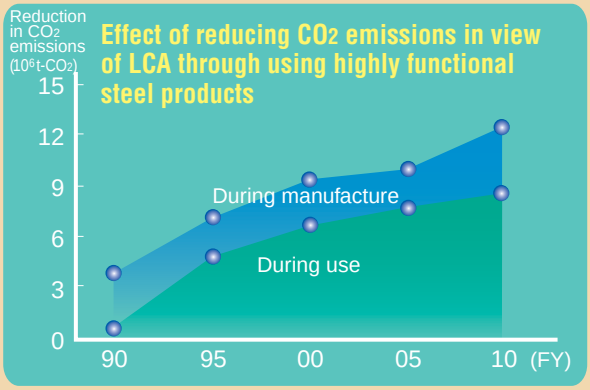
Between the first Oil Crisis in 1973 and 1990, JFE adopted an aggressive energy-saving policy, reducing consumption by a substantial 20%. Measures included waste energy recovery, improved equipment efficiency, integration of production processes, and construction of a comprehensive energy management system. As a global warming countermeasure, JFE has steadily reduced unit energy consumption (crude steel base), and in line with the Japan Iron and Steel Federation's Voluntary Action Plan, is working toward an energy-saving target of –4.4%/ton-crude steel by 2010 against a 1995 baseline. In 2002, consumption was down 3.3% from 2001. JFE is also actively committed to new approaches to energy conservation, including next-generation ironmaking technologies and waste plastic recycling.





Environmental Contribution of LCA-based Products

JFE is contributing to energy conservation by developing high-performance steel products which reduce both material consumption in the manufacturing process and final product weight. An LCA assessment of six high-performance steel products estimated that CO_2 emissions can be reduced by 3.1 million tons in manufacturing and 6.5 million tons in use, for a total of 9.6 million tons-CO_2, by adopting high-performance products (estimate for FY2000, entire Japanese steel industry).



(Source: The Japan Iron and Steel Federation)

Product types surveyed are:

- ○H-beams for buildings.
- ○Heat-resistant steel tubes for boilers.
- ○High-strength steel sheet for auto bodies.
- ○High-tensile steel plate for shipbuilding.
- ○Electrical steel sheet for transformers.
- ○Stainless steel sheet for railway carriages.

Terminology

●LCA

Life Cycle Assessment. Method of assessing the total environmental load (resource depletion, energy consumption, waste, pollutants, etc.) over the entire product life cycle from raw material extraction through manufacture, use, recycling, and waste.

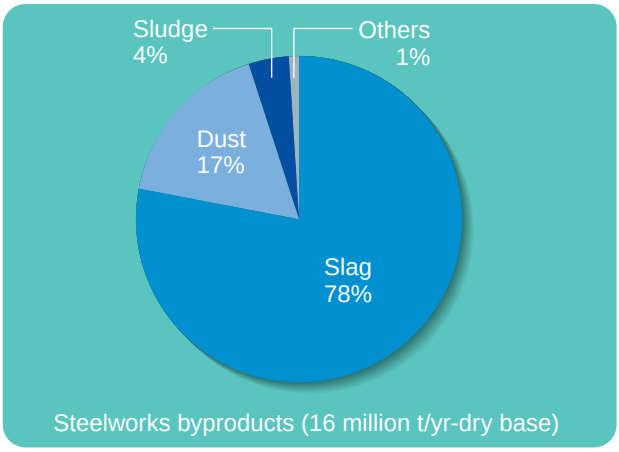
Building a Recycling-oriented Society

The transformation from a mass-production, mass-consumption, mass-waste society to a recycling-oriented society is causing a revolution in the basic paradigm of manufacturing. JFE is actively responding to the challenge of effective resource use, including the creation of new business to meet new social needs.

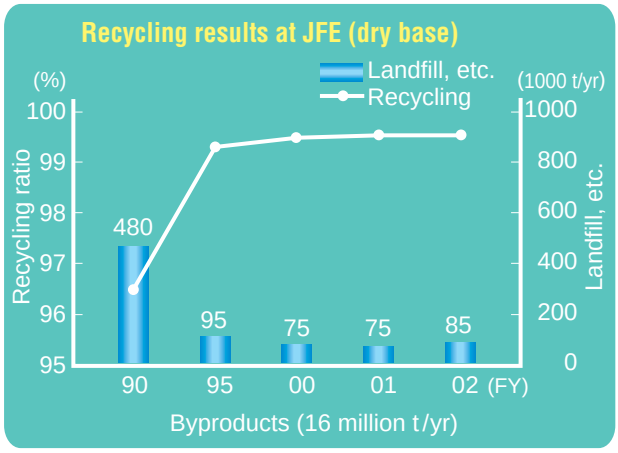
Zero Waste Activities in the Steelworks

JFE has implemented a program of "Zero Waste" activities for steelworks byproducts, which include slag, dust, sludge, waste oil, etc., and has already achieved 99.5% recycling. Landfill disposal has decreased to about 1/6 its 1990 level, meeting the Japan Iron and Steel Federation target of 1/5 the 1990 level by 2010. (This result includes a 10,000 ton increase in surplus dust in 2002 due to a downturn in cement production.) Future measures will include on-site recycling equipment.

The synergy of outstanding environmental and energy technologies, plant operation know-how, and steelworks infrastructure is contributing to effective recycling of waste from local community and other industries, beginning with waste plastic.



Steelworks byproducts (16 million t/yr-dry base)

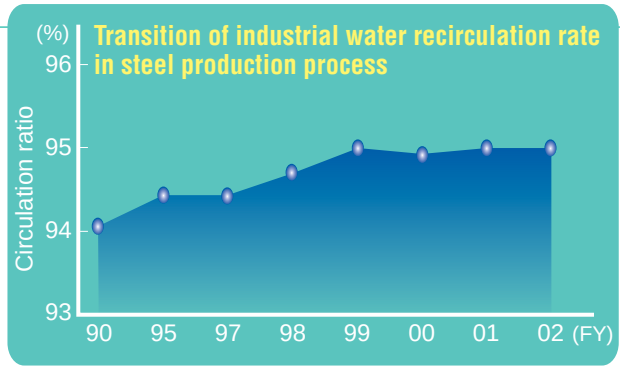


Byproducts (16 million t/yr)

Water Recirculation

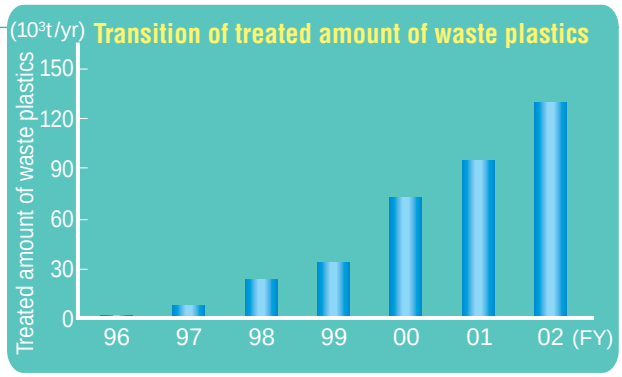
Because steel manufacturing requires huge quantities of water, JFE has created a comprehensive water recycling system. Purification technologies include advanced biological and physiochemical processes. Off-site release is minimized by recirculation and cascade techniques, achieving a water circulation ratio of approximately 95%.

Circulation ratio (%) = (Total consumption – makeup water) / Total consumption



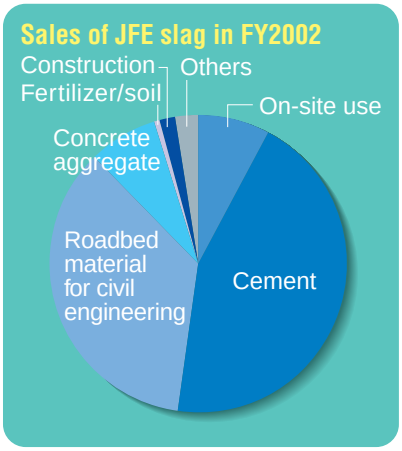
Waste Plastic Recycling

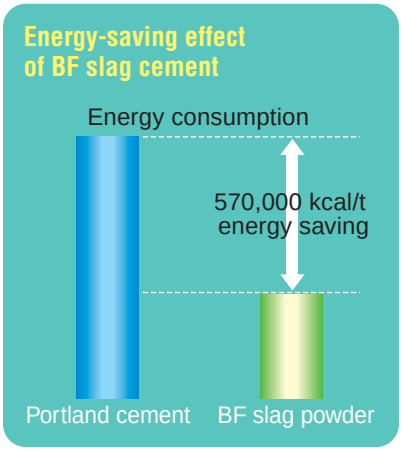
JFE entered the waste plastic recycling business in October 1996 and now has a treatment capacity of 190,000 tons/year.



Slag Reduction and Recycling

Slag generated by blast furnaces, BOFs, and electric furnaces accounts for about 80% of steel manufacturing byproducts. JFE Steel has a long record of reducing steel slag by applying hot metal pretreatment and on-site reuse. Thanks to JFE's efforts to develop product manufacturing/use technologies and encourage standardization under the Japan Industrial Standard (JIS), more than 99% of slag is now effectively used as roadbed material, aggregate for concrete, material for cement, etc.
Cement using BF slag powder also contributes to energy saving and CO_2 reduction.

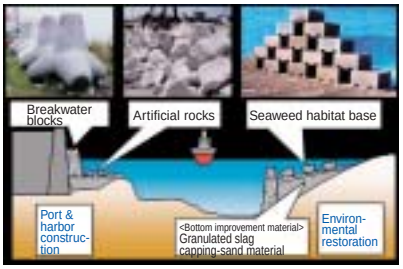




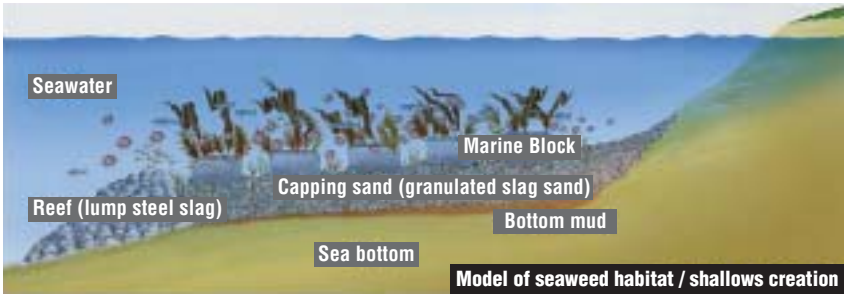
Development of Advanced New Applications for Slag (Example)

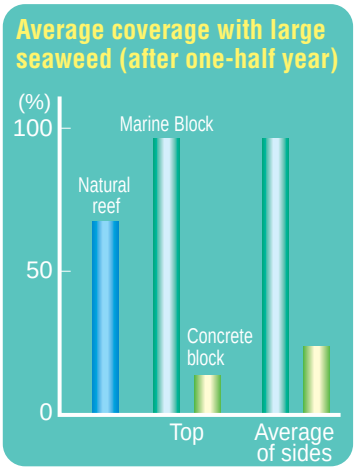
○Use of slag to restore shoreline environments

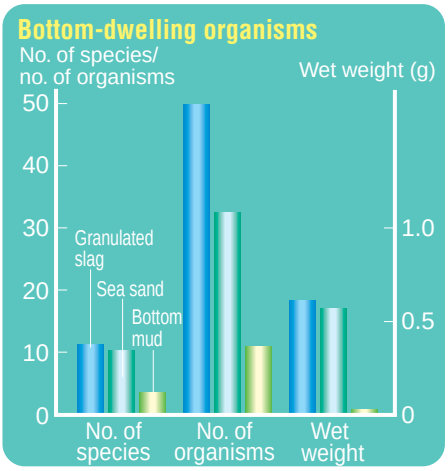
(1)Use of BF slag as sand capping material / shallows construction material for improvement of the marine environment
(2)Artificial reefs (Marine Block) for seaweed / fish farming using CO_2-absorbed slag solids
(3)Breakwater blocks and other marine structures using hydration hardening reaction (Ferro-Form)



Examples of slag materials for port & harbor construction/ marine environment restoration

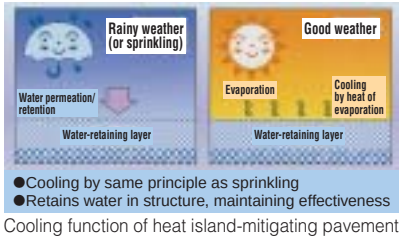






○Heat Island-Mitigating Paving Material

The heat-island effect can be mitigated by using a water-retaining solid composed mainly of fine BF slag in asphalt pavement. The pavement retains water in rainy weather and is cooled by evaporation in good weather, reducing the pavement temperature.



Cooling function of heat island-mitigating pavement

○Slow-release Potassium Silicate Fertilizer

Slag fertilizer is released slowly into soil over long period.

Slag fertilizer;slowly released over a long period of time to enrich the soil

Protecting the Environment

Historically, JFE Steel has developed or introduced numerous technologies to reduce loads on the atmosphere, water, and soil, and is now responding to recent requirements to control and reduce releases of chemical substances, for example, under the PRTR system. JFE is reducing environmental loads while also developing new technologies which satisfy the needs of both business and the environment.

Air Quality

SOx

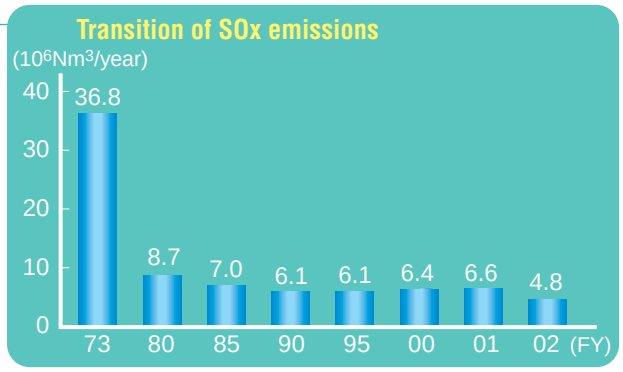
To reduce emissions of sulfur oxides (SOx), JFE has adopted low-S fuels and introduced the world's first high-efficiency ammonium-sulfate flue gas desulfurization system. After addition of another de-S system in 2002, JFE reduced SOx emissions to 1/7 the 1973 level.

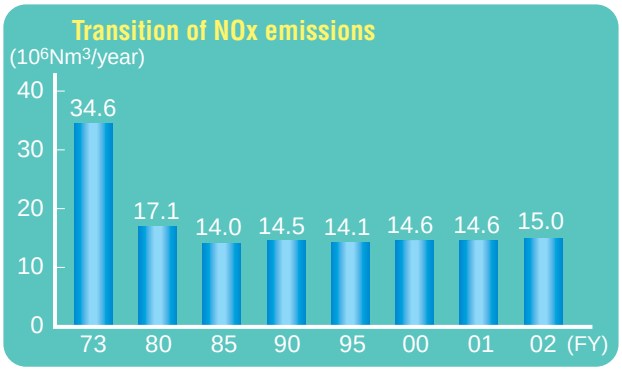
NOx

For nitrogen oxides (NOx), JFE installed a sintering furnace flue gas denitrification system which decomposes NOx into nitrogen and water. Emissions have been reduced by more than 50% since 1973.

Dust

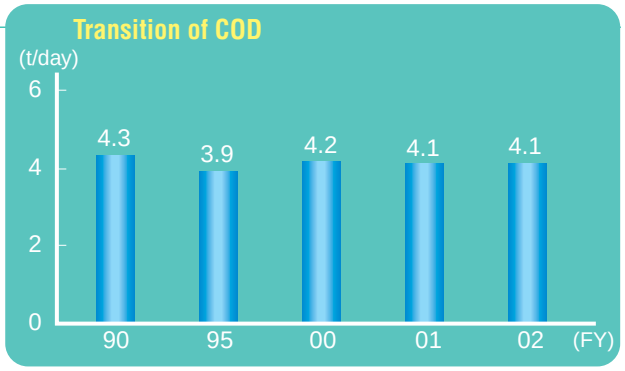
Sprinkling in ore and coal yards, sealed conveyor connections, and other measures prevent dust generation. At coke ovens, sintering furnaces, blast furnaces, BOFs, and other dust-generated facilities, high-performance dust collectors minimize airborne dust.





Water Quality

JFE has implemented thoroughgoing water recycling measures, achieving a recirculation rate of approximately 95%. Before discharge, wastewater containing organic matter is given biological treatment, and is then purified as required by coagulating sedimentation, filtration, adsorption with activated carbon (ammonia liquor), etc. to remove pollutants.



Soil Quality

JFE has adopted measures to prevent releases of hazardous substances into the soil and checks soil and groundwater to prevent pollution. To protect the soil and groundwater environment, the company fully complies with the Soil Contamination Control Law enacted in February 2003.

Terminology

COD

Chemical Oxygen Demand. Index of water pollution, expressing the amount of oxygen necessary to chemically oxidize and stabilize pollutants in water.

Control of Chemical Substances

PRTR

Japan's PRTR (Pollutant Release and Transfer Register) Law was enacted in March 2000. At the time, JFE was already participating in voluntary surveys by the steel industry as part of its commitment to controlling and reducing releases of chemical substances.

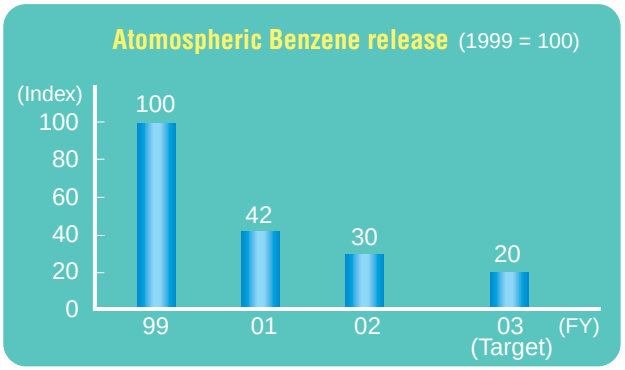
Substances reported under PRTR (FY2002, JFE steel division)

(Unit: t/yr; dioxins: g-TEQ/yr)

No.	Substance	Releases				Sewerage	
		Air	Public waters	Soil on-site	Landfill on-site	Off-site	Transfers
1	Zinc compounds (water-soluble)	0	4.6	0	0	0	0
16	2-aminoethanol	1.2	0.8	0	0	0	2
25	Antimony and its compounds	0	0	0	0	0	0
40	Ethylbenzene	35	0	0	0	0	0
43	Ethylene glycol	0.07	0	0	0	0	0
63	Xylene	270	0	0	0	0	0
68	Chromium and chromium (III) compounds	0	0.3	0	389	0	271
69	Chromium (VI) compounds	0	0	0	0	0	0.03
100	Cobalt and its compounds	0	0.02	0	0.3	0	0.002
102	Vinyl acetate	0	0	0	0	0	0
108	Inorganic cyanogen compounds	0	0.1	0	0	0	0
132	1,1-dichloro-1-fluoroethane; HCFC-141b	74	0	0	0	0	0
145	Dichloromethane; methylene dichloride	31	0	0	0	0	0
177	Styrene	1.2	0	0	0	0	0
179	Dioxins	15	0.00003	0	0.00002	0	0.1
200	Tetrachloroethylene	19	0	0	0	0	0
227	Toluene	53	0	0	0	0	3.6
230	Lead and its compounds	0	0	0	0	0	0.001
231	Nickel	0	0.03	0	0	0	36
232	Nickel compounds	0	0.8	0	105	0	115
283	Hydrogen fluoride and its water-soluble salts	0	52	0	0	0	0
299	Benzene	69	0	0	0	0	0
304	Boron and its compounds	0	8.9	0	0.001	0	0
309	Poly(oxyethylene) nonylphenyl ether	0	3	0	0	0	0
310	Formaldehyde	0	0	0	0	0	0
311	Manganese and its compounds	0	6.1	0	271	0	218
346	Molybdenum and its compounds	0	2.6	0	2.3	0	0.4
353	Tris (dimethylphenyl) phosphate	0	0	0	0	0	0

Benzene and Other Volatile Organic Compounds

Beginning in 2001, the steel industry adopted a second stage voluntary control plan for atmospheric releases of benzene and other volatile organic compounds, continuing from its first stage plan (FY1997-99), with the aim of achieving further reductions. JFE set a target of reducing benzene releases by 80% from the 1999 baseline by 2003 through company-wide improvement activities, and had achieved a 70% reduction by 2002. JFE is also reducing releases of tetrachloroethylene and dichloromethane. In addition to voluntary controls by industry unit, it is also participating in a new voluntary control plan for benzene by regional unit, which began in 2001, and is working to reduce benzene releases in cooperation with neighboring businesses in other industries.



Dioxins

The Law concerning Special Measures against Dioxins implemented in January 2000 set standard values for steelworks facilities (sintering furnaces, electric furnaces, and incinerators) effective December 2002. JFE satisfied the standard values for all regulated steelworks facilities in 2000, well in advance of the effective date, but is implementing additional voluntary measures to further reduce dioxin releases.

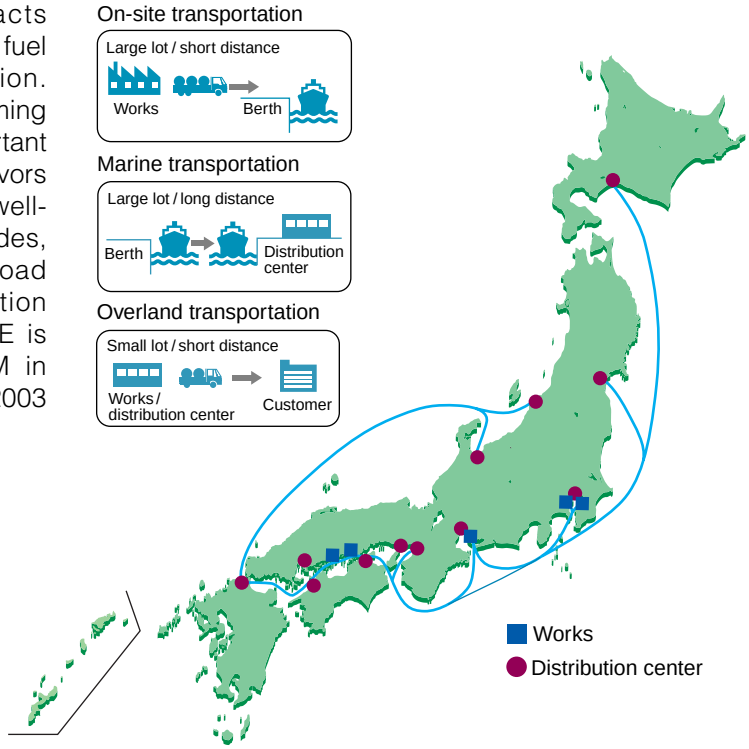
Terminology

●PRTR

Pollutant Release and Transfer Register. A system of reporting to the government the amounts of designated chemical substances released into the environment and transfers as waste. Annual reporting of quantified amounts in the previous fiscal year is required, beginning in FY2002.

Improving Transportation

Distribution-related environmental impacts include CO_2, NOx, and SPM generated by fuel combustion during product transportation. Because these are all factors in global warming and / or air pollution, distribution is an important environmental issue at JFE Steel. JFE endeavors to reduce environmental load through well-considered selection of transportation modes, reduction in distance, improvements in load efficiency, and introduction of information technology ahead of the steel industry. JFE is responding to stricter regulations on SPM in metropolitan areas beginning in October 2003 with a modal shift.



Viewpoint for improvement	Specific measures
(1)Selection of transportation mode	·Promotion of modal shift by introducing innovative ships (RORO ships, FERO ships, etc.) ·Avoidance of influence of weather by constructing all weather berths and using RORO ships and U-rack Ships
(2)Use of larger vehicles, effective use of information, and joint use (more efficient transportation)	(On-site) ·Use of larger transportation vehicles such as U-frame vehicles and carrier vehicles ·Direct transportation from mill ends to berths for eliminating temporary storage (Off-site) ·Making land transportation more efficient by using IT and effective use of return trips ·Development of a simulation system for optimizing the load efficiency of trucks ·Reduction of transportation distances to customers by selecting optimum transportation routes
(3)Effective ship operation	·Improvement of operating efficiencies of ships by using the coastal ship operation management system (JFE Coastal Ship Control System) ·Maximization of mixed loading of multiple products ·Joint transportation with other companies
(4)Measures for coping with stricter exhaust gas regulations and lowering environmental impact	·Idling-stop operation ·Use of vehicles with lower environmental impact ·Energy-conserving operation of coastal ships in view of loading & unloading schedules ·Use of ship-bottom paints containing no hazardous substances ·Selective collection of wastes at unloading sites
(5)Avoidance of truck transportation through urban central areas	·Use of dedicated RORO ships in the Inland Sea ·Use of FERO ships for coastal transportation in Tokyo Bay
(6)Reduction of materials	·Use of long-life cushioning materials (conversion from rubber to felt) ·Reduction of retaining timber (RORO ships, U-rack ships, FERO ships) ·Reduction of wire and timber (promotion of hoop lashing) ·Repeated use of retaining materials ·Simplification of packaging

Efficient On-site Transportation

Large on-site transportation vehicles such as the 100t U-frame vehicle and 160t carrier can carry larger single-trip loads than conventional trucks, helping to reduce CO_2 emissions.

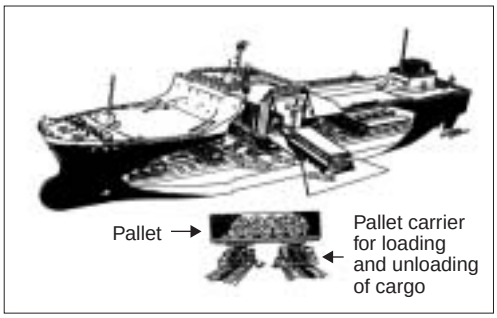
100t U-frame vehicle

160t carrier

Innovative Marine Transportation

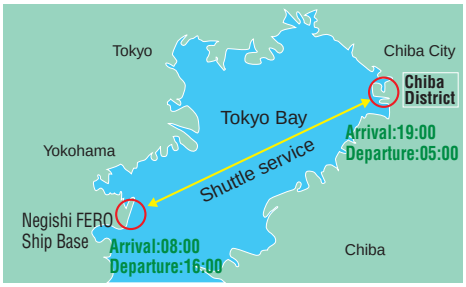
RORO Ship

RORO ships enable direct loading / unloading of pallet carriers and are used in scheduled service between JFE's steelworks and major cities.



FERO Ship

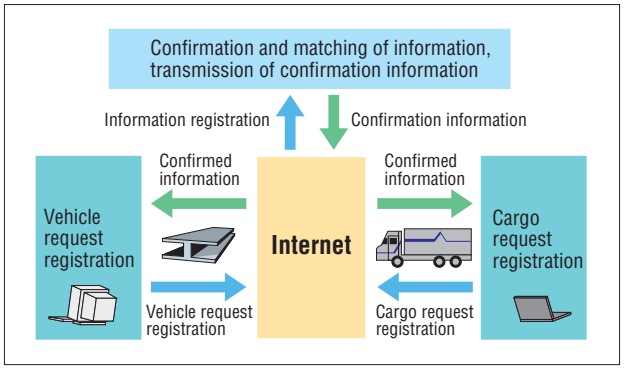
Similar to ferries, FERO ships are designed to carry loaded trucks. Regular service across Tokyo Bay between JFE's Chiba District and Negishi FERO base reduces truck traffic in the heavily-congested Tokyo area.



IT Applications and the Effect of the JFE Merger

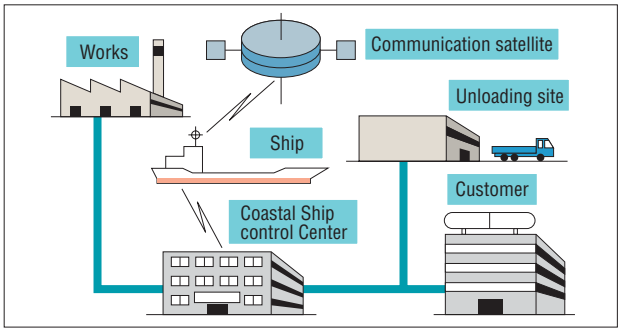
Optimized Land Transportation Network (Cargo,Vehicle Request System)

This is a specialized, IT-based dispatching system for heavy overland cargos, making maximum use of JFE's transportation and dispatching know-how for steel products and other heavy cargos. Optimum matching of cargo and vehicle information improves the vehicle operating rate and reduces the environmental impact of fuel consumption. JFE takes justified pride in this industry-leading open system.



Optimized Ship Operation Management (JFE Coastal Ship Control System)

An integrated system, for control of ship status and loading / unloading progress at JFE's works, reduces deadheading and ensures more efficient coastal transportation by optimizing ship operation management.



Effect of the JFE Merger

To maximize transport lots and minimize distance, the selection of manufacturing plants and distribution relay bases was reviewed as part of the merger of NKK and Kawasaki Steel to create JFE.

Terminology

SPM

Suspended Particulate Matter. Fine particulates under 10μm (1μm = 1/1000mm) which remain suspended in the atmosphere for long periods and tend to accumulate in the lungs and windpipe when inhaled.

Modal shift

Shift in transportation modes from truck to rail or ship to improve transportation efficiency and reduce environmental loads.