JFE

# JFE

Environmental Report

# 2004

C O N T E N T S



## Editorial Policy

"Environmental Report 2004" describes the basic policies related to the environment, environmental protection activities in fiscal year 2003, and results of those activities in the business operations of JFE Holdings, Inc., which is the holding company of the JFE Group, and its operating companies. To ensure a correct understanding of the environmental protection activities of the JFE Group, the Report considers changes in the business environment surrounding the steel industry, such as trends in world crude steel demand. This Report was edited/prepared in accordance with "Guidelines for Environmental Reports (FY2003 ed.)" issued by Japan's Ministry of the Environment (MOE) and "Sustainability Reporting Guidelines 2002" issued by the Global Reporting Initiative (GRI).

Among corporate social responsibility (CSR) items, Corporate Governance is included in Annual Report.

## Scope of Report

### Organizations Included

This Report centers on JFE Holdings, Inc. and JFE Steel Corporation, which is responsible for the JFE Group's steel business, and includes JFE Engineering Corporation and Kawasaki Microelectronics, Inc., which have also production facilities, JFE Urban Development Corporation, which is responsible for the Group's urban development business, and JFE R&D Corporation, which is responsible for general research and development in the JFE Group.

The following navigation tool is provided for easy understanding of the organization(s) covered on each page.

**Navigation tool**


The organizations included in environmental performance data totals are as follows:

**Organizations included in environmental performance data totals**

| |
|---|
| **JFE Steel Corp.**<br>East Japan Works (Chiba District/Keihin District)<br>West Japan Works (Kurashiki District/Fukuyama District)<br>Chita Works |
| **JFE Engineering Corp.**<br>Tsurumi Engineering and Manufacturing Center,<br>Shimizu Works, Tsu Works |
| **Kawasaki Microelectronics, Inc.**<br>Utsunomiya Works |

* Data for FY2002 and before are totals of data for Kawasaki Steel Corp. and NKK Corp. before merger.

* Affiliated companies which are subject to consolidated accounting by these operating companies are not included in the scope of this Report except where specifically noted.

* Tsurumi Engineering and Manufacturing Center is referred to as Tsurumi Center for short in some cases.

### Period of Environmental Report 2004

In principle, fiscal year 2003 (April 1, 2003 to March 31, 2004).

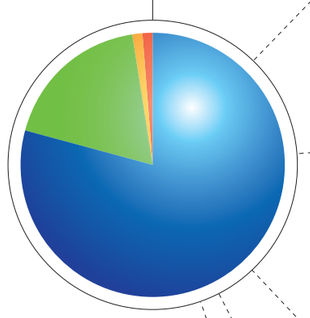
### Scheduled Publication Date of Next Report

December 2005

# Japan Future Enterprise

As one of Japan's representative future-oriented business groups,
the JFE Group is committed to creating the world's most advanced technologies
and maintaining preeminent competitiveness in the marketplace.

## JFE Group Businesses



Total sales of JFE Group
**¥2,473.7 billion**

### JFE Holdings

**Headquarters for the JFE Group**

| | |
|---|---|
| **Date est.** | Sep. 27, 2002 |
| **Head office** | 1-1-2 Marunouchi, Chiyoda-ku, Tokyo |
| **Consolidated sales** | ¥2,473.7 billion (year ended March 2004) |
| **Consolidated operating profit** | ¥253.6 billion (year ended March 2004) |
| **Employees** | 118 (as of April 1, 2004) |

**Content of business** Group headquarters responsible for the strategic functions of the JFE Group as a whole, risk management and external relations for entire JFE Group.

### JFE Steel

**World's excellent steel company**

| | |
|---|---|
| **Date est.** | April 1, 2003 |
| **Head office** | 2-2-3 Uchisaiwaicho, Chiyoda-ku, Tokyo |
| **Consolidated sales** | ¥2,103.9 billion (year ended March 2004) |
| **Consolidated operating profit** | ¥242.7 billion (year ended March 2004) |
| **Employees** | 14,272 (as of April 1, 2004) |

**Content of business** Manufacture and sale of iron and steel products, industrial and municipal waste treatment business, waste recycling business

**Group companies** Consolidated subsidiaries: 193
Companies covered under equity method: 37

### JFE Engineering

**Proposing optimum solutions in the global field**

| | |
|---|---|
| **Date est.** | April 1, 2003 |
| **Head office** | 1-1-2 Marunouchi, Chiyoda-ku, Tokyo |
| **Consolidated sales** | ¥339.4 billion (year ended March 2004) |
| **Consolidated operating profit** | ¥3.1 billion (year ended March 2004) |
| **Employees** | 2,477 (as of April 1, 2004) |

**Content of business** Total engineering business (energy-related fields, environment-related fields, steel engineering-related fields, steel structures, industrial machinery)

**Group companies** Consolidated subsidiaries: 22
Companies covered under equity method: 4

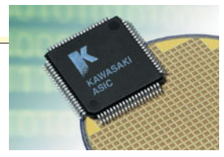
### Kawasaki Microelectronics

**Utilizing unique ASIC manufacturing technologies**

| | |
|---|---|
| **Date est.** | July 1, 2001 |
| **Head office** | 1-3 Nakase, Mihama-ku, Chiba City, Chiba Pref. |
| **Consolidated sales** | ¥40.5 billion (year ended March 2004) |
| **Consolidated operating profit** | ¥5.0 billion (year ended March 2004) |
| **Employees** | 488 (as of April 1, 2004) |

**Content of business** Manufacture and sale of semiconductors, centering on ASICs (application specific integrated circuits) (design, development, manufacture, and sales of ASCP/ASSP)

**Group companies** Consolidated subsidiaries: 3




### JFE Urban Development

**Applying diverse know-how to urban development**

| | |
|---|---|
| **Date est.** | April 1, 2003 |
| **Head office** | 1-1-2 Marunouchi, Chiyoda-ku, Tokyo |
| **Consolidated sales** | ¥26.2 billion (year ended March 2004) |
| **Consolidated operating profit** | ¥1.5 billion (year ended March 2004) |
| **Employees** | 58 (as of April 1, 2004) |

**Content of business** Urban development (large-scale complex development, condominium sales, asset utilization)

**Group companies** Consolidated subsidiaries: 3

### JFE R&D

**Development of common technologies for the JFE Group**

| | |
|---|---|
| **Date est.** | April 1, 2003 |
| **Head office** | 1-1 Minami Watarida-cho, Kawasaki-ku, Kawasaki City, Kanagawa Pref. |
| **Employees** | 89 (as of April 1, 2004) |

**Content of business** Research and development of core technologies common to the steel and engineering businesses (measurement/control, mechanical, civil engineering/building technology, numerical analysis, bio/catalysts) and projects in growth fields

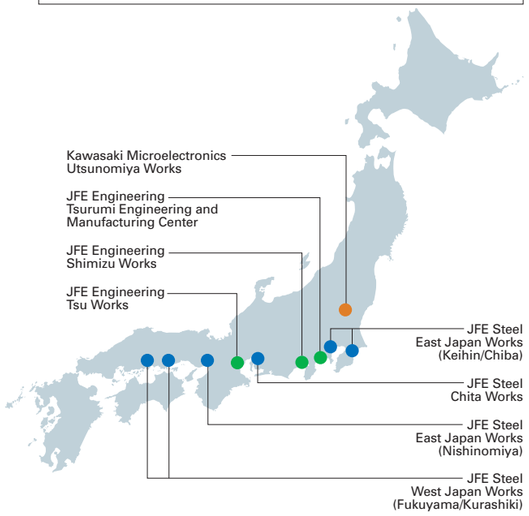
### The JFE Name

The JFE name is composed of the letter "J" for Japan, "F" for steel (as in Fe, the atomic symbol of iron) and "E" for engineering. The acronym can also be thought of as standing for "Japan Future Enterprise," i.e., a future-oriented Japanese business group centered around the core businesses of steel and engineering.

For the detail of JFE Name, refer to:
**http://www.jfe-holdings.co.jp/en/company/brand/index.html**

For the detail of consolidation, refer to:
**http://www.jfe-holdings.co.jp/en/company/tougou/index.html**

## Main Works in Japan and Main Products




### JFE Steel

| Works name | | Location | Main products |
|---|---|---|---|
| **East Japan Works** | **Chiba District** | Chuo-ku, Chiba City, Chiba Pref. | Hot rolled/cold rolled steel sheets, stainless steel sheets, coated steel sheets, UOE pipe, iron powder, welding consumables |
| | Nishinomiya Works | Nishinomiya City, Hyogo Pref. | Stainless steel products |
| | **Keihin District** | Kawasaki-ku, Kawasaki City, Kanagawa Pref. | Plates, hot rolled/cold rolled steel sheets, coated steel sheets, electrical steel sheets, special steel products, welded steel pipes and tubes |
| **Chita Works** | | Handa City, Aichi Pref. | Seamless/welded steel pipes and tubes, castings |
| **West Japan Works** | **Kurashiki District** | Kurashiki City, Okayama Pref. | Plates, hot rolled/cold rolled steel sheets, coated steel sheets, electrical steel sheets, steel sheet piles, H-shapes, steel bars, wire rod material |
| | **Fukuyama District** | Fukuyama City, Hiroshima Pref. | Plates, hot rolled/cold rolled steel sheets, coated steel sheets, steel sheet piles, H-shapes, rails, UOE pipe |

### JFE Engineering

| Works name | Location | Main products |
|---|---|---|
| **Tsurumi Engineering and Manufacturing Center** | Tsurumi-ku, Yokohama City, Kanagawa Pref. | Shield tunneling machines, diesel engines, container cranes, boilers, turbines, waterworks pipes, etc. |
| **Shimizu Works** | Shimizu City, Shizuoka Pref. | Steel frame structures |
| **Tsu Works** | Tsu City, Mie Pref. | Various large-scale steel structures (long/large bridges, water gates, caissons, etc.) |

### Kawasaki Microelectronics

| Works name | Location | Main products |
|---|---|---|
| **Utsunomiya Works** | Haga-cho, Haga-gun, Tochigi Pref. | ASICs |

## Meeting Rising World Crude Steel Demand

World crude steel demand is continuing to grow, driven by rapid economic development in the East Asian region, and particularly in China. Because the Japanese steel industry leads the world in steel manufacturing technologies, we must continue to provide a stable supply of high quality steel products.

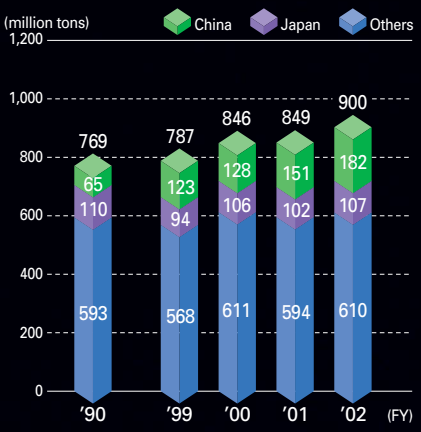
## Reducing Environmental Loads

With conventional technologies, rising crude steel demand means heavier environmental loads. Based on the world's most advanced energy saving and environmental protection technologies, we are committed to reducing environmental loads in the steel manufacturing process through continuing technical innovation.

## Building a Sustainable Society

Because today's affluent society places a heavy burden on the global environment, sustainable development will require new products and technologies which reduce environmental loads. This means that the environmental responsibilities of technology will become even larger in many areas, including energy saving materials, use of natural energy substitutes for fossil fuels and development of next-generation clean energy, creation of resource- and energy-recycling systems in cooperation with business and the local community, technologies for restoring the environment, and, at the global level, solutions to the problem of global warming.

**Transition of World Crude Steel Production**




# Responsibilities of Technology

"JFE means Technology." — In changing times, these are the missions which we must accomplish.

# The JFE Group is committed to improving the global environment while supporting social and industrial growth through steel and engineering businesses based on the world's most advanced technologies.

The JFE Group believes that improvement of the global environment is a critical management task. While we have achieved the world's best results in many areas of environmental protection, including air and water quality, recycling, and prevention of global warming, we are not satisfied with past accomplishments, and will continue to make further efforts.

Iron is the most common element in the planet. Steel has numerous outstanding properties, including formability and corrosion resistance, and was recognized in the market as the material with the highest recyclability long before today's calls for 3R (reduce, reuse, recycle resources and waste). As a necessary and indispensable basic material for many major industries, steel is widely used in construction, civil engineering, automobiles, and machinery, making an important contribution to the continuing growth of society and industry alike.

On the other hand, the steel manufacturing process requires huge amounts of energy. For example, energy consumption in the Japanese steel industry accounts for roughly 10% of this country's total energy consumption. The Japan Iron and Steel Federation therefore established a Voluntary Action Plan under which the industry will reduce energy consumption in FY2010 by 11.5% (including a supplementary target) in comparison with FY1990, and is steadily realizing this goal.

JFE Steel implemented its 1st Energy Saving Activities Plan in 1973 in advance of other industries, and carried out ongoing energy saving measures in the years that followed, reducing unit energy consumption by approximately 20% by 1990. To date, the company has invested about ¥800 billion in energy saving and environmental protection countermeasures, and has created the world's most advanced energy saving/environment-friendly steel manufacturing process. But our efforts do not end with the manufacturing stage. We are also making many important contributions to reducing environmental loads in the use stage, for example, by supplying environment-friendly products such as high strength steel sheets which reduce auto weight and low iron loss electrical steel sheets for motors.

Crude steel demand has continued to rise in recent years, supported by the economic growth of the Asian region, and most notably China, and further increases are also expected in the future. Utilizing the world's most advanced steel manufacturing technologies, JFE Steel is playing a key role as a supplier of high quality steel products to markets around the world, while developing, supplying, and encouraging wider use of energy saving and environment-friendly products and technologies worldwide.

At JFE Engineering, we are striving to reduce environmental loads in the manufacturing process and construction, and are devoting great effort to engineering products and technologies which specifically contribute to reducing environmental loads in the social infrastructure. These efforts include technologies which reduce emissions of dioxins and other harmful substances and a wide range of technologies for preventing global warming, such as wind power and other clean energy, energy saving air-conditioning systems, and biomass power generation. We are confident that these important technologies will let us leave a better planet to future generations.

In local society, the JFE Group is contributing to the creation of a recycling-oriented society through recycling businesses which take advantage of the synergies of engineering technologies and the high potential of the steelworks for waste treatment. In the world community, we intend to make even more active efforts to reduce the $CO_2$ emissions associated with global development by utilizing international systems such as the Kyoto Mechanism, established under the Kyoto Protocol.

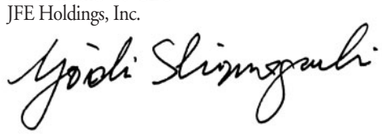
We are also putting great effort into research and development activities which take a long-term view of the future. For example, the JFE Group has already established a mass-production technology for DME (dimethyl ether), which has drawn attention as a form of next-generation clean energy, and is accelerating the pace of research aiming at entry in the energy market in the near future.

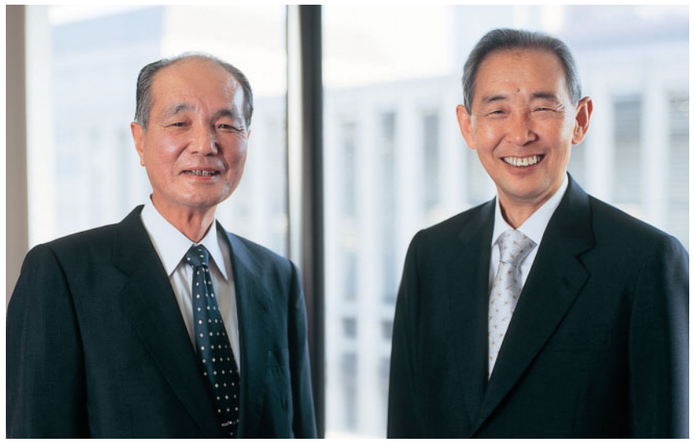
The JFE Group believes that its mission is to contribute to the creation of a better global environment through the activities of the group as a whole, not only by reducing environmental loads in business activities, but also by positively supplying environment-friendly Only 1 and No. 1 technologies, products, and services to society.

This Environmental Report describes representative efforts of the JFE Group to solve global environmental problems and the results we have achieved. We hope that this Report will give our friends a better understanding of our position and efforts with regard to environmental protection. We also welcome comments and suggestions for future activities.

Chairman and Co-CEO
JFE Holdings, Inc.

President and Co-CEO
JFE Holdings, Inc.





Chairman and Co-CEO
JFE Holdings, Inc.
Kanji Emoto

President and Co-CEO
JFE Holdings, Inc.
Yoichi Shimogaichi

## Corporate Vision

**The JFE Group —— contributing to society with the world's most innovative technology.**

## Environmental Philosophy

**The JFE Group considers the improvement of the global environment to be of utmost importance for management, and promotes business operations in harmony with the environment to create a prosperous society.**

## Environmental Policy

1. **To reduce environmental influence in all business operations**
   JFE endeavors to reduce present and future environmental loads and promotes the development of innovative technologies for reducing environmental loads.
2. **To make contributions through technologies and products**
   JFE contributes to the creation of a better environment through the development and supply of advanced technology, equipment, and ecological products.
3. **To make contributions through conservation of resources and energy**
   JFE contributes to the creation of a resource and energy-saving society through recycling and energy supply businesses which give priority to preservation of the global environment.
4. **To promote communications with society**
   As a member of regional society, JFE contributes to a better environment at the regional level in cooperation with local citizens, government and administrative authorities, and other businesses.
5. **To promote international cooperation**
   JFE contributes to environmental protection activities at the global level through active involvement in international cooperation in the form of technology transfer, etc.

# JFE Steel is using the world's most advanced energy saving and environmental protection technologies to realize a truly environment-friendly steel manufacturing process while contributing to the creation of a recycling-oriented society.

The steel manufacturing process requires huge amounts of energy and natural resources such as iron ore, coal, and water. For many years, JFE Steel has endeavored to reduce environmental loads through R&D on energy saving and environmental protection technologies and aggressive investment in facilities.

Our steel manufacturing process now boasts the world's highest energy efficiency and recycling rates, but we are continuing to conduct R&D and introduce equipment to further reduce environmental loads in each steel manufacturing process. The main inputs/outputs in FY 2003 are shown below. Details are presented in the section on JFE Steel in "Environmental Performance I: Reducing Environmental Loads in Production Activities," beginning on p. 20.

In addition to efforts in the manufacturing process, the JFE Group is actively involved in recycling and reuse of wastes received from society and other companies using the steelworks' infrastructure and unique JFE recycling technologies. With the remaining capacity of landfill sites steadily decreasing, reducing the amount of waste requiring landfill disposal has become an urgent necessity. In this area as well, JFE Steel and the JFE Group are helping to build a recycling-oriented society by receiving and recycling waste plastic, discarded appliances, food waste, and industrial and municipal waste. Details can be found in "Environmental Performance III: Recycling Solutions," beginning on p. 45.

## Input

**Materials for steel production**
- Iron ore 44 million t/yr
- Coal 24 million t/yr
- Lime 5 million t/yr

**Purchased energy**
- Electricity + oil-type fuels 91 PJ (petajoules)/yr

**Industrial water**
230 million tons/yr

**Recycled materials**
- Steel scrap (BOF)
- Waste plastic (BF)
- Toner (sintering)

**Recycled materials**
- Waste plastics
- Waste PET bottle
- Electric appliance
- Food waste
- Dust/ Sludge

Energy recycling in works (70%)

On-site byproducts recycling (36.2%)

Water recycling (93.9%)

Wastewater, evaporation loss (6.1%)

Landfill disposal (0.7%)

Recycled water

**Byproducts 15.6 million tons**
Slag, Dust, Sludge

**Recovered energy recycling**
- Byproduct gas
- Waste heat recovery steam
- Power (BF Top pressure Recovery Turbine: TRT)

**Chemical substances**
- Release 1,447 tons
- Transfer 446 tons

**Flue gas**
- SOx 3.9 million $m^3$
- NOx 14.8 million $m^3$
- Dust

## Steel Production Process at JFE Steel

### Energy conservation technology

| | Raw material yard | Coke oven | Sintering plant | Blast furnace | BOF, EF, CC | | Reheating furnace | Hot rolling, cold rolling | Continuous annealing, coating | Shipment |
|---|---|---|---|---|---|---|---|---|---|---|
| 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 continuation | 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<br>Power plant fuel preheating device<br>High efficiency air separation equipment | | | | | | | | |

### Steel production process

Coke oven gas, BF gas, BOF gas, Oxygen plant, Power generating plant

### Environmental conservation technology

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 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) |
| Counter-measures—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 |

**Recycling Process at JFE Group**

## Output

**Energy supply (30%)**
- Power
- Fuel gas
- Steam

**Marine & land civil engineering materials (63.1%)**
- Material for cement
- Roadbed material
- Fertilizer
- Port & harbor construction material

**Iron and steel products**
27 million tons/yr (crude steel base)

**Other products**
- Chemicals
- Oxygen
- Nitrogen
- Hydrogen
- Argon

**Recycled products**
- NF Board
- PET material

**Local community/ Other industries/ Society**

# Taking advantage of the total capabilities of the JFE Group, with its core steel manufacturing and engineering technologies, we supply environment-friendly products and technologies which support everyday life and society and improve the global environment.

With heightened awareness of the environment, environmental protection in everyday life and society has progressed in many respects.

The JFE Group supplies environment-friendly Only 1 and No. 1 steel products (steel environmental-friendly products) which reduce environmental loads in everyday life and industrial society, and engineering technologies/products which contribute to environment-friendly urban development.

Utilizing its total capabilities, the JFE Group is contributing to the creation of a sustainable society through environmental protection activities which look ahead to coming generations. These include total environmental solutions for environment-friendly urban development, efforts to achieve practical application of DME, which is the leading candidate for next-generation energy, and R&D on other forms of clean energy.

Detailed descriptions of these environment-friendly products and technologies can be found in "Environmental Performance II: Contributing through Environment-friendly Products and Technologies" beginning on p. 33, "Environmental Performance III: Contributing to Environmental Improvement in Local and International Society" beginning on p. 42, and "Environmental Performance IV: R&D on Environmental Technologies" beginning on p. 49.

## In everyday life

### Toxic substance-free steel sheets
- Chromate-free coated steel sheets (p. 35)

### Low environmental load products
- Laminated steel sheet for food cans (p. 35)

### Long-life low environmental load products
- Steel-framed House

## In society

### High strength sheets & tubes for weight reduction
- High tensile strength automotive steel sheets (HITEN) (p. 34)
- Ferritic stainless steel with high corrosion resistance and ultra-deep drawing property (p. 34)
- HISTORY, ERW steel tubes
- As-sintered alloy steel powder (heat treatment-free) (p. 36)
- Tailor Welded Blanks

### Low environmental load materials
- Lead-free steel sheets for fuel tank
- Stainless steel sheets/tubes for automotive exhaust system

### Low core loss electrical steel sheets
- High efficiency electrical steel sheets (p. 36)

### Waste detoxification and recycling
- High-temperature gasifying & direct melting furnace
- JFE THERMOSELECT gasifying & melting furnace
- Electric resistance and plasma-type ash melting furnaces
- Hyper 21 Stoker System (p. 41)
- Circulating fluidized bed (CFB) boiler turbine power generation
- Sewerage sludge methane fermentation
- BIGADAN process biogas system (p. 41)

### Contribution to recycling-oriented society
- Waste plastic recycling for BF feed (p. 22)
- NF Board (p. 46)
- Home electric appliance recycling (p. 46)
- Food waste recycling (p. 46)
- Eco-Town Concept (p. 43)

### High strength plates for weight reduction
- TMCP high strength steel plates

### High corrosion-resistance tubular products & steel plates
- Martensitic stainless steel tubes (p. 37)
- Weathering steel/ Rust stabilization treatment (p. 37)

### Environmental load reduction technologies
- Flue gas & fly ash dioxin treatment technology (p. 40)
- Bio-Tube system (p. 40)
- Sewerage sludge circulating fluidized bed (CFB) incinerator

### Environmental improvement technologies
- Marine Block (p. 25) Marine Base (p. 25) Marine Stone (p. 25)
- Seawater exchange-type hybrid caisson
- Dam sediment removal, Dam/river water quality preservation
- Protection of soil environment

### Supply of energy-saving equipment
- Gas engine cogeneration system
- Regenerative burners (p. 21)
- Clathrate hydrate slurry (CHS) latent heat air-conditioning system (p. 39)

## For the planet

### Creation and popularization of clean energy
- Wind power generation (p. 39)
- High-purity silicon for solar cells (p. 38)
- DME (dimethyl ether) (p. 47)

# The JFE Group has a long history of responding to the environmental problems of the times with technology, based on a clear understanding of the needs of a changing society.

1965 1970 1975 1980 1985 1990 1995 2000 2005

## Social Trends

- '67 Implementation of Basic Pollution Control Law
- '72 United Nations Conference on the Human Environment (Stockholm): Adoption of Stockholm Declaration
- '73 First Oil Crisis
- '79 Second Oil Crisis
- '79 Implementation of Energy Conservation Law
- '91 Implementation of Law for Promotion of Effective Utilization of Resources (Recycling Law)
- '92 Earth Summit in Rio de Janeiro
- '92 Adoption of Framework Convention on Climate Change, Agenda 21, and Convention on Biological Diversity
- '93 Implementation of Basic Environment Law
- '96 Implementation of ISO14001 environmental standard
- '97 Kyoto Conference of the Parties of the United Nations Framework Convention on Climate Change (COP3): Adoption of Kyoto Protocol
- '98 Implementation of Law concerning the Promotion of the Measures to Cope with Global Warming
- '99 Implementation of Law concerning Special Measures against Dioxins
- '99 Implementation of PRTR Law
- '00 Implementation/revision of 6 laws related to establishment of recycling-based society
- '02 Implementation of Soil Contamination Control Law

## Environmental Protection & Energy-Saving Activities at Works

### General Measures

- '67 Creation of Environmental Control Section in Head Office Technology Dept.
- '70 Establishment of companywide Environmental Management Committee
- '71 Establishment of Environmental Management Dept.
- '72 Establishment of environmental control regulations
- '70 Pollution Prevention Agreement with Kanagawa Pref., Kawasaki City, and Yokohama City
- '71 Pollution Prevention Agreement with Hiroshima Pref. and Fukuyama City
- '72 Pollution Prevention Agreement with Okayama Pref. and Kurashiki City
- '74 Pollution Prevention Agreement with Chiba Pref. and Chiba City
- '80 Establishment of energy control regulations
- '91 Establishment of Global Environmental Charter by Keidanren (Japan Business Federation)
- '91 Establishment of Coordinating Committee for Global Environmental Issues
- '92 Settlement of suit concerting Chiba Works No. 6 BF
- '93 Establishment of Global Environmental Dept.
- '93 Establishment of Guideline and Program Principle for Activities for Global Environmental Protection
- '96 Establishment of Voluntary Action Plan by Japan Iron and Steel Federation
- '96 Establishment of Environmental Charter
- '96 Settlement of Kawasaki pollution suit
- '96 Settlement of Kurashiki pollution suit
- '97 Establishment of Voluntary Action Plan by Keidanren
- '97 ISO14001 certification of Keihin Works
- '97 ISO14001 certification of Mizushima (Kurashiki) Works and Utsunomiya Works (LSI plant)
- '98 ISO14001 certification of Fukuyama Works
- '98 ISO14001 certification of Chiba Works
- '99 ISO14001 certification of Engineering Division
- '99 ISO14001 certification of Chita Works
- '01 Establishment of Environment & Energy Liaison Center
- '02 **Start of JFE Group** (Sept.)
- '03 **Start of 5 operating companies** (April)
- '03 Start of Environmental Management Network System

### Energy-saving Activities

- '73–'78 **1st Period**: Energy saving by operational improvements (reduced fuel consumption by reheating furnaces, etc.)
- '79–'85 **2nd Period**: Introduction of large-scale waste heat recovery equipment, power saving measures
- '86–'94 **3rd Period**: Process continuation and integration, energy-saving operation, conversion to low-cost fuels
  - '94 Introduction of regenerative burners
- '95–'02 **4th Period**: Energy saving for global warming prevention
- '03– **5th Period**: Thorough effort for global warming prevention

## Supply of Environment-friendly Products, Engineering Technology, Equipment

### Supply of Environment-friendly Steel Products, Equipment

- '80 TMCP high strength steel plates
- '83 Rust stabilizer for weathering steel
- '86 Start of production of stainless clad plates
- '91 Fire resistant steel construction products
- '91 Heat-treated rails
- '92 Oriented electrical sheets for high efficiency transformers
- '93 Martensitic stainless steel tubes
- '95 Non-oriented electrical sheets for high efficiency motors
- '96 Steel-framed House
- '96 Start of waste plastic recycling for BF feed
- '98 Development of Super-OLAC technology for plates (high strength, high toughness, high weldability)
- '98 Ni-added high performance weathering steel
- '98 Water-permeable steel sheet piles
- '98 BF cement/BF granulated slag
- '98 Chromate-free coated steel sheets
- '99 "Tsubasa" screw pile
- '00 Development of Super-OLAC technology for shape steel
- '01 Tailor Welded Blank
- '01 As-sintered alloy steel powder (heat treatment-free)
- '01 High-purity silicon for solar cells
- '01 Lead-free free-cutting bars for machine structural use
- '02 Development of Super-OLAC technology for high carbon hot-rolled sheets
- '02 Start of production of NF Board for concrete forms using recycled resin
- '03 Laminated steel sheet for food cans

### Supply of Clean, Energy-saving Technologies

- '66 Startup of Matsukawa Geothermal Power Plant
- '81 Startup of in-ground LNG storage tank
- '81 Gas engine cogeneration system
- '97 Startup of circulating fluidized bed (CFB) boiler turbine power plant
- '98 Startup of wind power generation facilities
- '01 Tie-up for high efficiency fuel cell power generation (SOFC)
- '03 Startup of pilot-scale plant for high efficiency fuel cell power generation (SOFC)
- '03 Startup of BIGADAN process biogas system
- '03 Order for JFE-Babcock & Wilcox Volund fixed-bed updraft gasifier for wood chips
- '03 Startup of RDF gasifying power generation plant
- '03 Order for clathrate hydrate slurry (CHS) latent heat air-conditioning system

### Supply of Environmental Protection Equipment

- '73 Startup of stoker type waste incinerator
- '87 Startup of sewerage sludge methane fermentation plant
- '91 Startup of large-scale deep-shaft night soil treatment facility
- '97 Startup of electric resistance type ash melting furnace
- '00 Startup of JFE THERMOSELECT gasifying & melting furnace
- '00 Startup of U-tube ozone contact equipment
- '01 Completion of home electric appliance recycling plant
- '01 Startup of environment-friendly high-efficiency arc furnace (ECOARC)
- '01 Completion of seawater exchange-type hybrid caisson
- '02 Startup of sewerage sludge circulating fluidized bed incinerator
- '02 Startup of high temperature gasifying & direct melting furnace
- '02 Startup of fly ash dioxin removal equipment Hi-Clean DX
- '03 Development of Hyper 21 Stoker System

1965 1970 1975 1980 1985 1990 1995 2000 2005

# Implementation & Operation of the Environmental Management System (EMS)

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## "JFE Group EMS" using 3-Tiered Committee System

Because the JFE Group assigns high priority to "improvement of the global environment" as a management task, it has established a JFE Environmental Committee as the highest decision-making body for environment-related problems common to the Group.

JFE is dealing with environment-related problems with a 3-tiered committee system consisting of the JFE Environmental Committee, Environmental Committees in each of the Group's five operating companies, and Affiliated Company Environmental Committees at affiliates under each of the operating companies. JFE has also established a Group Environmental Liaison Committee made up of persons responsible for environmental matters at JFE Holdings and the five operating companies to smoothly communicate related to the environment. In a similar manner, each of the operating companies decides and implements environmental measures for the individual company and holds liaison meetings with its subsidiaries.

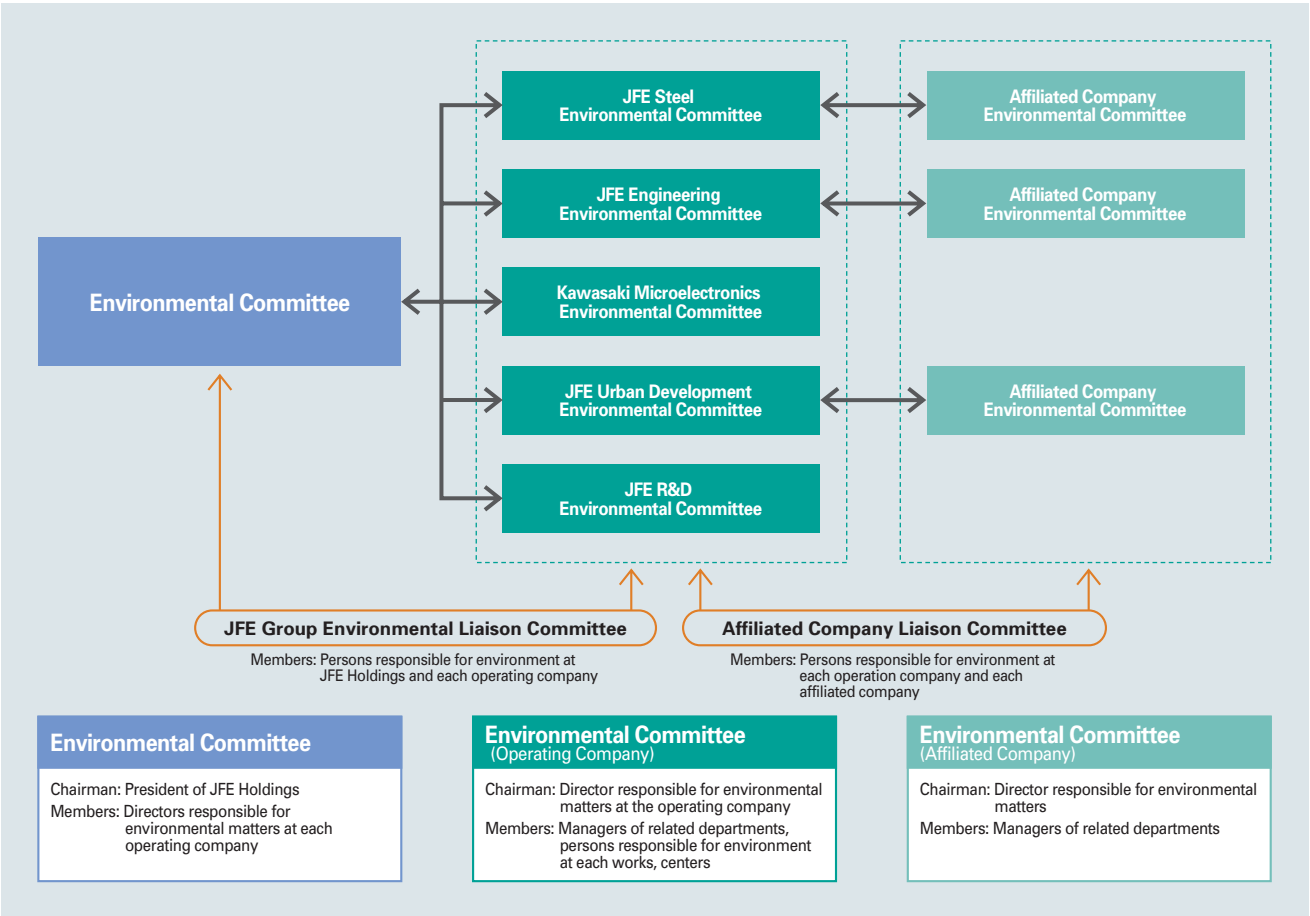
The JFE Environmental Committee is chaired by the President of JFE Holdings, with related Directors of JFE Holdings and Directors responsible for environmental matters at the five companies as members. Thus, the decisions of the JFE Group's top management are reflected in the Group as a whole, enabling JFE to implement unified environmental management.

Environmental Committee

## IT System Supporting Environmental Management: "Environmental Management Network System"

The JFE Group created an "Environmental Management Network System" on the group's intranet to facilitate operation of the 3-tiered committee system. The network system has proven useful in improving the level of environmental management in the group as a whole, for example, in communicating decision-making items and environment-related information (legal regulations, etc.) affecting the Group, and informing those concerned of risk and trouble and supporting solutions to problems.

**Environmental Management System**



## Status of the JFE Environmental Management System

The JFE Group aims at developing a comprehensive environmental management system based on its environmental philosophy. As such, it is promoting voluntary and continuous environmental activities by each company in the JFE Group based on ISO 14001 certification.

Among the JFE Group's operating companies, those with production facilities have all received ISO14001 certification, either for individual works or at the company level. These include JFE Steel, JFE Engineering, and Kawasaki Microelectronics.

As shown in the following table, many JFE subsidiaries have also received ISO certification. In the future, the JFE Group intends to increase the number of certified companies and works.

## Environmental Auditing

In order to implement a high-quality environmental management system, it is important to understand whether the system is operating appropriately, and whether performance is being continually improved. At JFE, in addition to external inspection by certification authorities, employees experienced in environment-related work such as environmental and energy management participate in internal auditing. Also, the training of in-house environmental inspectors is being promoted. Teams of employees led by external experts carry out internal auditing in JFE in order to ensure transparency in inspection. Issues pointed out by internal or external auditing are used as a basis for revising and continuously improving the system, taking into account the changes in the surrounding conditions.


Environmental Auditing

**Environmental Management System Certification Certified in Operating Companies**

| | Company/Works | Certified in |
|---|---|---|
| 1 | JFE Steel, East Japan Works (Keihin) | May 1997 |
| 2 | JFE Steel, West Japan Works (Kurashiki) | Oct. 1997 |
| 3 | Kawasaki Microelectronics | Oct. 1997 |
| 4 | JFE Steel, West Japan Works (Fukuyama) | March 1998 |
| 5 | JFE Steel, East Japan Works (Chiba including Nishinomiya plant) | July 1998 |
| 6 | JFE Steel, Chita Works | July 1999 |
| 7 | JFE Engineering | Dec. 1999 |

**Environmental Management System Certification Certified in Affiliated Companies**

| | Company | Certified in |
|---|---|---|
| 1 | JFE STEEL PIPE | May 1997 |
| 2 | JFE GALVANIZING & COATING | May 1997 |
| 3 | JFE URBAN RECYCLE | May 1997 |
| 4 | NKK TUBES | May 1997 |
| 5 | JFE REFRACTORIES | April 1999 |
| 6 | JFE CHEMICAL | July 1999 |
| 7 | JFE KANKYO | Dec. 1999 |
| 8 | JFE MATERIAL | Jan. 2000 |
| 9 | JFE Soldec | Feb. 2000 |
| 10 | JFE CONTAINER | March 2000 |
| 11 | JFE LOGISTICS | March 2000 |
| 12 | TOYOHIRA STEEL | Sep. 2000 |
| 13 | JFE METAL PRODUCTS & ENGINEERING | Dec. 2000 |
| 14 | KAWASHO | Dec. 2000 |
| 15 | JFE Mie Tech. Service | Feb. 2001 |
| 16 | JFE KOKEN | June 2001 |
| 17 | Fuji Kako | Sep. 2001 |
| 18 | Philippine Sinter Corporation | Nov. 2001 |
| 19 | JFE MINERAL | Dec. 2001 |
| 20 | JFE Environmental Services | Dec. 2001 |
| 21 | NKK BARS & SHAPES | May 2002 |
| 22 | JFE KOHNAN STEEL CENTER | March 2004 |

# Implementation & Operation of the Environmental Management System (EMS)

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Environmental Education

The JFE Group conducts environmental education at all levels to deepen the understanding of each employee and encourage individual efforts to improve the environment as part of regular work.

In each operating company, environmental education is incorporated in training programs for new employees and promotion, and also includes annual programs at each level, covering social trends related to environmental problems, the significance of the environment to JFE and measures being taken by the company, the responsibility of individual employees, and the importance of environmental management.

Based on an annual schedule, each works conducts periodical environmental education (once/year) such as environment-related regulations for general employees, employees engaged in designated work, internal environmental auditors, etc. as part of its environmental management system.

To strengthen environmental education, JFE introduced an Environmental Management Network System, creating an electronic environment in which all employees, including those at affiliated companies, can access internal and external environment-related information such as Environment Month Activities.

### ● Environment Month Activities

As part of its environmental management system, the JFE Group voluntarily conducts a unique program of Environment Month Activities at each works in June of each year to raise employee awareness of the environment, as follows.

**Program**

- Public Road Cleanup Operations
- Lectures on the environment
- Works Environmental Patrols
- Facility inspections/chemical inventory check
- Environmental Education under ISO14001
- Guided plant tours
- Fund-raising for environmental campaign, etc.

Public Road Cleanup Operations

Works Environmental Patrols

Lectures on the environment

## Status of Green Purchasing

In 2002, the JFE Group established a common group-wide set of "Green Purchasing Guidelines" for purchases of office supplies and parts/materials for production. Application is currently being expanded to affiliated companies.

**In outline, the Guidelines specify**

- Adequate study of required quantities before purchase to minimize purchased amounts.
- Consideration of environmental loads over the entire life cycle of final products, in addition to price, quality, delivery schedules, etc.
- Requests for and cooperation with environmental protection efforts of suppliers on a daily basis.

**<Examples of green purchasing>**

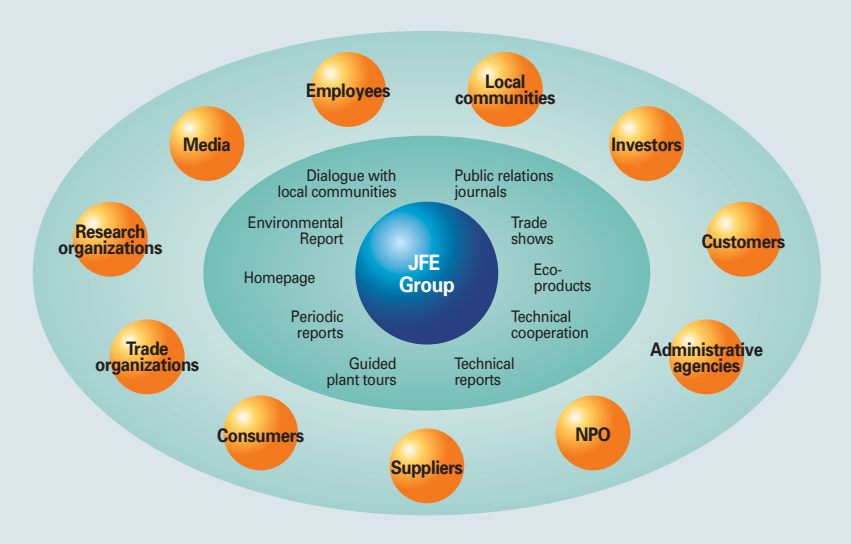
- Stationeries, office equipment
- Recycled oil, solvent containers, packaging materials, electric/natural gas/hybrid vehicles
- Introduction of hybrid car


Hybrid car

# Communication with Society

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

Communication with all stakeholders, including local society, investors, customers, and consumers, is important not only for ensuring a deeper understanding of the JFE Group's environmental protection activities, but also for heightening the awareness of JFE's managers and employees and deepening understanding between departments, and thus is contributing to increased environment awareness in the JFE Group as a whole. We also believe that the resulting activities will bring us closer to an environmentally-responsible society. For this reason, the JFE Group considers communication with society to be an important activity for environmental management and is working to improve the quality of its environmental communication.




## Agreements with Local Governments

The JFE Group has concluded environmental protection agreements (pollution prevention agreements) for air and water quality, noise, waste, etc. with local governments at the prefectural and city levels in areas where it has plants. Some of these agreements apply stricter standards than those in national laws, and some also cover items not required by the national government. The JFE Group enters into such agreements from the viewpoint of regional environmental protection, and strictly observes their terms in all cases. Under greening agreements with local governments, the JFE Group has created greenbelts in all of its works and is active in maintaining and managing wooded areas. These efforts help preserve the local scenery and have important environmental functions in absorbing $CO_2$ and suppressing dust and noise.


Greenbelt at Fukuyama, West Japan Works

## Participation in the Activities at Local Communities

As a good citizen in local society, the JFE Group attaches special importance to direct contact with community residents, conducting public service cleanup activities in the area and holding sports classes and tournaments.

For example, employees of West Japan Works (Fukuyama) participate in annual horseshoe crab habitat cleaning activities in Kasaoka City, Okayama Pref. as part of the works' "Cleanup Volunteer" program. In FY2003, a total of 155 employees participated. Employees also participate in annual cleanup activities at the Ashidagawa River in Fukuyama City, Hiroshima Pref.


Horseshoe crab habitat cleaning activities in Kasaoka

## Opening the Works to the Public

JFE holds annual open-house events at each of its works for the enjoyment of area residents. In FY2003, the company's various works held a total of 5 festivals, which drew more than 300,000 participants. In addition to the steelworks' own festivals, employees also actively participate in local festivals and other events.

To encourage better understanding in the surrounding community, JFE Steel has also established Visitors' Centers in its works and opens its plants to tour groups of local elementary and middle school students and the general public. Other programs include opening gymnasium and athletic ground in the works to the people in local communities.

Works festival at Fukuyama, West Japan Works

# Communication with Society

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Exchanges through Exhibitions

The JFE Group participates in various exhibitions on environmental themes to encourage information exchanges with the widest possible range of people.

At Eco-Products 2003, which attracted more than 100,000 visitors, the JFE Group presented an exhibition called "Contributing to the Environment through JFE's Only 1 and No. 1 Technologies" to highlight the Group's environment-friendly technologies and products. At the Top Management Seminar held at the same time, the Chairman of JFE Steel was an invited panelist and exchanged opinions on environmental management. In addition to exhibitions of this type, the JFE Group is actively publicizing its environmental efforts through environment-related lectures and other activities.


Eco-Products 2003

## Information though Internet

The JFE Group actively offers information related to environment through Internet. On the JFE Group web site, its environmental management policy and activities are introduced in the title of "Environmental activities."


Website of JFE Holdings
http://www.jfe-holdings.co.jp/en/environment/index.html

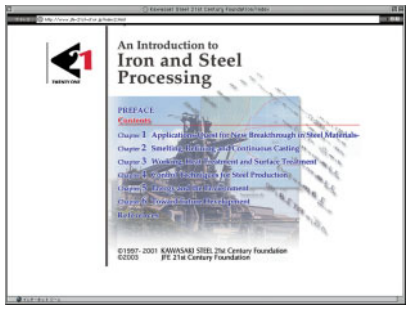
## Support and Funding Activities of JFE 21st Century Foundation

The JFE 21st Century Foundation was established in 1990 to "further promote coexistence and shared prosperity with society in order to achieve a presence which is open to society." Over the 13 years since establishment, the Foundation has carried out survey/research contributing to the creative development of the steel industry and related industries, support for technical research, and projects which contribute to regional development/international exchanges related to the steel industry with the aim of "promoting the 21st century iron and steel industry and contributing to an affluent life culture."

Support for technical research at universities is considered the Foundation's most important activity. Beginning in FY2003, the JFE 21st Century Foundation began providing support for technical research on the environment as a new field in addition to technical research on steel, and increased total support for technical research to 25 projects with a total budget of ¥50 million. As one indication of its high reputation in the academic community, the Foundation received 226 applications. Grants for environmental research included 3 projects in air purification, 2 in water purification, 2 in $CO_2$ reduction, and 1 for recovery of scarce metals from waste, for a total of 8 environment-related projects. Of the 17 grants for steel-related research, 5 were for environmental protection and purification. Thus, of the 25 grants awarded in FY2003, 13 were for environment-related topics.

Because the Japanese steel industry has been the world's leader in environmental protection and energy saving, in FY1994, the Foundation published "An Introduction to Iron and Steel Processing" to assist in environmental protection and purification efforts worldwide, and by FY1997, had donated these materials to 46 universities in Japan and 79 universities overseas. These materials can be accessed at the Foundation's homepage.

The JFE 21st Century Foundation
http://www.jfe-21st-cf.or.jp



An introduction of Iron and Steel Processing
http://www.jfe-21st-cf.or.jp/index2.html

## Participation in Kanagawa Riverhead Forest Partnership

In order to pass riverhead forest areas on to future generations, Kanagawa Prefecture is purchasing poorly-maintained private forests for management and cultivation as prefectural forests. These activities are supported by the "Kanagawa Riverhead Forest Partner" system.

As a water consumer in the Keihin area, East Japan Works of JFE Steel understands the importance of healthy water circulation between water sources and urban areas, and is therefore participating in Kanagawa Prefecture's Kanagawa Forest Conservation Program for Water Resource Regions as a Riverhead Forest Partner since 1999, contributing to the creation of riverhead forests.

かながわ水源の森林づくり

## Cooperation with NPO in Oceanographic Survey

Together with JFE LOGISTICS, JFE Steel is cooperating with the NPO (nonprofit organization) VOS Nippon*1 in a Voluntary Oceanographic Monitoring Activities*2 by installing automatic monitoring equipment on oceangoing vessels operated by JFE LOGISTICS. Data are collected each time vessels return to Japan and made available to interested researchers.


Oceangoing vessel M/V Sun Frontier

***1) VOS Nippon**
Designated nonprofit organization (NPO) which conducts the following nonprofit activities to promote interest in and understanding of the marine environment by collecting, analyzing, and publishing surface-layer oceanographic monitoring data from private commercial ships and investigating surface-layer material circulation and the reproductive mechanisms of resource life forms.
(1) Collection, organization, analysis, and publication of oceanographic surface-layer monitoring data
(2) Development of automatic continuous oceanographic monitoring devices
(3) Recruitment of volunteer monitoring ships to participate in monitoring activities
(4) Education, popularization, and publicity activities related to the marine environment
(5) Other activities necessary for achieving the organization's purposes

***2) Voluntary Oceanographic Monitoring Activities**
Activities involving monitoring of the temperature, salinity, etc. of oceans with monitoring devices mounted on private commercial ships and use of results in verification/elucidation of the actual condition of global warming, mechanism of climate change, etc.

# Objectives and Results for Global Environmental Activities

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | aJFE R&D |

| Aims of JFE Group | Objectives | Results in FY2003 |
|---|---|---|
| **1 Environmental management and communication** | | |
| **(1) Expansion of environmental management** | Strengthening of systems and improvement in level of environmental management | • ISO14001 certificationJFE KOHNAN STEEL CENTER CO., LTD.<br>• JFE Environmental Committee and environment-related committees in operating companies<br>• Study of condition of environmental management in affiliated companies |
| | Expansion of green procurement in Group as whole | • Expansion of guidelines to affiliated companies (in progress) |
| **(2) Communication with society** | Strengthening of communication | • Disclosure of environmental information by Environmental Report and homepage<br>• Timely information by company and works magazines<br>• Participation in eco-product and waste technology trade shows<br>• Research support by JFE 21st Century Foundation<br>• Contribution to Kanagawa Prefecture's Kanagawa Forest Conservation Program for Water Resource Regions program by participating as Riverhead Forest Partner |
| **(3) International cooperation** | Contribution to global warming countermeasures under Kyoto Mechanism (joint implementation, CDM, etc.) | • Receiving of trainees from Environmental Agency in Shenyang, China<br>• Completion of energy conservation model project of NEDO for waste heat recovery from WTE plant in Malaysia |
| | Communications with overseas organizations, etc. | • Presentation of environmental measures and examples of Japan's Eco-Town projects in China (CCICED)<br>• Presentation at International Symposium on Waste Treatment |
| **(4) Environmental accounting** | Qualitative measurement and evaluation of environmental activities | • Education and Publication of environmental accounting |
| **2 Reduction of environment loads in all business activities** | | |
| **(1) Prevention of global warming** | Measures for preventing global warming referring to Voluntary Action Plan by Japan Iron and Steel Federation | • Achieved 3% reduction in energy unit consumption in FY2003 from 2002<br>• Achieved 0.6% reduction in energy consumption in FY2003 from 2002<br>• Achieved 1.7% reduction in $CO_2$ emission in FY2003 from 2002 |
| **(2) Promotion of recycling** | Increase recycling ratio of byproducts of manufacturing processes | • Recycling ratio dropped to 99.3% in FY2003 from 99.5% in 2002. Continuous R&D activities for better recycling ratio |
| | Recycling of byproducts (waste) generated by society | • Increased receiving of waste plastic as blast furnace feed<br>• Received 534,000 used appliances for recycling |
| **(3) Promotion of environmental protection** | Reduced use and improved control of PRTR substances | • Reporting of releases/transfers in FY2003 to government and disclosure in Environmental Report |
| | Dioxin countermeasures | • Measures to strengthen flue-gas treatment equipment at sintering plants |
| | 80% reduction in benzene by FY 2003 against 1999 baseline | • Achieved 74% reduction in benzene emissions against 1999 baseline Continuous efforts for achieving target by additional countermeasures in FY2004 |
| | Reduced environmental loads by more efficient product distribution | • Shortened transportation distance and increased transportation lot size |
| **3 Contribution through technologies, products, and services** | | |
| **(1) Environment-conscious R&D** | Development of innovative technologies to solve global environmental problems | • Development of high efficiency natural gas hydrate production technology<br>• Development and commercialization of JFE Gas Clean DX (compact dioxin removal equipment in flue gas)<br>• Development of Hyper 21 Stoker System |
| | LCA-based product development | • Development marine remediation material (Marine Block, Marine Base, Marine Stone) and promotion of Sea Purification Project |
| **(2) Eco-products** | Reduction of environmental loads in society by expanded use of high performance steel products | • Increased sales of high performance chromate-free coated steel sheet<br>• Development of high tensile strength steel sheet for ultra-light weight auto body<br>• Development of laminated steel sheet for food cans<br>• Expanded application of heat island mitigating paving material<br>• Sales of slow-release potassium silicate fertilizer<br>• Increased production of high-purity silicon for solar cells |
| **(3) Total solutions for the environment** | Contribution to Eco-Town and recycling-oriented society | • Start of fluorescent lamp recycling plant<br>• Start of RDF gasifying power generation plant<br>• Start of food waste recycling business (BIGADAN biomass system) |
| | Development of clean energy sources anticipating next-generation needs | • Start of 100t/day DME direct synthesis plant operation<br>• Development of DME fueled diesel engine power generation system<br>• Cumulative wind power capacity reached 91,850kW(end of March 2004)<br>• Start of high efficiency fuel cell power generation (SOFC)<br>• Start of biomass power generation<br>• Start of Clathrate Hydrate Slurry Latent Heat Air-conditioning System |
| | Contribution to society by multi-faceted environmental engineering activities | • Completion of RDF power generating plant<br>• Providing the design and manufacturing technology of stoker furnace to a Chinese company |

# Environmental Accounting

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

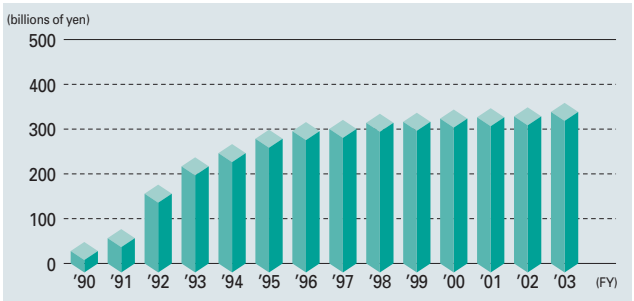
## Transition of Capital Investment

To reduce the environmental loads associated with its production activities, JFE Steel has actively invested in energy saving and environmental protection equipment based on the results of technical development.

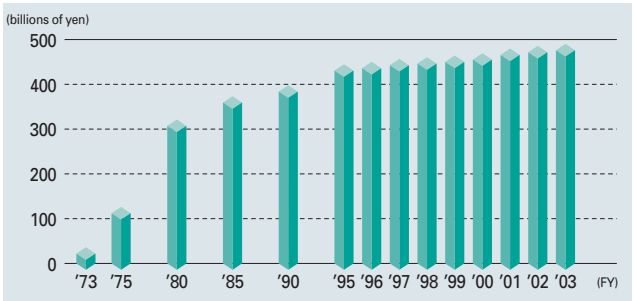
As energy conservation measures, it developed or introduced a wide variety of waste heat recovery equipment and invested heavily in energy-saving production processes such as continuous casting and continuous annealing. Cumulative investment since 1990 has now reached approximately ¥339 billion. Today, JFE Steel is maintaining its position as a world leader in energy efficiency.

JFE Steel has made particularly strong efforts to protect the environment, including construction of desulfurization and denitrification plants as measures against SOx and NOx in the atmospheric environment and water treatment facilities to reduce COD and prevent water pollution. As a result of companywide investment in environment-related equipment, which totals approximately ¥477 billion since 1973, JFE's clean steelworks boast the world's highest levels of environmental performance.

**Cumulative investment in energy-saving**




**Cumulative investment in environmental measures**




## Environmental Accounting

Investment in environment-related facilities was ¥14.9 billion in FY2003, which accounted for approximately 15% of total capital investment for the year. Expenses were ¥68.9 billion. The primary focus of investment was environmental protection and prevention of global warming. Primary expenses were environmental protection, effective use of resources, and prevention of global warming. Operation/maintenance and depreciation accounted for the majority of these expenses. Environment-related research and development expenses were ¥4 billion, or approximately 13% of total research and development expenses.

In FY2003, JFE Steel achieved a recycling rate of more than 99%. Energy-saving benefits were equivalent to ¥2.8 billion.

**Environmental conservation cost**

(billions of yen)

| | | Major item | Investment | Expenses |
|---|---|---|---|---|
| Environmental investment & expenses related to JFE's own business | Management | Monitoring & measurement of environmental influence, EMS-related activities, environmental education & training, etc. | — | 1.2 |
| | Prevention of global warming | Energy conservation, effective use of energy, etc. | 9.4 | 13.8 |
| | Effective use of resources | Recirculation of industrial water, Recycling of by-products & wastes generated in-house, waste management, etc. | 0.4 | 16.7 |
| | Environmental protection | Prevention of air pollution, water pollution, soil contamination, noise, vibration, ground subsidence, etc. | 5.1 | 30.7 |
| | Miscellaneous | Fees/charges for SOx, etc. | — | 1.8 |
| Environmental investment & expenses related to customers and society | Research & development | Technological development for the environment, energy, prevention of global warming | — | 4 |
| | Social activities | Protection of the nature, support to forestation, information disclosure, advertisement, etc. | — | 0.7 |
| | | **Total** | **14.9** | **68.9** |

The totals mentioned above were calculated on the following basis.
- Period: April 2003 to March 2004
- Scope: Environment-related investment and expenses at JFE's steelworks, but in the case of research and development, on a companywide basis (JFE Steel and JFE Engineering).

*Calculations do not include investments made primarily for purposes other than environmental protection, for example, renovation of superannuated facilities, even when the process as a whole realizes a net energy saving in comparison with the former process.
**Calculations include only actual effects, excluding presumed effects based on estimates or risk avoidance benefits.

Environmental Performance Report I

# Reducing Environmental Loads in Production Activities

## Using the World's Most Advanced Environmental Load Reduction Technologies

# Preventing Global Warming at JFE Steel

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Reducing Energy Consumption

In December 1996, the Japan Iron and Steel Federation established a Voluntary Action Program for Environmental Protection*1, which targets a 10% reduction in energy consumption in FY2010 against a FY1990 baseline. Among other positive efforts to prevent global warming, in September 1997, a supplementary goal*2 was incorporated in the Voluntary Action Program, calling for an additional 1.5% reduction in energy consumption. In FY2002, energy consumption of Japan's steel industry was 6.6% below the FY1990 baseline, demonstrating the success of voluntary action.

On the other hand, world crude steel demand has continued to grow in recent years, supported by the economic growth of the East Asian region, most notably China (p. 2). Responding to calls for sustainable development, the Japanese steel industry, which boasts the world's highest energy efficiency, is contributing to preventing global warming, while continuing to meet rising crude steel demand as a long-term supply base for steel materials.

JFE Steel has a long history of positive efforts in energy saving (p. 21) and is continuing its energy saving activities based on the Japan Iron and Steel Federation's Voluntary Action Plan, while responding to rising crude steel demand and the requirements of higher value-added products.

In FY2003, unit energy consumption (energy consumption/ton-crude steel) at JFE Steel and four affiliated electric furnace steelmakers*3 was 22.4 GJ/t-s, or a 15% reduction from FY1990 (3% reduction from FY2002). In response to increased demand for high value-added products such as automotive steel sheets and plates for shipbuilding, JFE Steel increased crude steel production to 30.5 million tons, up 17% from FY1990 (2% increase from FY2002), but at the same time, reduced energy consumption to 685 petajoules (PJ)*4, or a 0.3% reduction from FY1990 (0.6% reduction from FY2002) by energy saving activities such as optimizing operating parameters. In a trial calculation, actual $CO_2$ emissions*5 in FY2003 were estimated at approximately 56 million tons (1.3% reduction from FY1990).

JFE Steel fully recognizes the importance of global warming and is committed to solving this urgent problem by developing and introducing new energy saving technologies and developing next-generation steel manufacturing technologies. At the same time, JFE Steel is contributing to preventing global warming in the social/transportation sectors with environment-friendly steel products.

***1)** Details of the steel industry's Voluntary Action Program for Environmental Protection can be found at the Japan Iron and Steel Federation's website, "Ongoing Commitment of the Steel Industry Against Global Warming" at the following address:
http://www.jisf.or.jp/energy/index/htm

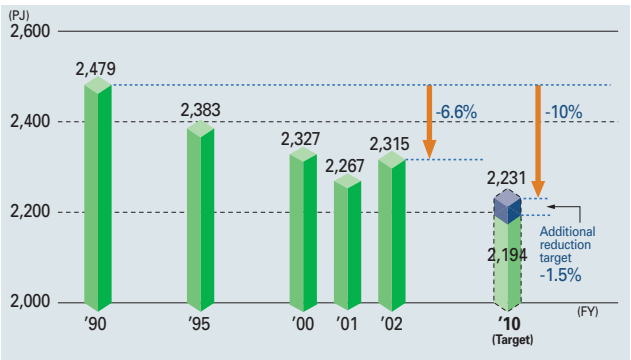
***2) Supplementary goal under Voluntary Action Plan**
The steel industry incorporated in its Voluntary Action Plan a 1.5% reduction in energy consumption by effective use of waste plastic in blast furnaces, coke ovens, etc., assuming creation of an adequate collection system.

***3) Four affiliated electric furnace steelmakers**
NKK Bars & Shapes Co., Ltd., Daiwa Steel Corp., Tohoku Steel Corp., and Toyohira Steel Corp.

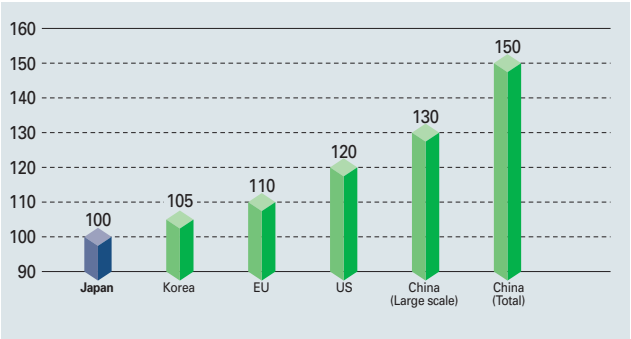
***4) Petajoule(PJ)**
Joule (heat unit) x $10^{15}$ (1000 trillion), 1 cal=4.186J

***5) $CO_2$ emissions**
$CO_2$ emissions = $CO_2$ emissions/unit of energy consumed x unit energy consumption x production

### Japanese steel industry's total energy consumption
(Source: The Japan Iron and Steel Federation)

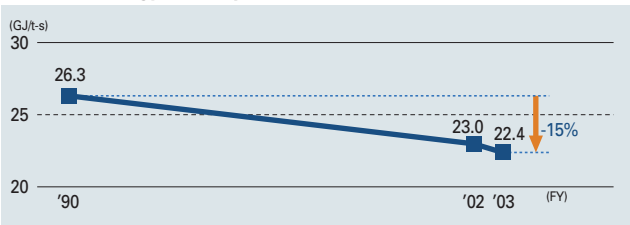



### Energy efficiency of steelworks in major countries
(Source: The Japan Iron and Steel Federation)




(Source: Korea Iron & Steel Association, China Iron and Steel Association, etc.)

### JFE Steel's energy consumption rate*6




### JFE Steel's crude steel production*6


### JFE Steel's energy consumption*6


***6)** The sum of data from JFE Steel and four affiliated electric furnace steel makers.

# Preventing Global Warming at JFE Steel

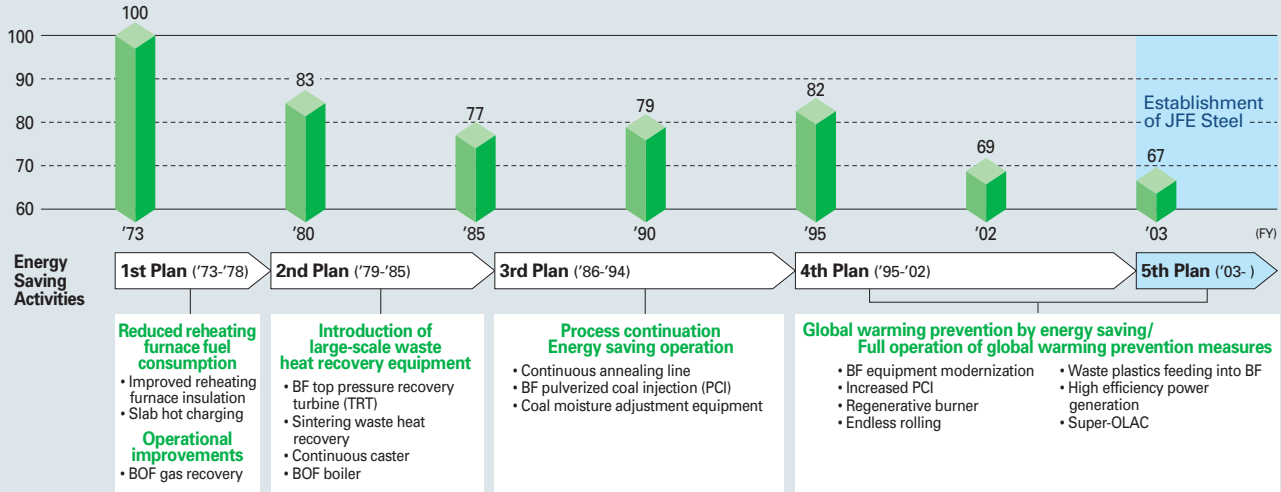
| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## History of Energy Saving Activities

JFE Steel began its 1st Energy Saving Activities Plan in response to the First Oil Crisis in 1973. By 1990, the company had achieved energy savings of approximately 20% in comparison with FY1973 through measures such as reduced reheating furnace fuel consumption, operational improvements, introduction of large-scale waste heat recovery equipment, and process continuation/energy saving operation of production processes. The company also continued its aggressive energy saving activities in the years that followed.

Since the establishment of JFE Steel in April 2003, the company is implementing further measures to prevent global warming under its 5th Energy Saving Activities Plan.

**Transition of unit energy consumption index at JFE Steel (1973 = 100)**




### Examples of Energy Saving Activities (1)

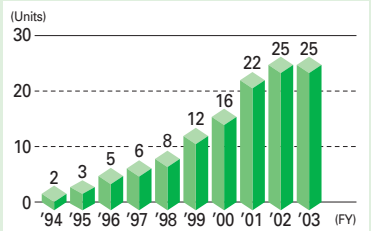
## Expanded Application of Regenerative Burners

At the hot strip mill, a reheating furnace is used to heat steel slabs to high temperatures exceeding 1000°C before hot rolling. The reheating furnace burns byproduct gas from the steelworks. Efficient recovery of the sensible heat of the high temperature combustion flue gas discharged from the furnace is essential for reducing energy consumption and $CO_2$ emissions. Conventionally, this high temperature flue gas was passed through a metal heat exchanger to preheat the burner combustion air. However, the heat recovery ratio was limited to 50-60% due to temperature restrictions on the heat exchanger.

Each regenerative burner is equipped with a high heat-resistant ceramic heat exchanger, called a regenerator, making it possible to preheat burner combustion air to virtually the furnace temperature. This dramatically improves the heat recovery ratio, to 70-80%, realizing a large energy saving.

JFE Steel confirmed the energy saving effect of this technology by applying regenerative burners at the continuous reheating furnace at West Japan Works (Kurashiki) in 1994, and then successively expanded application. The continuous reheating furnaces at West Japan Works (Fukuyama) were completely retrofitted with regenerative burners in 1996, with the epoch-making effect of reducing energy consumption by approximately 25% and NOx by about 80%. Regenerative burners have now been installed at more than 20 furnaces, including reheating furnaces, heat treatment furnaces, ladle heating burners, and others at JFE Steel and its affiliates, with an energy saving effect of 2PJ/year, achieving a $CO_2$ reduction of 200,000 tons/year.

**Number of reheating furnaces equipped with regenerative burners**





Reheating furnace with regenerative burners

# Stop Global Warming!

We are reducing $CO_2$ through voluntary efforts.

**Examples of Energy Saving Activities (2)**

## World's First Continuous Finishing Hot Rolling Process: "Endless Rolling"

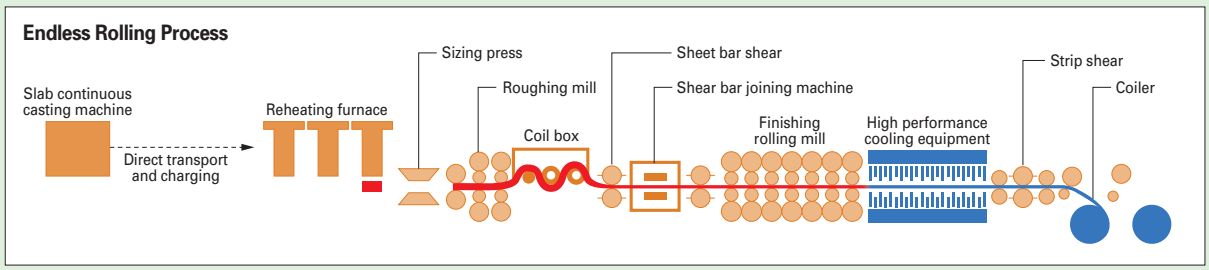
JFE Steel's East Japan Works (Chiba) led the world in development and practical application of a new rolling process called continuous finishing hot rolling, or "Endless Rolling."

Conventionally, hot rolling was performed in one-slab units, but in Endless Rolling, sheet bars (semi-finished product produced by rolling slabs at roughing mill) are joined before the finishing mill, enabling continuous (endless) rolling.

Sheet bar joining was optimized by adopting a unique high accuracy on-line material flow control technology and a new joining technology, which are not found in conventional processes. By using rolling technology which prevents joint rupture, rolling conditions can be optimized to match the timing when joints in the strip pass the mill, realizing continuous rolling. This, together with the new high speed shearing and coiling technologies, has realized unprecedented smooth continuous rolling and dramatically improved yield in the hot rolling process.

Productivity in the rolling process has improved by more than 20% in comparison with conventional processes, reducing power and fuel consumption by rolling mills and the reheating furnace by 20%. Endless Rolling also contributes to resource saving because head and tail end crops are greatly reduced.

JFE Steel introduced this technology at No. 3 hot strip mill at East Japan Works (Chiba) and began full scale production in March 1996.



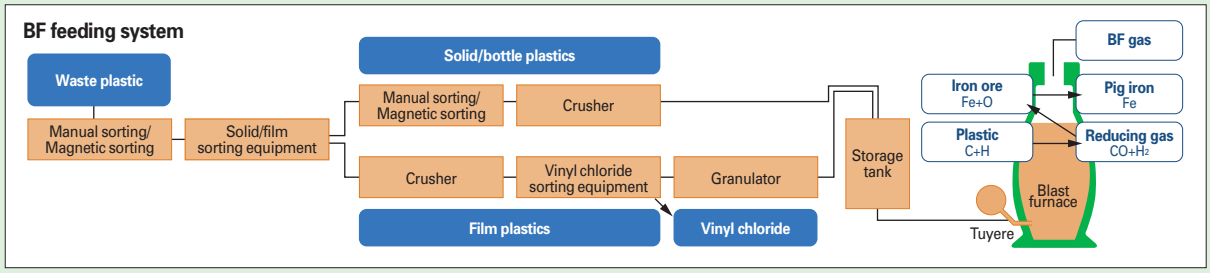

**Examples of Energy Saving Activities (3)**

## Expanded Application of Waste Plastic Recycling System for Blast Furnace Feed

In Japan, industrial and municipal waste plastic reaches 10 million tons/year. About 45% is used effectively in power generation or recycling, but the remainder is either incinerated or buried in landfills. As a result, securing landfills has become serious problem for local governments.

In October 1996, JFE Steel established Japan's first waste plastic recycling system for blast furnace feed for industrial waste plastic at East Japan Works (Keihin). Waste plastic, which consists mainly of carbon and hydrogen, is blown into the blast furnace as a raw material and fuel for ironmaking. Approximately 60% serves as a substitute for coke, which is conventionally used as a reductant for ironmaking, and the remaining 40% is consumed as energy, reducing landfill disposal and saving energy. By reducing coke consumption, this system also reduces $CO_2$ emissions in ironmaking because plastic contains less carbon than coke.

With full implementation in April 2004 of Containers and Packaging Recycling Law, which applies to municipal wastes, JFE Steel began operation of blast furnace feeding systems for used plastic containers and packaging at both East Japan Works (Keihin) and West Japan Works (Fukuyama). JFE Steel is also active in waste plastic gasification treatment and manufacture of Concrete Form Boards (material recycling). In FY2003, the company received and effectively used a total of approximately 160,000 tons of waste plastic.



# Reducing Generation/Discharge of Byproducts at JFE Steel

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Reducing Generation/ Discharge of Byproducts at JFE Steel

The steel manufacturing process generates various byproducts, including slag,*1 dust, and sludge.*2 In 1996, the Japan Iron and Steel Federation established a Voluntary Action Plan with a target of reducing landfill disposal in FY2010 by 75% in comparison with FY1990, to a total amount of 500,000 tons.

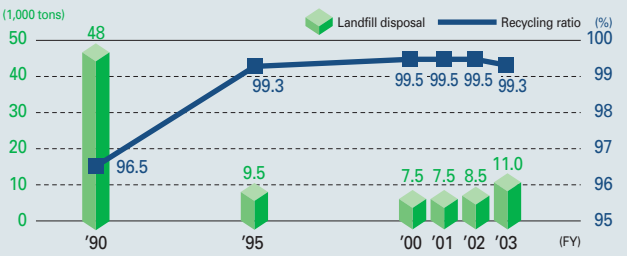
JFE Steel began Zero Waste Activities in advance of the industry, constructing a recycling system which uses generated byproducts in the works as raw materials for steel manufacturing, and now recycles more than 99% of the byproducts generated in its steel manufacturing processes. The company has also made efforts to reduce the amount of byproducts generated, and is helping to reduce landfill disposal by positively developing applications/expanding the market for recycled products made from slag, which accounts for the largest part of steel works byproducts.

Although crude steel production increased by about 2% in comparison with FY2002, in FY2003, total amount of byproducts decreased to approximately 15.6 million tons, 400,000 tons reduction from FY2002, by reducing slag generation. However, higher crude steel production caused an increase in byproducts having low recycling ratios such as dust and sludge. As a result, landfill disposal increased by 25,000 tons from FY2002, reaching 110,000 tons (77% reduction from FY1990). Combining these results, JFE Steel's recycling ratio for FY2003 was 99.3%. In the future, JFE Steel will continue its efforts to reduce landfill disposal.

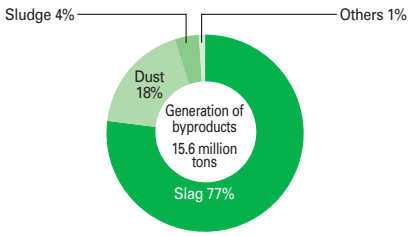
***1) Slag**
Material consisting of non-iron rock components in iron ore, and lime, etc. added to remove impurities such as phosphorus during steel refining. It separates from and floats on the molten metal, enabling deslagging. Slag is processed into fine particles and lumps as material for cement, civil works, fertilizer, etc.

***2) Sludge**
Material remaining after dewatering of the mud-like substance separated and removed by circulating water/waste water treatment equipment. Although sludge consists mainly of iron, in some cases it also contains components which affect blast furnace operation and the quality of steel products and therefore cannot be completely recycled. Technologies for removing harmful components are being developed.

**Transition of landfill disposal/recycling ratio**




**Breakdown of steelworks byproducts in FY2003 (dry base)**




### Example of Zero Waste Activities (1): Reducing Generation of Byproducts

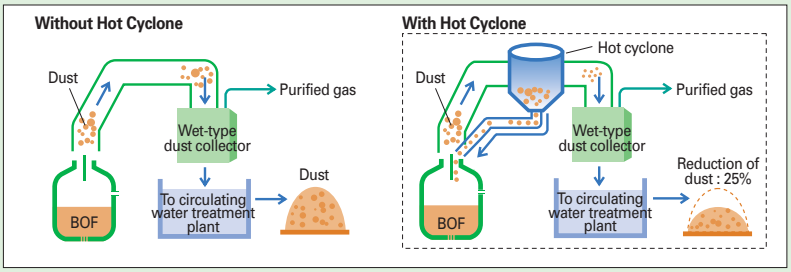
## Development/Introduction of Hot Cyclone Equipment for Reducing Dust Generation

JFE Steel is developing technology and equipment to reduce dust generation. In 2001, Hot Cyclone equipment, which reduces steelmaking dust generation by the BOF in the stainless steelmaking process, was developed and installed at East Japan Works (Chiba).

In this advanced stainless steelmaking process, refining is performed by oxygen blowing, using chromium ore, carbon, and molten iron as raw materials, but dust is also generated. Formerly, this dust, together with the gas generated by the BOF, was cooled with water and recovered by dust collection, treated by the circulating water treatment equipment, then dewatered and recycled to the reducing furnace. However, problems remained, as the amount of generated dust was large and the dust was oxidized by contact with the air in the recycling process.

With the Hot Cyclone, relatively coarse dust is captured near the top of the BOF and returned directly to the BOF while still at high temperature, resulting in a final reduction of more than 25% in the dust which must be treated in the water treatment process.

Moreover, because the captured dust does not pass through the water treatment process, dewatering is unnecessary, and oxidation does not occur because the dust is recycled to the BOF without contact with the air, eliminating the need for reduction. These features also contribute to energy saving.



## Zero Waste Activities (2): Recycling of Byproducts in Steel Manufacturing Process

# Use of Sludge as Hot Metal Pretreatment Material

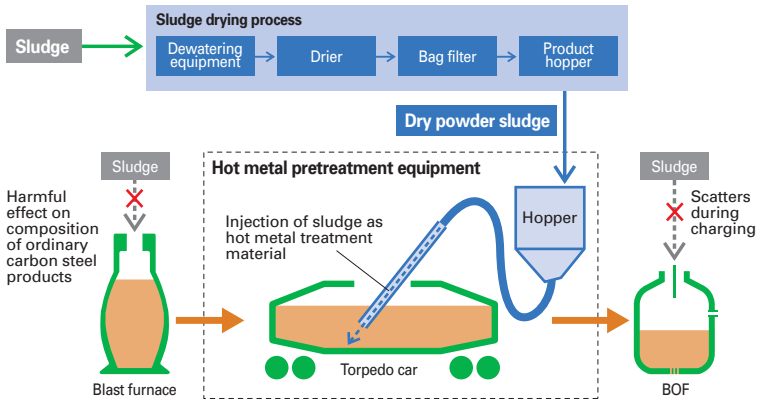
Among the byproducts generated in steel manufacturing processes, sludge is particularly difficult to recycle. JFE Steel has therefore actively conducted research and development on sludge recycling.

For example, if the sludge generated in rolling stainless steel sheets (called "stainless sludge") is used as material in the blast furnace, it may affect the composition of the pig iron in the furnace as a whole, resulting in a composition unsuitable for ordinary carbon steel products. On the other hand, when used as a BOF material, particles of stainless sludge tend to scatter during charging due to their extremely small size.

East Japan Works (Chiba) therefore developed a technology for recycling sludge in the hot metal pretreatment process, which is an intermediate process between the blast furnace and BOF. Stainless sludge is dried and injected in powder form as a hot metal treatment material, solving the problems mentioned above. Drying and use as powder also increase its effectiveness in hot metal treatment.

East Japan Works (Chiba) installed a sludge drying facility with 16,000-ton/year capacity and began full-scale recycling of stainless sludge in hot metal pretreatment in FY2002, thereby increasing sludge recycling.

**Flow of sludge recycling in hot metal pretreatment process**




## Efforts to Reduce Byproduct Discharges: Promoting Byproduct Recycling outside the Company

# Development and Expanded Application of Recycled Slag Products

Slag generated by blast furnaces, BOFs, and electric furnaces accounts for about 80% of steel manufacturing byproducts. JFE Steel is developing products using slag and encouraging expanded use by establishing technologies for recycling slag in roadbed material, concrete aggregate, raw material for cement, etc., achieving virtually 100% recycling of the slag generated in steel manufacturing processes, and is also working to expand use through standardization of recycled slag products under JIS.

At present, the slag generated by East Japan and West Japan Works is used in a variety of recycled products and, under Japan's Green Purchasing Law,[*1] is specified as a "Designated Procurement Items."[*2]

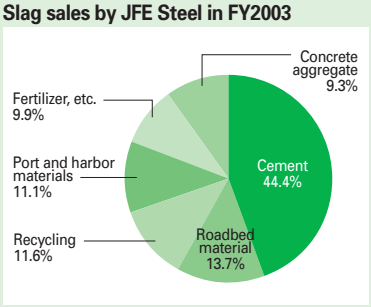
Because blast furnace cement, which is used as a substitute for Portland cement and material for concrete, makes it possible to omit the crushing and calcining processes in cement manufacturing, energy consumption in production is reduced by approximately 43%, while $CO_2$ emissions are cut by 41%, also contributing to prevention of global warming.

"Steel Slag Carbonated Blocks" and "Steel Slag Hydrated Blocks," which were developed by JFE Steel as concrete substitutes using steel slag, are used to restore shoreline environments and as materials for port and harbor works.

***1) Green Purchasing Law**
Short name of "Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities and Promotion of Demand for Eco-Friendly Goods "

***2) Designated Procurement Items**
Items including 176 products in 15 fields, such as paper, office supplies, OA equipment, etc. selected for priority in purchasing by the states and other entities under the "Basic Policy for the Promotion of Procurement of Eco-Friendly Goods and Services."

**Slag sales by JFE Steel in FY2003**




**Products specified as "Designated Procurement Items" under Green Purchasing Law**

- Blast furnace cement
- Blast furnace slag aggregate
- Mixed roadbed material containing steel slag
- Asphalt mixture containing steel slag
- Rock wool using steel slag as material
- Granulated slag for civil works
- Steelmaking slag for ground improvement

# Reducing Generation/Discharge of Byproducts at JFE Steel

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

*In Focus*

## Advanced Applications for Slag

To ensure effective use of slag, JFE Steel is working to develop recycled slag products and expand their use. Recycled products developed to date include the following.

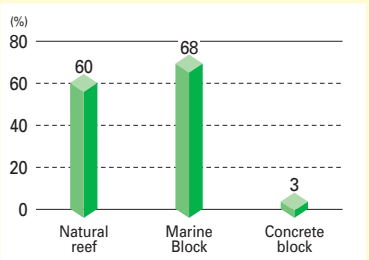
### Use in Restoring Shoreline Environments

**(1) Artificial reefs for seaweed/coral breeding: "Marine Block" (steel slag carbonated block)**

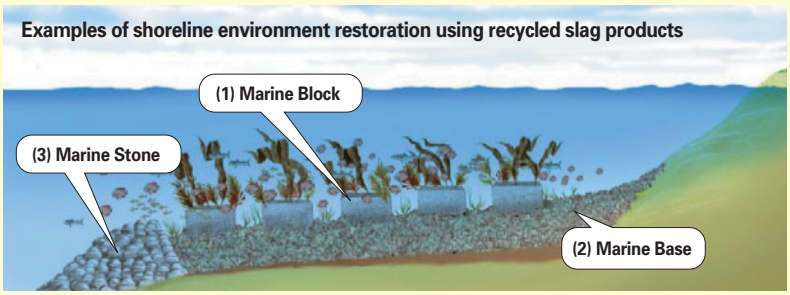
Artificial reef material for seaweed/coral breeding produced by absorbing $CO_2$ in steelmaking slag. Because the main component is calcium carbonate, same composition as shells and coral, artificial reefs are highly stable in seawater, and make excellent breeding habitats for seaweeds and coral.

Marine Block

**Average coverage with large seaweed (after one-half year)**




**Examples of shoreline environment restoration using recycled slag products**



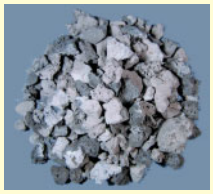

**(2) Sand-capping material: "Marine Base"**

A sand-capping material which is made from granulated blast furnace slag and composed mainly of calcium oxide and silicon oxide. Covering the sea bottom with organic material (sludge) suppresses elution of orthophosphates and nitrogen compounds, which cause eutrophication, and prevents occurrence of hydrogen sulfide, which causes blue tide. The material size is suitable for bottom-dwelling organism habitats.

Marine Base

**(3) Submerged embankment: "Marine Stone"**

Submerged embankment/breakwater material using steelmaking slag. Because steelmaking slag provides minor elements necessary for life, Marine Stone habitats are superior to natural stone.



Marine Stone

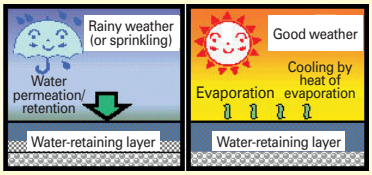
**● Concrete substitute: "Ferro-Form" (steel slag hydrated blocks)**

Concrete substitute produced by hydration hardening using a mixture of pulverized powder, etc. in steelmaking slag. Progressively adopted as a port and harbor material, for example, in breakwater blocks.

### Road Material Application

**● 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 by same principle as sprinkling
Retains water in structure, maintaining effectiveness
Cooling function of heat island-mitigating pavement

### Fertilizer Application

**● Slow-release Potassium Silicate Fertilizer**

Slag fertilizer is released slowly into soil over long period.

Slow-release Potassium Silicate Fertilizer

# Preserving Environmental Quality at JFE Steel

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Air Quality Preservation

### ● Reducing sulfur oxide (SOx) emissions

To reduce emissions of sulfur oxide (SOx), JFE has adopted low-S fuels and introduced the high-efficiency flue gas desulfurization system. In 1976, the company installed a high-efficiency sintering flue gas desulfurization plant using the ammonium-sulfate process,*1 which was unprecedented in the world, at East Japan Works (Keihin), achieving a broad reduction in SOx. In FY2002, two new de-S plants were constructed at West Japan Works (Fukuyama). As a result, a 100% contribution was realized, reducing SOx emissions in FY2003 by approximately 2% from the FY2002 level, to 3.9 ($10^6Nm^3$). This was equivalent to 11% of emissions in FY1973, and was 1/9 the former level.

### ● Reducing nitrogen oxide (NOx) emissions

JFE Steel has actively installed flue gas denitration systems to reduce NOx emissions. Sintering flue gas de-N systems, which decompose NOx into nitrogen and water, were installed at East Japan Works (Chiba) in 1976 and East Japan Works (Keihin) in 1979, greatly reducing NOx emissions.

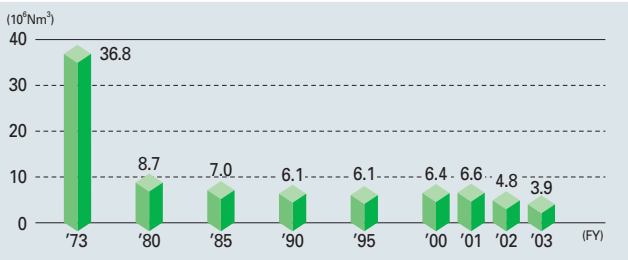
In FY2003, NOx emissions were maintained at the FY2002 level, at 14.8 ($10^6Nm^3$). This was 43% of the level in FY1973, or a reduction of more than half.

### ● Reducing dust

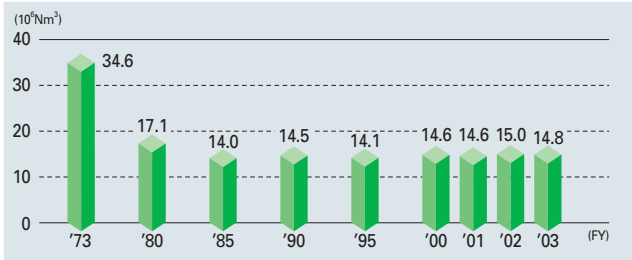
Dust is mainly generated in yards and conveyors for raw materials. Sprinkling in ore and coal yards, sealed conveyor connections, and other measures prevent dust generation. At coke ovens, sintering furnaces, blast furnaces, BOFs, and other dust-generated facilities, high-performance dust collectors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

***1) Ammonium-sulfate process**
Flue gas treatment method which combines deammonification of coke oven gas and desulfurization of sintering flue gas. Research was carried out jointly by 9 steel companies (existing at the time) in 1971-1972, and practical application was achieved in 1976.

**Transition of SOx emissions**




**Transition of NOx emission**



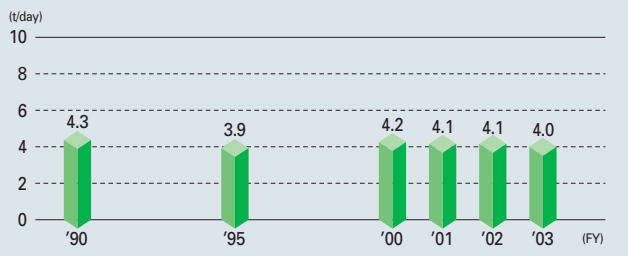

## Water Quality Preservation and Water Recycling

Large quantities of water are used in steel manufacturing. JFE Steel performs complete purification treatment by various methods, including biological, physical, and chemical treatments, depending on the properties of the water after use, and has adopted circulating use and cascade use*1 of water, maintaining a high circulation ratio*2 of approximately 94% of industrial water consumption. For release into public waters, wastewater is given thorough purification treatment. For example, wastewater containing organic substances is given biological treatment by activated sludge, followed by coagulating sedimentation, filtration, and activated carbon adsorption (ammonia liquor).

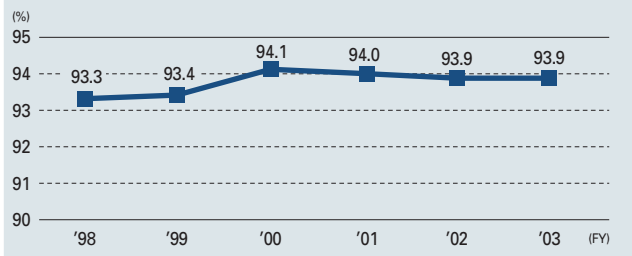
***1) Cascade use**
Multi-stage (cascade) use, in which use of resource is not completed in one step, but rather, the resource with its properties altered by use or waste discharged is used in a different application, followed by further use in another application.

***2) Circulation ratio**
Circulation ratio (%) = [Total consumption - received industrial water]/Total consumption

**Transition of COD**




**Transition of industrial water circulation ratio**



# Reducing Release of Harmful Chemicals at JFE Steel

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Control of Chemical Substances

In FY2003, which was the 3rd year of mandatory reporting under the PRTR system, the cutoff level for Class 1 designated chemical substances *1 which are subject to mandatory data collection/reporting was reduced from 5 tons to 1 ton (limit for Specific Class 1 designated chemical substances *2 remained unchanged at 0.5 tons). As a result, the number of reported substances at JFE Steel increased by 12 in comparison with FY2002, reaching 40 in FY2003.

Reported amounts of releases into the air and public waters rose approximately 200 tons from FY2002, reaching 838 tons in FY2003, due to the larger number of substances and increased crude steel production.

JFE Steel gives priority to reducing releases beginning with substances having high toxicity and large release amounts. In FY2003, releases of dioxins were reduced by approximately 3 g-TEQ from FY2002, to 12 g-TEQ, and benzene was reduced similarly by approximately 12 tons, to 57 tons.

Efforts to recycle byproducts reduced the total of releases/transfers as waste, including on-site landfill disposal and transfers outside the company, by approximately 360 tons from FY2002, to 1,055 tons.

JFE Steel will continue its voluntary efforts to reduce releases and transfers of chemical substances.

***1) Class 1 designated chemical substance**
Substances which exist pervasively and persistently in the environment and fall under any of the following three conditions for harmfulness. To date, 354 such substances have been designated.
(1) Substance with harmful effect on human health or the ecosystem.
(2) Substance which itself does not have a harmful effect on human health or the ecosystem, but which undergoes chemical change after release into the environment and easily forms harmful chemical substance(s).
(3) Substance which may destroy the ozone layer.

***2) Specific Class 1 designated chemical substance**
Among Class 1 designated chemical substances, substances assessed as having carcinogenic effects on humans, requiring special care. To date, 12 such substances have been designated, including the dioxins, benzene, and hexavalent chromium.

***3) Steel business**
The scope of the data totaled at the right includes East Japan Works (Chiba and Keihin), West Japan Works (Fukuyama and Kurashiki), and Chita Works, but excludes the Steel Laboratories.

**Substances reported under PRTR** (FY2003, JFE steel business)*3 (Unit: tons; dioxins: g-TEQ)

| No. | Substance | Releases | | | | Transfers | |
|---|---|---|---|---|---|---|---|
| | | Air | Public waters | Soil on-site | Landfill on-site | Sewerage | Off-site |
| 1 | Zinc compounds (water-soluble) | 0 | 5.0 | 0 | 0 | 0 | 0 |
| 16 | 2-aminoethanol | 1.6 | 3.2 | 0 | 0 | 0 | 1.8 |
| 25 | Antimony and its compounds | 0 | 0.05 | 0 | 0 | 0 | 0 |
| 30 | Bisphenol A type epoxy resin | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | Ethylbenzene | 47 | 0 | 0 | 0 | 0 | 0 |
| 43 | Ethylene glycol | 0.3 | 0 | 0 | 0 | 0 | 9.2 |
| 63 | Xylene | 453 | 0 | 0 | 0 | 0 | 1.4 |
| 68 | Chromium and chromium (III) compounds | 0 | 0.4 | 0 | 258 | 0 | 154 |
| 69 | Chromium (VI) compounds | 0 | 0.0005 | 0 | 0 | 0 | 0.0001 |
| 85 | HCFC-22 | 0 | 0 | 0 | 0 | 0 | 1.9 |
| 100 | Cobalt and its compounds | 0 | 0 | 0 | 0 | 0 | 0 |
| 102 | Vinyl acetate | 0 | 0 | 0 | 0 | 0 | 0 |
| 108 | Inorganic cyanogen compounds | 0 | 0.1 | 0 | 0 | 0 | 0 |
| 132 | HCFC-141b | 64 | 0 | 0 | 0 | 0 | 1.4 |
| 144 | HCFC-225 | 5.5 | 0 | 0 | 0 | 0 | 0 |
| 145 | Methylene dichloride ; dichloromethane | 18 | 0 | 0 | 0 | 0 | 0 |
| 177 | Styrene | 0.9 | 0 | 0 | 0 | 0 | 0 |
| 178 | Selenium and its compounds | 0 | 0.03 | 0 | 0 | 0 | 0 |
| 179 | Dioxins | 12 | 0.00001 | 0 | 0 | 0 | 0 |
| 198 | Hexamethylenetetramine | 0 | 0 | 0 | 0 | 0 | 0 |
| 200 | Tetrachloroethylene | 25 | 0 | 0 | 0 | 0 | 0 |
| 224 | 1,3,5-Trimethylbenzene | 3.9 | 0 | 0 | 0 | 0 | 0 |
| 227 | Toluene | 65 | 0 | 0 | 0 | 0 | 3.5 |
| 230 | Lead and its compounds | 0 | 0 | 0 | 0 | 0 | 0.001 |
| 231 | Nickel | 0 | 0.03 | 0 | 0 | 0 | 0 |
| 232 | Nickel compounds | 0 | 1.3 | 0 | 87 | 0 | 122 |
| 253 | Hydrazine | 0 | 0 | 0 | 0 | 0 | 0 |
| 270 | Di-n-butyl phthalate | 0.2 | 0 | 0 | 0 | 0 | 0 |
| 272 | Bis(2-ethylhexyl) phthalate | 1.1 | 0 | 0 | 0 | 0 | 0 |
| 283 | Hydrogen fluoride and its water-soluble salts | 0 | 49 | 0 | 0 | 0 | 1.1 |
| 299 | Benzene | 57 | 0 | 0 | 0 | 0 | 0 |
| 304 | Boron and its compounds | 0 | 12 | 0 | 0.0002 | 0 | 0.8 |
| 307 | Poly(oxyethylene) alkyl ether | 0 | 2.0 | 0 | 0 | 0 | 0 |
| 308 | Poly(oxyethylene) octylphenyl ether | 0 | 2.8 | 0 | 0 | 0 | 0 |
| 309 | Poly(oxyethylene) nonylphenyl ether | 0 | 8.7 | 0 | 0 | 0 | 0 |
| 310 | Formaldehyde | 0 | 0 | 0 | 0 | 0 | 0 |
| 311 | Manganese and its compounds | 0 | 6.4 | 0 | 262 | 0 | 149 |
| 345 | Mercaptoacetic acid | 0 | 0 | 0 | 0 | 0 | 0 |
| 346 | Molybdenum and its compounds | 0 | 3.9 | 0 | 2.3 | 0 | 0.008 |
| 353 | Tris(dimethylphenyl) phosphate | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 743 | 95 | 0 | 609 | 0 | 446 |
| | | Total releases 1,447 | | | | Total transfers 446 | |

# Preserving the Environment through Innovative Transportation at JFE Steel

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Rational/Efficient Transportation of Steel Products

JFE Steel believes that reducing $CO_2$, NOx, and SPM[*1] through improved fuel efficiency in steel product transportation is an important issue. The company is therefore promoting a modal shift[*2] aimed at reducing environmental loads in physical distribution, for example, by operating trucks and ships efficiently and selecting transportation modes rationally.

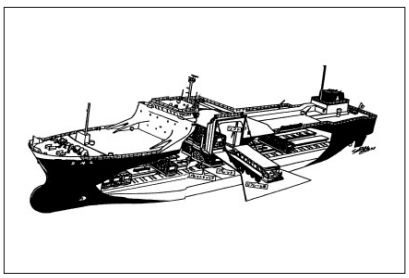
**Environmental efforts in physical distribution**

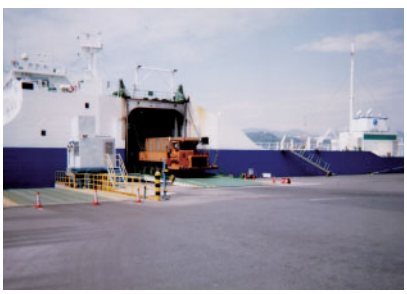
| Viewpoint of improvement | Specific measures |
|---|---|
| 1) Modal shift | • Shift to marine transport of traditional overland products by improving transportation lots (approx. 60,000 tons/year) |
| 2) Reduction of tractor exhaust gas | • Positive introduction of new low-exhaust gas vehicles<br>• Response to stronger environmental regulations on SPM, etc., particularly in urban areas |
| 3) Introduction of larger vehicles and control system | • Introduction of 160 tons carrier and special large-scale trucks<br>• Development/introduction of automatic truck dispatching system, optimizing trailer transportation efficiency |
| 4) Others | • Increased recycling ratio of in-ship retaining materials and simplified packaging |

### ● Improved efficiency in marine transportation with innovative ships

In marine transportation, JFE Steel has introduced innovative ships such as the RORO ship,[*3] which makes it possible to drive special large-scale vehicles directly into the ship and load/unload products packed on pallets in pallet units. This reduces the number of transportation-related handling operations in the works and eliminates reloading for transshipment at the wharf, reducing environmental loads through energy saving and other effects.

With conventional ships, information on the ship's operational status and loading/unloading destinations is controlled in a unified manner by the Coastal Ship Control Center, realizing efficient transportation, for example, by reducing deadheading between destinations.





Concept and view of actual RORO ship

### ● Improved efficiency in on-site transportation using large-scale vehicles

JFE Steel has introduced a 160 tons carrier and other special large-scale vehicles for use in transportation of materials/products within its works. Because larger loads can be transported with these vehicles than with conventional trailers, total number of transportation are reduced and total emissions of $CO_2$ can be reduced by approximately 10% with the 160 tons carrier compared with conventional trailer.

160 t carrier

### ● Rational land transportation by Optimized Land Transport Network

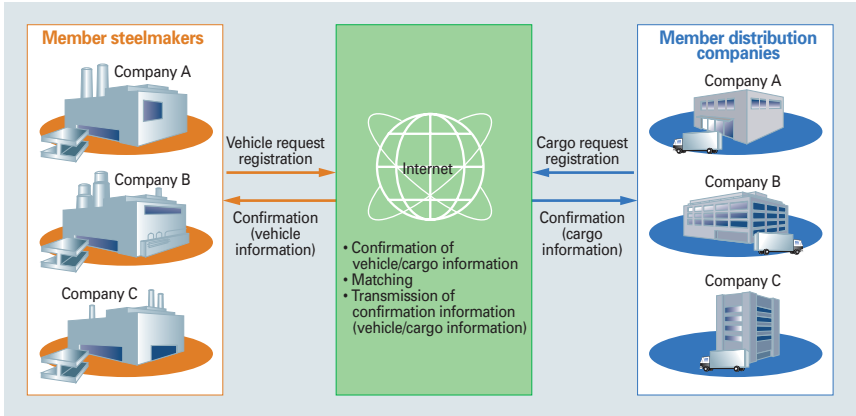
To achieve higher efficiency in land transportation of steel products, JFE Steel created a member-type internet-based joint transportation system. With this system, cargo/vehicle information can be grasped in real time, and the optimum vehicle can be dispatched based on product features and the conditions specified by the customer. This makes it possible to group multiple loads on transportation routes where this was difficult in the past, resulting in an improved vehicle utilization ratio and reduced environmental impacts through energy saving, etc.

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

***2) Modal shift**
Shift in transportation modes from truck to rail or ship to improve transportation efficiency and reduce environmental loads.

***3) RORO ship**
Abbreviation for Roll-On/Roll-Off ship. To speed up loading, cargos are loaded and unloaded directly by trucks and trailers from the front and rear rampways of the ship.

**Internet-based joint transportation system**



# Reducing Environmental Loads in Production Activities at JFE Engineering

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Preventing Global Warming

In 1997, the Japan Society of Industrial Machinery Manufacturers (JISM) established a "Voluntary Action Plan for the Environment by the Industrial Machinery Industry" which called for positive, voluntary efforts to prevent global warming by the industry as a whole, targeting an annual improvement of 1% in unit $CO_2$ emissions ($CO_2$ emissions per unit of production) until 2010.

Based on these circumstances, JFE Engineering implemented Environmental Management Systems suited to the functions and features of business at each of its works and is making efforts to prevent global warming.

JFE Engineering has three production sites, Tsurumi Center, Shimizu Works, and Tsu Works. Shimizu Works is a production division with work centering on fabrication of steel structures, whereas work at Tsu Works and Tsurumi Center is broadly divided between the office division, which performs design and other work, and the production division, which fabricates steel structures, and manufactures and assembles equipment and machinery.

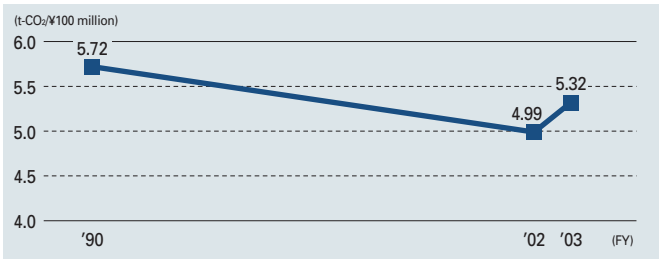
In the production divisions, targets call for a reduction of unit energy consumption (electricity consumption per unit weight of steel processed) in FY2003 to 94% of the FY1997 level. Efforts include a changeover to energy saving lighting system and turning off welders and other equipment when not in use. Unit energy consumption in the production divisions at Tsurumi Center and Shimizu Works was reduced to 93% and 88% of the FY1997 levels, respectively, achieving the target value for FY2003. However, at Tsu Works, nighttime power consumption increased due to a change to a 2-shift system accompanying an increase in orders. Consequently, unit energy consumption increased to 108% in comparison with FY1997, and the works did not achieve the target.

In the office division, efforts include power conservation activities such as turning off lights during the lunch break and turning off personal computers when not in use, together with check patrols. Power consumption in the office division in FY2003 showed a 6% decrease from FY1997 at Tsurumi Center and a 4% decrease from FY1999 at Tsu Works.

As a result of these activities, the combined $CO_2$ emissions in the production and office divisions showed a decline of 7% from FY2002, to 13,200 tons (21% decrease from FY1990). However, due to a decline in sales revenues, unit $CO_2$ emissions in FY2003 increased by 6% from FY2002, rising to 5.3 tons/¥100 million (decrease of 7% from FY1990).

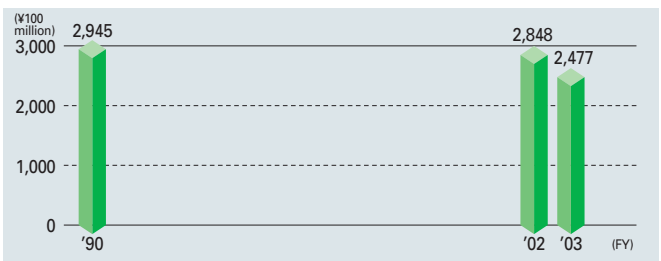
It should also be noted that JFE Engineering is currently working to establish procedures for determining energy consumption and $CO_2$ emissions in work at construction sites.

**Transition of unit $CO_2$ emissions**




**Transition of actual $CO_2$ emissions (total of office and production divisions)**


**Transition of sales revenues**[*1]




*1) Does not include sales in the shipbuilding division.


Tsurumi Center


Shimizu Works


Tsu Works

## Reducing Generation/ Discharge of Waste

JFE Engineering has three works, which fabricate steel structures, and manufacture and assemble machinery, and execute various types of construction work related to utility infrastructure in the fields of energy, the environment, water, steel manufacturing, and civil engineering/construction at locations throughout Japan. Based on the features of these business activities, the company is making efforts to "reduce generation/discharge of waste at construction sites" together with to "reduce generation/discharge of waste at works."

The three works set respective targets for FY2003 and are endeavoring to reduce generation/discharge of waste associated with production activities.

Tsurumi Center set a target of reducing waste treatment costs to ¥8.2 million, and made efforts to ensure thoroughgoing sorting of byproducts, including complete sorting of recyclable resources, and effective use of a waste plastic compacting machine. Waste treatment costs for FY2003 were 7.7 million, achieving the target.

Shimizu Works set a target of 0.72 tons/1000 hours for waste generation per unit of operating time. Efforts include thoroughgoing sorting. However, painting work increased due to increased bridge construction, resulting in a considerable increase in slag*1 and shot scrap.*2 Waste per unit of operating time was 1.03 tons/1000 hours and did not achieve the target. For the future, the works is studying methods of recycling slag.

Tsu Works also set a target in terms of waste per unit of operating time, at 0.11 tons/1000 hours. In addition to thoroughgoing sorting of byproducts, the works made efforts to recycle slag and shot scrap as a mulling/roadbed material and realized a recycling ratio of 97.5%. Waste per unit of operating time was 0.10 tons/1000 hours, achieving the target.

In site construction work, in FY2003, a target of 40% or less was set for reduction of the landfill disposal rate*3 of construction site waste, to be achieved by FY2004. Efforts include thoroughgoing sorting of waste and volume reduction/recycling, etc. In particular, because rubble and sludge account for the major part of landfill disposal waste at construction sites, reduction of these wastes is indispensable. For rubble (concrete and asphalt debris), JFE Engineering carries out thoroughgoing recycling. Sludge is positively recycled at the discharge site by applying sludge reforming, etc. As a result, the landfill disposal rate of construction site waste was 30% in FY2003, achieving the target ahead of schedule.

***1) Slag**
Waste generated during welding and cutting steel plates.

***2) Shot scrap**
Residue containing sand, iron rust, and paint, generated when sandblasting is performed to remove old paint from steel structures.

***3) Landfill disposal rate**
Landfill disposal rate (%) = [Generated waste-(Recycling + Reduction)] / Generated waste

**Reduction of wastes in production division**

| Works (unit) | Target | Actual |
|---|---|---|
| Tsurumi Center (million yen/year)*4 | 8.20 | 7.70 |
| Shimizu Works (t/1000 hrs)*5 | 0.72 | 1.03 |
| Tsu Works (t/1000 hrs)*5 | 0.11 | 0.10 |

***4)** Annual waste treatment cost.
***5)** Amount of waste generated per unit of operating time.

**Reduction of construction site waste**

| | Target | Actual |
|---|---|---|
| Landfill disposal rate of construction site waste | 40% | 30% |

## Control and Reduction of Chemical Substances

In accordance with PRTR Law (Law concerning Reporting, etc. of Release to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management), JFE Engineering has been controlling and reducing releases of designated chemicals.

**Substances reported under PRTR (FY2003)**
(Substances handled more than 1 ton per year at Tsurumi Center, Shimizu Works and Tsu Works)

(Unit: kg)

| No | Substance | Releases | | | | Transfers | |
|---|---|---|---|---|---|---|---|
| | | Air | Public waters | Soil on-site | Landfill on-site | Sewerage | Off-site |
| 1 | Zinc compounds | 0 | 0 | 0 | 0 | 0 | 470 |
| 30 | Epoxy resin | 0 | 0 | 0 | 0 | 0 | 26,544 |
| 40 | Ethylbenzene | 24,920 | 0 | 0 | 0 | 0 | 1,343 |
| 63 | Xylene | 80,769 | 0 | 0 | 0 | 0 | 5,151 |
| 230 | Lead compounds | 0 | 0 | 0 | 0 | 0 | 5,251 |
| 227 | Toluene | 49,049 | 0 | 0 | 0 | 0 | 3,427 |
| 232 | Nickel compounds | 0 | 0 | 0 | 0 | 0 | 2,020 |
| 311 | Manganese and its compounds | 0 | 0 | 0 | 0 | 0 | 30,720 |
| Total | | 154,738 | 0 | 0 | 0 | 0 | 74,926 |
| | | Total releases 154,738 | | | | Total transfers 74,926 | |

# Reducing Environmental Loads in Production Activities at Kawasaki Microelectronics

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Preventing Global Warming

Four electrical machinery/electronics industry associations[*1] have set a goal of improving unit $CO_2$ emissions ($CO_2$ emissions per unit of production) by 25% in comparison with FY1990, to be achieved by FY2010.

Kawasaki Microelectronics' Utsunomiya Works manufactures semiconductor products called ASIC (application specific integrated circuits). Semiconductors are manufactured in clean rooms, which use large quantities of cooling water (circulating water) for air-conditioning, and the power load on the refrigerators which produce this cooling water accounts for approximately 15% of Utsunomiya Works' total power consumption. Since it began operation in October 1990, the works has made great efforts to conserve energy while increasing its production capacity, and also practices load leveling by storing power using a large capacity (2,300 $m^3$) chilled water heat-storage tank.

Each year since FY1998, Utsunomiya Works has achieved energy savings, for example, by adopting inverter-type pumps for pure water tanks and reducing loss in compressed-air dehumidifiers. The energy saving rate,[*2] which expresses the results of these efforts, has shown a trend of 0.5-1.5% in recent years and an average value of 0.825% up to FY2003. The consistent energy saving effects achieved through these ongoing activities have been highly evaluated and were recognized with the Kanto Economic and Industrial Bureau Director General's Award in FY2000.

Unit $CO_2$ emissions[*3] ($CO_2$ emissions per unit of production[*4]) in FY 2003 showed a 3.9% decrease from FY2002 (27% decrease from FY1995) due to the fact that $CO_2$ emissions were held to a 0.2% increase from FY2002 (31.7% increase form FY1995) in spite of a 13.7% increase in production in the same period (41% increase from FY1995). The energy saving rate in FY2003 was 0.82%. To achieve further energy savings, a target of 0.9% was set for FY2004.

Utsunomiya Works

***1) Four electrical machinery/electronics industry associations**
Japan Electrical Manufacturers Association, Japan Electronics and Information Technology Industries Association, Communications and Information Network Association of Japan, and Japan Business Machine and Information System Industries Association.

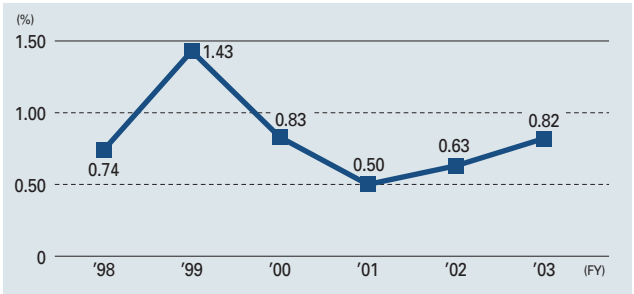
***2) Energy saving rate**
Kawasaki Microelectronics defines the index showing the energy saving improvement effect as "percentage energy saving effect for the year relative to power consumption in the works as a whole." Accordingly, the entire energy saving effect is only manifest in the following year. The equation used to calculate the energy saving effect is as follows:

For each object equipment, assuming former energy consumption is A (kWh/yr) and energy consumption after improvement is B (kWh/yr), the energy saving effect is C = A - B (kWh/yr). The effect of multiple energy saving projects carried out during the year are D = ΣC (kWh/yr). If energy consumption in the works as a whole is E (kWh/yr), the energy saving ratio = D/E (%).

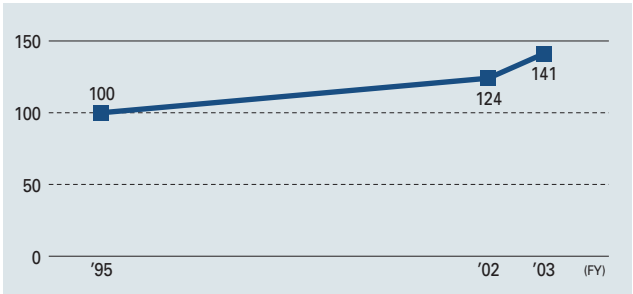
***3) Unit $CO_2$ emissions**
The four electrical machinery/electronic industry groups set a target of 25% for improvement in unit $CO_2$ emissions ($CO_2$ emissions/unit of production) in comparison with FY1990, to be achieved by FY2010. However, because construction of Utsunomiya Works was completed in October 1990 and production was low during the 5 years after startup, until the works achieved mass production, this index could not be applied. Utsunomiya Works therefore uses 1995 as the baseline year.

***4) Production**
Because semiconductor products consist of circuits formed on silicon wafers, "production" can be expressed by the number of wafers. However, the degree of integration differs depending on the product, and the number of manufacturing processes varies greatly depending on this difference. Thus, the size of the operational load cannot be expressed simply by the number of wafers. Utsunomiya Works manufactures products with various different degrees of integration and numbers of processes, from 1 to 0.25μm μproducts. For this reason, an operation index which considers the number of manufacturing processes such as burning circuit patterns is used as "production."

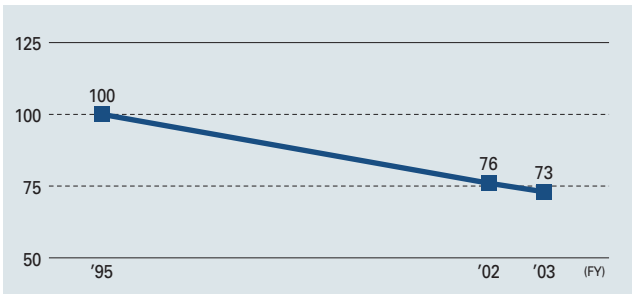
**Transition in energy saving rate**




**Transition in production (operation index) (1995 = 100)**




**Transition in unit $CO_2$ emissions index (1995 = 100)**




**Transition in $CO_2$ emissions**

## Reducing Generation/ Discharge of Waste

Since FY1998, Utsunomiya Works has made active efforts to recycle industrial wastes. In FY2001, the recycling rate[*1] exceeded 98% and has remained on a high level since then.

In FY2001, when the recycling rate had reached virtual saturation, Utsunomiya began industrial waste reduction activities aimed at reducing the amount of industrial waste generated as such. These activities took two directions, reduction of generated wastes and conversion of conventional industrial wastes to valuable resources.

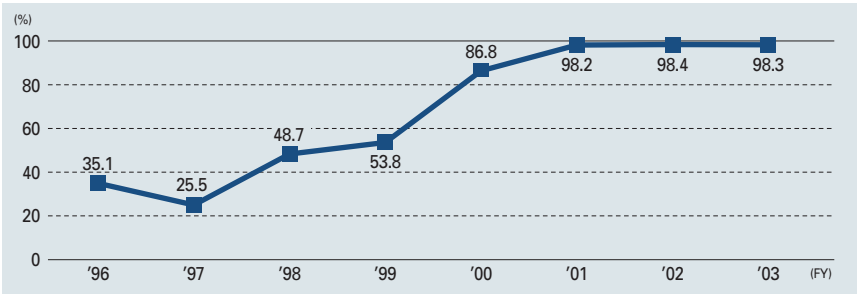
Efforts to reduce waste generation included reduced consumption of polishing agents and chemicals such as fluoric acid which are used to clean wafers and jigs. While maintaining product quality, this reduced waste generation by a maximum of 50%. In the past, waste solution of photosensitive agents used in patterning, which is a central technology in semiconductor manufacturing, were recycled as waste oil fuel. However, as a result of high-priority efforts to reduce consumption of photosensitive agents from FY 2002 to FY2003, a large reduction of approximately 70% was achieved.

As a method of converting conventional industrial wastes to valuable resources, nonferrous metals are sorted and recovered as resources. Continuing into FY2004, Kawasaki Microelectronics is promoting reductions in waste generation and sorting/recovery of nonferrous metals.

Since FY2001, Kawasaki Microelectronics has also recycled raw garbage from the company cafeteria as a material for organic fertilizer.

***1) Recycling rate**
Recycling rate (%) = Amount recycled/Total amount of industrial waste

**Transition of recycling rate**




## Control of Chemical Substances and Reduction of Releases

In response to heightened concern about chemical substances contained in products and their packaging among customers and society, Kawasaki Microelectronics has adopted lead-free and halogen-free alternatives to reduce the environmental load of products. Further expanding the scope of these efforts, company-wide activities to implement a Green Assurance System were begun in FY2002.

During FY2002, the company investigated domestic and foreign laws and regulations related to chemical substances, not limited to customer requirements, and identified substances which should be controlled.

In FY2003, the company implemented a Green Approval system based on its ISO9001 Quality Assurance System and ISO14001 Environmental Management System. Under the new system, suppliers and purchased items are approved from two viewpoints, namely, "Company Green Approval" for the suppliers of parts and materials and "Part/material Green Approval" for the supplied parts and materials for the company's products and packaging, thus expanding the conventional scope of supplier and product approvals. The company plans to introduce this system in FY2004, and will conduct approvals of partner companies and parts/materials.

Where PRTR substances are concerned, in FY2002, 4 listed substances were replaced with substitutes. Additionally 2 substances were replaced in FY2003, reducing the number of PRTR substances used from 16 in FY2003 to 14 in and after FY2004. Among these 14 substances, reporting of two is required under the PRTR Law. The remaining substances are used in smaller amounts which do not require reporting.

Although not a PRTR substance, it was recently been pointed out in the United States that PFOS (Per Fluoro Octane Sulfonate) shows high accumulation in the human body. The company therefore began efforts to use substitutes for chemicals containing PFOS in FY2002. Although potential substitutes were identified and evaluated during FY2002, none was compatible with the company's products. Efforts were therefore made to reduce consumption of the conventional chemicals, achieving a reduction of more than half. In FY2003, other materials not considered in FY2002 were identified/evaluated, resulting in successful substitution.

In FY2004, the company plans a review of manufacturing conditions and reductions in consumption of PRTR substances and other chemical substances.

**Substances reported under PRTR (FY2003)**

(Unit: kg)

| No. | Substance | Releases | | | | Transfers | |
|---|---|---|---|---|---|---|---|
| | | Air | Public waters | Soil on-site | Landfill on-site | Sewerage | Off-site |
| 172 | N,N-dimethylformamide | 66 | 13 | 0 | 0 | 0 | 2,800 |
| 283 | Hydrogen fluoride and its water-soluble salts | 190 | 1,500 | 0 | 0 | 0 | 1.7 |
| Total | | 256 | 1,513 | 0 | 0 | 0 | 2,801.7 |
| | | Total releases 1,769 | | | | Total transfers 2,801.7 | |

Environmental Performance Report II

# Contributing through Environment-friendly Products and Technologies

## For Society, Outstanding Products and Engineering Technologies that Contribute To Preservation of the Global Environment



# Environment-friendly Steel Products

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Contributing to Auto Weight Reduction
## High Tensile Strength Automotive Steel Sheets (HITEN)

Auto weight reduction is an effective means of preventing global warming because it improves fuel economy, thereby reducing exhaust gas emissions. In particular, further reduction in the weight of automotive steel sheets is needed, as these account for the largest percentage by mass of auto structural materials. At the same time, improved crashworthiness is also required to ensure passenger safety during collisions.

High tensile strength steel sheets (HITEN) are extremely effective for both weight reduction and crashworthiness because the same strength can be secured with thinner material. However, press formability, weldability, and fatigue characteristics, all tend to deteriorate in high strength steel sheets, limited their applicability.

JFE Steel was among the first steel makers to take up this problem, and has developed a wide range of innovative high strength steel sheets using the company's own technologies.

For example, "SFG HITEN," which offers extremely high formability and attractive surface appearance, was the first 390 MPa[*1] and 440 MPa grade steel sheet in the world used in auto side panels, enabling a 10 kg weight reduction, while 980 MPa HITEN sheets manufactured with JFE Steel's proprietary continuous annealing process are used in the seat frame and various reinforcing members, reducing weight by 15-20 kg. JFE Steel has also developed and commercialized many other high quality, high strength steel sheets for a wide range of applications, including "NANO HITEN" (p. 51) and "BHT steel sheets."[*2]

***1) MPa**
Unit of tensile strength. 390 MPa grade steel sheets can withstand a load of 40 kg/mm$^2$. Similarly, 440 MPa and 980 MPa can withstand loads of 45 kg/mm$^2$ and 100 kg/mm$^2$, respectively.

***2) BHT steel sheet**
High strength hot rolled steel sheet utilizing strain aging hardening. Products display high formability during press forming and a large increase in strength after paint baking.

High tensile strength automotive steel sheets (HITEN)
*Door panel test produced with 1200t press at JFE

## Ferritic Stainless Steel with High Corrosion Resistance and Ultra-deep Drawing Property
## JFE-SX1

With automotive fuel tanks, it is important to maximize capacity in the limited space available, which requires forming in extremely complex shapes. The material must have excellent formability, combined with high corrosion resistance to prevent dangerous fuel leaks.

Conventionally, lead-tin plated steel sheets were used in fuel tanks, but in recent years, lead substitutes have been demanded in response to stricter environmental regulations such as the ELV Directive[*1] in the EU and California's CARB regulations[*2] in the U.S. The Strategic Alliance for Steel Fuel Tanks (SASFT) of the American Iron and Steel Institute (AISI) conducted evaluation tests of various fuel tank materials supplied by steelmakers to meet extended product warranties of 15 years-150,000 miles, as required under the California regulations, with the aim of establishing the superiority of steel fuel tanks in terms of both durability and environmental performance.

JFE Steel is a leader in R&D on ferritic stainless steels for fuel tanks, where this material offers excellent corrosion resistance and recyclability, and developed "JFE-SX1" with high formability and corrosion resistance. The performance of this product has also been confirmed in the common corrosion resistance test for North America by the SASFT. JFE-SX1 also possesses sufficient corrosion resistance for high concentration biomass alcohol fuels. Because heavy painting for corrosion resistance is not necessary, it also contributes to reducing environmental loads and improving the working environment in the tank manufacturing process.

Where formability is concerned, JFE-SX1 is the world's first ferritic stainless steel to achieve an extremely high Lankford value (r-value)[*3] of 2.6 and has demonstrated satisfactory ultra-deep drawability.

***1) ELV(end-of-life vehicle) Directive (EU)**
EU Directive on scrapped automobile recycling/disposal. Effective July 2003, it banned the use of four substances, lead, mercury, cadmium, and hexavalent chromium.

***2) California's CARB regulations (US)**
Strict exhaust regulations imposed by the California Air Resources Board (CARB), centering on ZEV (Zero Emission Vehicle) regulations.

***3) Lankford value (r-value)**
Index of the deep drawing property of steel.

Test-manufactured fuel tank using stainless steel

# Environment-friendly Steel Products

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Eliminating Use/Discharge of Harmful Chemical Substances

## Chromate-free Coated Steel Sheets (2002 Japan Coating Technology Association Technology Award)

The EU has set a deadline of July 2006 for replacing hexavalent chromiun, lead, mercury, and cadmium with substitutes, in accordance with RoHS Directive*1 effective from February 2003. In Japan, the manufacturing industry is reducing the use of harmful substance amount to their products along with the introduction of "Green Procurement Programs." In the view of reduction of environmental load and consideration of workers' health, to replace chromate coated steel sheets, JFE Steel developed a coated steel sheet which contains no chrome (VI) but still offers excellent corrosion resistance, electrical conductivity, paint adhesion, anti-fingerprint property, and lubricity. In particular, because simply substituting other heavy metals for chrome (VI) reduces corrosion resistance, the same performance as in conventional products is secured by a composite film with a unique design consisting of a special organic resin and inorganic substance.

In order to secure high long-term use reliability in electric appliances made from Chromate-Free Coated Steel Sheets, a test method for accurately evaluating corrosion resistance in actual service environments is indispensable. JFE Steel therefore began development in 2001 and established an independent Accelerated Corrosion Test for Electric Appliances (ACTE*2) in November 2003. This test method accurately reproduces corrosion phenomena in coated steel sheets in actual service environments, which had been difficult with the conventional salt spray test, and is useful in appropriate development and selection of coated sheets.

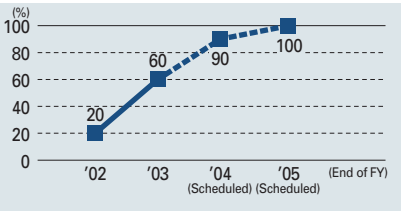
This product is now used in internal panels of appliances and vending machines, internal components of OA equipment and copiers, chassis of televisions, VTRs, and audio equipment, and other parts, and an expanded range of applications is expected.

The chromate-free ratio of steel sheets at JFE Steel was 60% as of April 2004, and a complete changeover is scheduled by the end of FY2005.

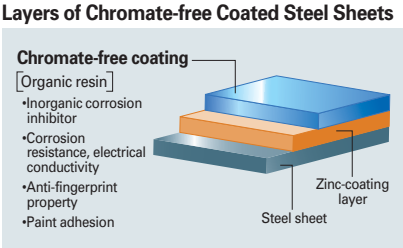
***1) RoHS Directive**
EU Directive placing restrictions on the use of designated chemical substances in electrical/electronic equipment. Abbreviation for Restriction on the use of certain Hazardous Substances in electrical and electronic equipment.

***2) ACTE**
Abbreviation for Accelerated Corrosion Test for Electric Appliances.

**Transition of chromate-free products**




**Layers of Chromate-free Coated Steel Sheets**




## Large Reduction in Solvent/$CO_2$ Emissions

## Laminated Steel Sheet for Food Cans (Universal Brite)

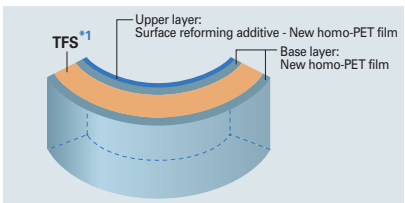
As conventional painting/baking process in canmaking generates harmful chemical substances (waste solvents/paint) and flue gas, there have been increasing demands for eliminating the painting process.

JFE Steel produces approximately 800,000 tons/year of coated steel sheets for cans. Replacing this entire amount with laminated sheets would greatly reduce environmental loads in the canmaking process, reducing releases of solvents from approximately 4,000 tons to 0 and $CO_2$ emissions from 600,000 tons to 200,000 tons. JFE Steel is therefore developing new laminated steel sheets to realize a 100% laminated canmaking product line.

"Universal Brite" is an epoch-making laminated steel sheet for food cans which was developed based on proprietary JFE Steel technologies. Using a base homo-PET film with a unique molecular structure, a special additive which improves the meat release property (easy removal of the contents) is added to the film surface layer, making it possible to omit the painting/baking processes while securing excellent formability, adhesion, corrosion resistance, and a meat release property equal to or better than those of existing paints.

Example of canmaking (half-pound food can)

**Cross-sectional structure of Universal Brite**




***1) TFS** Abbreviation for Tin Free Steel.

Universal Brite has been ordered in large quantities by major canmakers in North America and has a steadily increasing record of use around the world. It is expected to contribute to expansion of the market as the standard coated steel sheet product for food cans.

**Comparison of environmental loads in canmaking (annual)** (unit: 1000 tons)

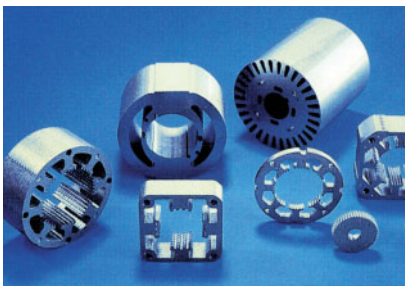
| | Solvent releases | $CO_2$ emissions |
|---|---|---|
| Painted can | 4 approx. | 600 approx. |
| Laminated can | 0 | 200 approx. |

Assuming 800,000 tons of product (JFE Steel's total annual production of steel sheets for cans)

## Reducing Power Loss in Electrical Appliances and Heavy Electrical Machinery

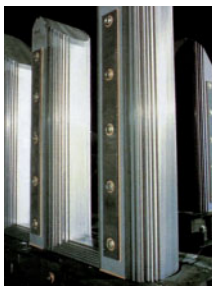
# Non-oriented Electrical Steel Sheets for High Efficiency Motors/ Grain-oriented Electrical Steel Sheets for High Efficiency Transformers

Motors are used in a diverse range of products and currently account for more than half of Japan's total power consumption. A trial calculation showed that an improvement of only 1% in motor efficiency would result in energy savings equal to the output of one medium size (550 MW) nuclear power plant.[*1] Under the Revised Energy Conservation Law, which took effect in April 1999, the "energy saving top-runner system[*2]" was introduced to promote higher motor efficiency in designated equipment. However, improvement by methods such as inverter control has now basically completed one full cycle. To achieve higher efficiency, improved performance must be achieved in motor materials as such.



Non-oriented electrical steel sheets for high efficiency motors

JFE Steel has developed and is producing "Non-oriented Electrical Steel Sheets for High Efficiency Motors," which were developed to achieve low iron loss[*3] in motors, and thereby reduce power loss, particularly by reducing high frequency iron loss.



Grain-oriented electrical steel sheets for high efficiency transformers

In FY2003, transformers for the social sector were newly included in the designated equipment under the top-runner system. Because transformers have a long life of around 30 years, a large energy saving effect over an extended period can be achieved by using high efficiency cores with low iron loss, while also solving the characteristic problem of transformer noise during excitation.

Using its own proprietary technologies, JFE Steel developed and is producing "Grain-oriented Electrical Steel Sheets for High Efficiency Transformers." With excellent magnetic properties, these products achieve energy savings while reducing transformer noise by increasing magnetic flux density and suppressing the magnetostriction.

***1) Source**
Toshiro Higaki, '99 Motor Technology Symposium GS, Japan Management Association (JMA)

***2) Energy saving top-runner system**
Energy saving standard introduced under the Revised Energy Conservation Law. For designated equipment, the product with the highest energy efficiency among current commercial products is considered the "energy saving top-runner," and a higher target value and time frame for achievement are set.

***3) Iron loss**
Energy loss by power consumption as heat due to magnetic hysteresis and eddy current in the cores of motors and transformers.

## Energy Saving Through Omission of Heat Treatment Processes

# Alloy Steel Powder for Sinter-hardening

Sintered parts can be manufactured in complex shapes at comparatively low cost. Taking advantage of this feature, applications have expanded to include automotive and electrical machinery parts.

Carburizing heat treatment[*1] is performed after sintering to increase the strength of high strength sintered parts for gears and clutches. This requires reheating to around 900°C, but reheating generates environmental loads (fossil fuel consumption, $CO_2$ emissions, etc.) equivalent to about 20% of the total environmental load in the sintering process.[*2]

To eliminate the need for reheating, JFE Steel developed "Alloy Steel Powder for Sinter-hardening", which realizes high strength without carburizing. Because the microstructure is strengthened in the cooling process after sintering, tensile strength exceeding 900 MPa and surface hardness exceeding 30 HRC[*3] can be obtained. These mechanical properties are superior to those of conventional alloy steel powders with carburizing. The product has been adopted in power tools gears and similar applications.

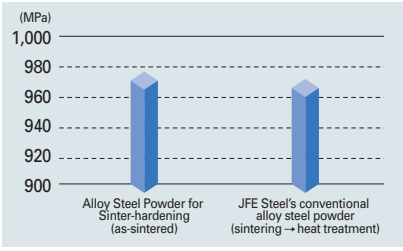
Power tool part

***1) Carburizing heat treatment**
Hardening process used to increase surface hardness by increasing the carbon content in the surface layer.

***2) Source**
Kohmei Harada, Materia Japan, Vol. 37 (1998) p. 42

***3) HRC**
Unit of hardness. Converted to tensile strength, 30 HRC is equivalent to 950 MPa.

**Comparison of tensile strength of as-sintered 21SX and Sigmalloy 415 with carburizing**



# Ecological Steel Products

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Reducing Environmental Loads and the Life Cycle Cost of Steel Structures

## Weathering Steel/Rust Stabilization Treatment

Rustproof paint is generally used to prevent corrosion in steel structures such as bridges, but paint deteriorates and loses its corrosion resistance after 10-20 years, requiring expensive repainting. The work load is heavy, and chemical substances in the paint may affect the environment.

JFE Steel therefore developed "Weathering Steels," using the steel material itself to suppress corrosion. A fine, dense layer of strongly protective rust forms on the steel, effectively preventing further corrosion without painting and contributing to a long life of 50-100 years. Because the protective rust (iron oxide) has the same composition as natural iron ore, it does not cause environmental pollution.

JFE Steel has also developed and introduced nickel-added high atmospheric corrosion resistant steels for use in environments with high airborne salt concentrations, which was impossible with conventional products. Conventional JIS weathering steel is susceptible to lamellar exfoliation of the rust layer in airborne salt environments, and therefore cannot be used in coastal areas. In contrast, the new JFE products prevent this problem, even in environments with high concentrations of airborne salt. At present, these products are used mainly in bridges.

In cities and other areas where appearance is important, rust outflows and uneven rusting in the early period are problems which sometimes limit the applicability of weathering steels. JFE Steel solved this problem by developing new rust stabilization treatments. These treatments are applied only once, at the start of use. Thereafter, the dense layer of protective rust which is the essential feature of weathering steels forms on the steel surface over time, eliminating the need for periodical paint repair, while preventing rust outflow and uneven rusting, and maintaining satisfactory scenic appearance.

JFE Steel developed and introduced two types of new rust stabilizer, "CUPTEN COAT M", aging as protective rust, and "e-RUS", quickly growing as protective rust. They are 100% free of chrome, lead, and other heavy metals and meet a variety of requirements for formation of a dense protective rust layer.

Bridge constructed using weathering steel

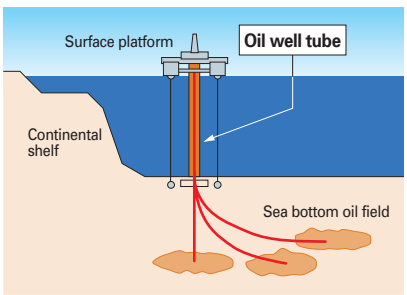
## Supporting Stable Energy Supply

## Martensitic Stainless Steel Tubes/Threaded Joints

To meet increasing demand for natural gas as a form of clean energy, deep oil and gas fields have been developed in recent years. Oil well tubes, or OCTG (oil country tubular goods), must have the strength to withstand high temperature/pressure and possess corrosion resistance against $CO_2$ in natural gas, while threaded joints must provide airtightness under the high compound loads associated with inclined/horizontal drilling.

With conventional OCTG, damage to the oil or gas well due to corrosion was a concern. Chemical inhibitors were used to prevent corrosion but caused environmental loads. JFE Steel therefore developed and supplies "Martensitic Stainless Steel Tubes," such as "13%Cr Steel Tubes," and threaded joints with excellent airtightness for use with these tubes. These products satisfy strength and corrosion requirements and reduce inhibitor use, and are widely employed as OCTG for natural gas development. By reducing environmental loads through extension of the life of oil and gas wells, they are contributing to a stable supply of natural gas.

**Structure of sea bottom oil well**




Surface platform

## Development and Popularization of New Energy

# Solar Cell Material Business

Although the manufacturing process for solar cells is energy-intensive, power generation is $CO_2$-free. Thus, life-cycle $CO_2$*1 emissions are low, at 1/14 to 1/18 the levels in thermal power generation. Solar cells have therefore drawn attention as a means of preventing global warming and depletion of fossil fuels. In addition to heightened environmental awareness in recent years, many nations have adopted preferential policies to encourage the use of solar power, resulting in large worldwide growth in the demand for solar cells, and in turn, rising demand for silicon wafer/ingot materials.

In 1997, JFE Steel began R&D on a new manufacturing technology using a metallurgical refining process for solar-grade (SOG) silicon ingots. By applying steel refining techniques, in 2001, the company established the metallurgical foundations for phosphorus and boron removing processes for SOG silicon for the first time in the world. With this process, production can be adjusted flexibly as required by demand for silicon ingots/wafers for solar cells.

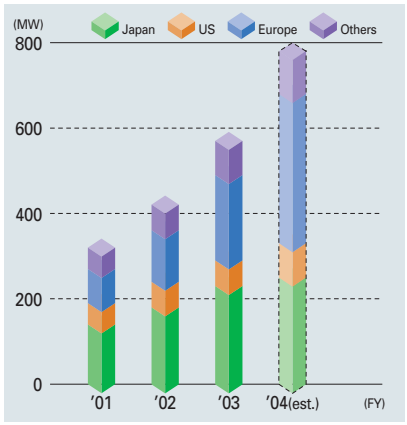
In the same year, JFE Steel also began commercial production of silicon blocks for solar cell substrates at 200 tons/year using purchased polysilicon material. In August 2004, production was scaled up to 800 tons to meet increasing demand.

Purity exceeding 99.9999% is secured in JFE Steel silicon ingots/wafers by applying contamination prevention technology, and thanks to the homogeneous solidification structure realized with casting technology, solar cells made from JFE's SOG silicon established a world's highest level of conversion efficiency*2 of 16% in multicrystalline silicon.

***1) Life cycle $CO_2$**
Total $CO_2$ emissions generated in all processes from extraction of resources to manufacture of generating equipment and fuel transmission, as well as in the combustion of fuel for power generation.

***2) Conversion efficiency**
Ratio (%) expressing conversion of light energy to electrical energy by solar cells. For example, if 1 kW/m$^2$ of light (energy of sun in clear weather) on a 1 m$^2$ solar cell area produces 100 W of electrical power, conversion efficiency = 10%.

**Transition of solar cell demand worldwide**



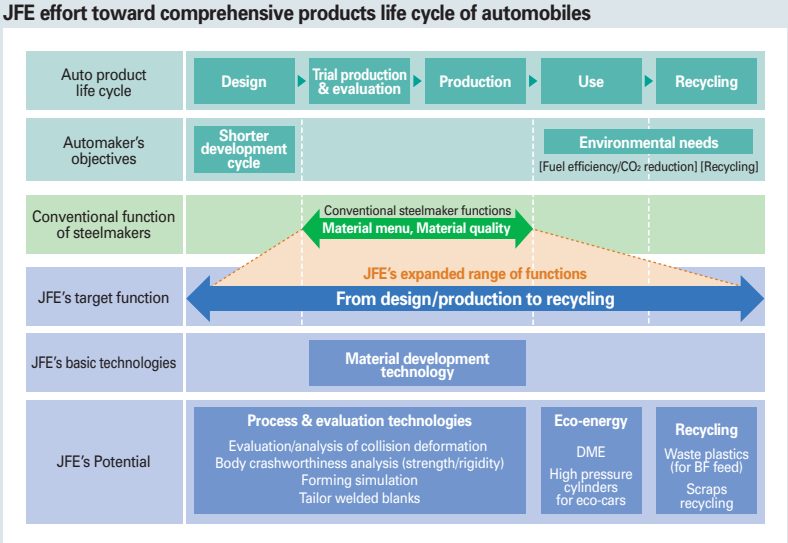

Silicon ingot manufacturing plant

## Responding to Customers' Green Procurement Programs

In addition to eco-product R&D, JFE Steel has strengthened its marketing and created a marketing system for eco-products. It is also actively responding to the entire range of customer needs related to eco-products, which include implementation of EMS, reduction of toxic substances, submission of environmental load data, development of judgment criteria for green procurement materials, and proposal systems.

Green Procurement Network was created to enable company-wide sharing of information on customers' green procurement programs and studies regulatory and social trends to better serve customers with product information and direct contact. As an ultimate goal, JFE is working to establish a quantitative evaluation method based on Life Cycle Assessment (LCA).

**JFE effort toward comprehensive products life cycle of automobiles**



# Environment -friendly Engineering Technologies

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Realizing Energy Savings in Air-Conditioning Systems

## Clathrate Hydrate Slurry (CHS) Latent Heat Air-Conditioning System

Because energy consumption for social sector air-conditioning is increasing annually, energy saving in air-conditioning systems is important for reducing $CO_2$ emissions. Moreover, cooling loads tend to be concentrated in the daytime hours, requiring technical development for load leveling in air-conditioning. Regenerative (heat-storage) air conditioning systems using chilled water or ice as the heat storage medium are one solution to these problems, and are being promoted by power companies.

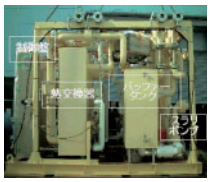
With chilled water heat storage systems, the refrigerator can generally be operated at a high coefficient of performance (COP*1), but in comparison with ice systems, the heat storage capacity is small, requiring space for a large heat storage tank. On the other hand, although ice storage systems have a larger heat storage capacity than chilled water, refrigerator COP is smaller and power consumption tends to be large. To realize an energy saving air-conditioning system with a high COP, it is necessary to use a new heat storage/transportation medium with the optimum balance of heat storage capacity and refrigerator power consumption.

JFE Engineering confirmed that it is possible to maintain the optimum balance of heat storage and power consumption, and a large increase in COP can be expected, by utilizing a thermal storage/transportation medium with a higher thermal density than chilled water in the temperature range (approx. 5-12°C) used in air-conditioning, and developed a new thermal medium called "Clathrate Hydrate Slurry (CHS)"*2 as a substitute for chilled water and ice. CHS is a mixed solid-liquid fluid composed of fine particles of clathrate hydrates and an aqueous solution. Advantages include high thermal density at 5-12°C, excellent heat storage/transportation, and heat transfer properties. In comparison with conventional chilled water transportation, pumping power consumption can be reduced by up to 80%. In comparison with ice, the energy required to produce cooling can be reduced by 40% and direct transportation to room air-conditioning units is possible.

***1) COP**
Abbreviation for Coefficient of Performance. Value which expresses the cooling/heating capacity (kW) per kW of power consumption; calculated by the following equation:
COP = Cooling or heating capacity (kW) ÷ Power consumption (kW)

***2) Slurry**
Solid-liquid mixed fluid with a smooth consistency.


Clathrate hydrate slurry


Energy saving air-conditioning system


Energy saving air-conditioning system

## Total Engineering for Wind Power Generation

## Wind Power Generation Business

Wind power generation has drawn considerable attention as form of clean energy and has been introduced rapidly in recent years. JFE Engineering supplies total engineering for wind power plants from site selection through project planning, design, manufacture, construction, and maintenance.

The 750 kW/J-50 model wind turbine manufactured by JFE Engineering features a gearless direct-drive synchronous-type generator. The rotor and generator are directly coupled without a step-up gear, eliminating mechanical loss during operation and reducing noise. Synchronous power generation prevents power surges during system interconnection, and the power factor can be controlled to a constant value, realizing a stable supply of high quality power.

In FY2003, JFE Engineering began handling the large-scale "G80" wind turbine manufactured by Gamesa (Spain), which pursues improved cost performance. With a rotor diameter of 80 m, total height of 100 m, and output of 2 MW, this wind turbine is the largest class in Japan and has an annual output of 3.5 million kWh, which is equivalent to the consumption of about 700 average families.

JFE Engineering is Japan's leader in the field, with a record of orders received for 124 units, and a total installed capacity of 92,000kW (end of March 2004). As a clean power producer, JFE Engineering is participating in wind power projects in Hokkaido and Mie Prefecture to encourage wider use, giving it a strong presence in the large-generator sector.

To encourage wider use of wind power, JFE Engineering is developing wind power generation equipment suitable for various wind conditions peculiar to Japan, such as wind turbulence in mountainous areas, and weather conditions including typhoons and winter lightning on the Japan Sea coast.


Wind power plant (Kushizaki, Chinzei-cho, Saga Pref.)

## High Efficiency, Compact Design Activated Carbon Adsorption System for Dioxins

# JFE Gas-Clean DX

Legal regulations on the concentration of dioxins in flue gas from waste incinerators set a level of 0.1 ng-TEQ/Nm$^3$[*1] or less (for new incinerators with capacity of 4 t/hr or more). However, in recent years, there have been increasing calls for a reliable dioxin removal method which can consistently satisfy standard values at much lower concentrations (0.01 ng-TEQ/Nm$^3$ or less) and also removes volatile toxic heavy metals such as mercury.

To meet these requirements, JFE Engineering introduced a "Moving Bed Activated Carbon Adsorption System" which has a record of use in Europe and is capable of removing dioxins to the level of 0.01 ng-TEQ/Nm$^3$ or less. However, the system is large and uses a large quantity of flammable carbon, requiring a fire prevention system. To solve this problem, in November 2003, JFE Engineering developed a high efficiency, compact design activated carbon adsorption system, "JFE Gas-Clean DX."

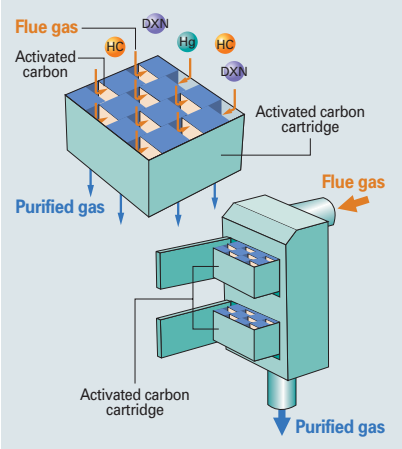
JFE Gas-Clean DX uses a cross-flow method in which the flue gas and activated carbon are placed in contact in a bed-shaped cartridge filled with granular activated carbon, which has an excellent thermal conduction property. This substantially improves contact efficiency with the activated carbon, making it possible to reduce the installation area to less than 1/5 that with the conventional technology while maintaining the same removal performance. Because the system does not have a drive section, there is no danger of fire, greatly improving routine operation and maintenance work and allowing worry-free use.

At present, JFE Engineering is conducting a long-term performance test using a demonstration unit at the waste incinerator in the Hamura Clean Center operated by Hino Motors with satisfactory results.

Application of this system is not limited to waste incineration facilities. Because flue gas treatment at steelworks and removal of volatile organic compounds (VOC) and foul smells are also possible, JFE Engineering is carrying out applied development work to further expand the range of applications.

***1) ng-TEQ/Nm$^3$**
Unit showing concentration of dioxins, where ng (nanogram) is 1 billionth of a gram, TEQ is the concentration obtained by equivalent conversion of the toxicity of dioxins to 2,3,7,8 tetrachloride dioxin, and Nm$^3$ means "normal cubic meter," which is a unit showing the volume when the sampled flue gas volume is converted to conditions of 0˚C and 1 atm.

**JFE Gas-Clean DX**




## Easy Retrofitting as Advanced Sewerage Treatment

# Bio-Tube System

Progressive eutrophication[*1] of closed natural water area, such as lakes, marshes and inner bays, and deterioration of water quality in public waters, including rivers, lakes, marshes, and bays have become serious problems. Removal of the nitrogen (N) and phosphorus (P) which cause these problems from sewerage requires an advanced sewerage treatment plant with approximately double the tank capacity of the standard activated sludge method[*2] used in conventional sewerage treatment. This involves various problems, as considerable revamping of civil structures is necessary, and when land cannot be secured for construction, the treatment capacity of the plant is inevitably reduced by half.

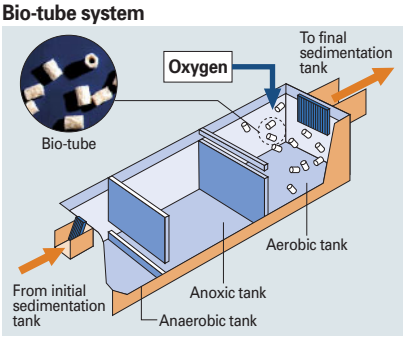
JFE Engineering developed a practical advanced sewerage treatment system called the "Bio-Tube System," which greatly increases the N and P treatment capacity while saving space and reducing costs.

Because it is possible to fix a large quantity of nitrification bacteria and other useful bacteria which have the slow reproduction rates indispensable for N removal on the carrier surface, a high concentration of effective bacteria can be maintained in the reaction tank by using Bio-Tubes in the reaction tank as a microorganism fixing carrier. This makes it possible to reduce the capacity of the reaction tank by approximately half in comparison with conventional advanced sewerage treatment systems. Moreover, a space-saving, low-cost advanced system can be introduced using the civil structures of the existing standard activated sludge facility.

***1) Eutrophication**
Phenomenon in which nutrient salts in water increase rapidly due to a cycle in which N and P in closed natural water area increase due to sewerage or industrial waste water, vegetable plankton and large aquatic plants multiply explosively, and, after their death, N and P generated by the decay process are released into the water.

***2) Standard activated sludge process**
The most commonly used sewerage treatment process in Japan. It is, however, not suitable for removal of N and P in sewerage.

**Bio-tube system**



# Environment -friendly Engineering Technologies

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Greatly Increased Energy Recovery in Waste Incineration
## Hyper 21 Stoker System

For environmentally-sound waste treatment, it is important to reduce discharges of organic substances and increase the energy recovery rate by thermal recycling, using the waste heat generated during incineration.

Using technical know-how gained with a large number of waste treatment plants, in April 2003, JFE Engineering developed the "Hyper 21 Stoker System," which simultaneously increases energy recovery by thermal recycling in waste incineration treatment and reduces discharges of harmful substances such as NOx and dioxins.

Combining a high temperature mixed-gas injection technology, in which high temperature air combustion technology is applied, and two-way gas flow as a stoker incinerators[*1] combustion technology, the Hyper 21 Stoker System employs a low excess-air ratio combustion technology to realize stable perfect combustion at a low excess-air ratio of $\lambda$ = 1.3. This increases heat recovery by the boiler by approximately 10% in comparison with conventional stoker incinerators, while reducing exhaust gas by approximately 20% and NOx emissions by 50%. Adoption of an integrated incinerator-ash treatment furnace system greatly increases the heat recovery rate of ash treatment furnace input heat and the latent heat of bottom ash, which could not be recovered with conventional stoker incinerators. Approximately 40% of ash treatment furnace input heat can be recovered, and the equipment is compact and economical.

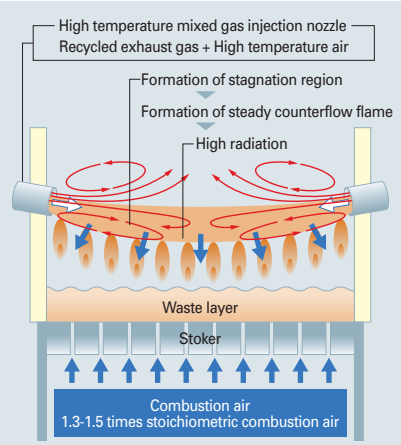
A water-cooled grate[*2] increases grate life by approximately 3 times, even under high thermal load conditions, and is suitable for a wide range of waste treatment, including mixed incineration of industrial waste, which will be required in the future.

JFE Engineering applies these technologies not only to new incinerators, but also in revamping of existing incinerators, and will continue to propose the optimum systems for waste treatment needs.

***1) Stoker incinerators**
Type of waste incinerator in which waste is transported on a grate-type combustion device called a stoker and incinerated at a high temperature exceeding 1000°C.

***2) Water-cooled grate**
In stoker combustion systems, the grate promotes combustion by enabling air supply from below while waste is stirred and transported through the combustion chamber. With the water-cooled type, combustion damage to the grate is prevented by internal water cooling and durability is greatly improved. Use of a hollow cast grate and pressurized water circulation improves cooling efficiency by enabling direct cooling of the grate, and stable operation with no internal steaming in the grate is achieved by using pressurized water to raise the saturation temperature of the cooling water.

**Stabilization of combustion by high temperature mixed-gas injection**




## Effective Use of Biomass
## BIGADAN Process Biogas System

Since establishment of the Biomass Nippon Strategy[*1] for encouraging positive use of biomass, recycling technologies for organic waste have become increasingly important.

One such technology which has attracted attention is biogasification of organic waste. Because biogas contains 60-65% methane and its properties are stable, it has the advantage of easy conversion to electric power on site. However, disposal of the digested liquid remaining after biogasification had become a problem. The digested liquid contains large amounts of chemicals with a fertilizing effect, such as nitrogen and phosphorus, and thus can be recycled to agricultural land as liquefied fertilizer, but treatment to kill and deactivate microbes and weed seeds was necessary.

To solve this problem, JFE Engineering developed the "BIGADAN Process[*2] Biogas System," which recovers biogas from organic waste such as livestock and food waste. Because organic waste is sterilized at 70°C for 1 hour (100% pasteurization) before methane fermentation, the discharge can be used safely as liquefied fertilizer. If the digested liquid is to be dewatered and the solid portion composted, the product is adequately sterilized in the heat exchanger and can be used safely without separate high temperature sterilization.

A non-closed double screw type heat exchanger was adopted to recover heat from the slurry between the pasteurization and methane fermentation processes. This prevents clogging of the heat exchanger by the highly concentrated slurry, which contains calcium and magnesium. Although conventional systems used indirect heat exchange by warm water, in this system direct heat exchange from high concentration slurry to high concentration slurry is possible, realizing waste-free heat recovery. These innovations made it possible to perform sterilization treatment with no loss in the total thermal efficiency of the plant.

***1) Biogas Nippon Strategy**
One national strategy for promoting a recycling society, with a framework finalized in July 2002 by the main Japanese Ministries. The Strategy presents concrete policies and schedules for positively utilizing biomass and recycling energy, biodegradable materials, animal feed/fertilizers, etc.

***2) BIGADAN process**
The name derives from the company from which this technology was introduced, BIGADAN A/S (BIGADAN stands for Bio-Gas Denmark).

BIGADAN process Biogas System

Environmental Performance Report III

# Contributing to Environmental Improvement in Local and International Society

## Diverse Environmental/Energy Technologies and Know-How for Local Society and the World

# Providing Total Solutions for a Better Environment

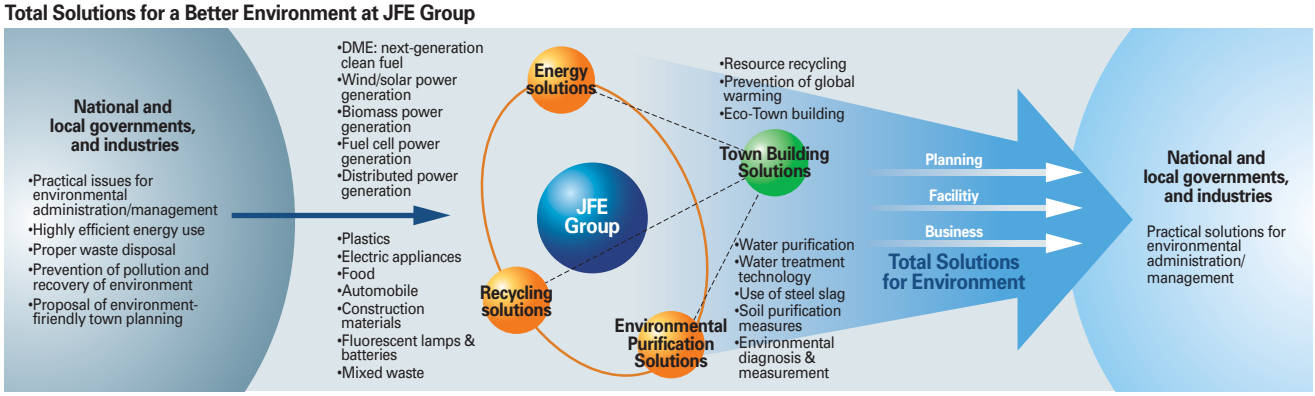
| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Providing Solutions to Environmental Needs Based on Technologies and Know-how Cultivated in Steel and Engineering

In response to rising environmental and eco-energy needs at the national and local government levels and in business, the JFE Group is expanding it environmental solution business with the total capabilities of the JFE Group, taking advantage of technologies and know-how cultivated to date. The JFE Group is contributing to the creation of a recycling-oriented society by providing total solutions which offer an integrated response from concept development through business planning and project realization.

Concretely, the JFE Group develops solutions in three areas, "Recycling," "Eco-energy," and "Environmental purification," and provides total solutions for "Town Building" by combining these three elements.

**Total Solutions for a Better Environment at JFE Group**




## Proposal/Implementation of Environment-friendly Town Building
## Town Building Solutions

Making maximum use of the infrastructure in its steelworks, the JFE Group provides "Town Building Solutions" for environment-friendly urban development in cooperation with local governments and companies in neighboring industrial complexes. The JFE Group is contributing to the creation of a recycling-oriented society by actively participating in environment-friendly urban development from the planning stage, based on technologies and know-how developed in its steel and engineering businesses.

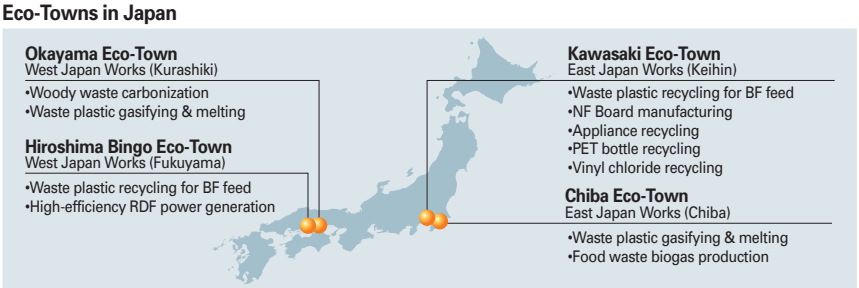
For example, the JFE Group proposes projects under the Eco-Town Concept, which was created in 1997 and is being promoted by METI/MOE. The Group has also expanded these activities to the Eco-Industrial Complex Concept in cooperation with other industries, and industry, government, and academic circles, and is using the PFI method to create new environmental businesses.

### Town Building Solutions: Example 1

### Proposal of Environment-friendly Town Building Based on the "Eco-Town Concept"

A representative example of JFE's urban development solutions can be seen in environment-friendly Town Building projects carried out with local governments under the "Eco-Town Concept." The JFE Group has proposed several "Eco-Town Plans" for towns being planned by local governments where steelworks are located. In March 2004, Okayama, where West Japan Works (Kurashiki) is located, was approved as the 20th Eco-Town in Japan. With this, all four cities where JFE Steel's main works are located have been designated as Eco-Town Areas.

**Eco-Towns in Japan**




In the future, the JFE Group will promote "sustainable local society building" through environment-friendly town building suited to the distinctive features of each region in cooperation with industry, government, and universities.

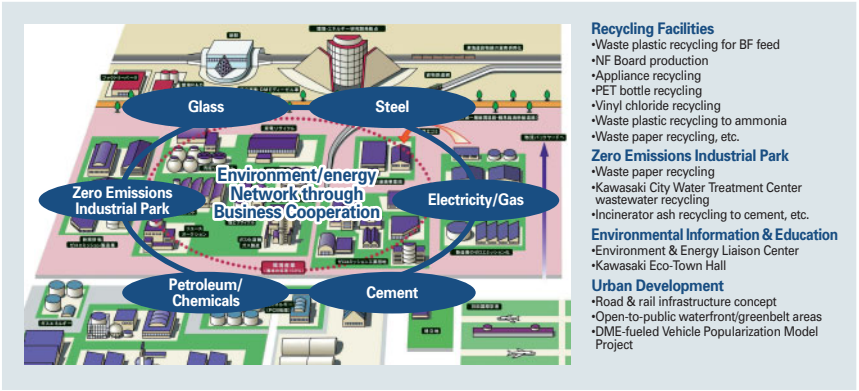
Town Building Solutions: Example 2

## Eco-Industrial Complex Concept and Urban Revitalization

There are limits to recycling and $CO_2$ reduction activities in individual companies and factories. However, a higher level of recycling can be achieved through cooperation between heterogeneous industries such as those in large industrial complexes.

The JFE Group is actively involved in creating "Eco-Industrial Complexes" which promote recycling through this kind of inter-industry cooperation. The Group has already created a cooperative inter-industry network in the Keihin Coastal Area, and intends to contribute to further development of the Keihin Coastal Area as a new core for urban revitalization in the Tokyo Metropolitan area by environment-friendly town building through a fusion of the Eco-Industrial Complex and Eco-Town Concepts.

**Eco-industrial complex concept at Kawasaki coastal area (Kawasaki Eco-Town area)**



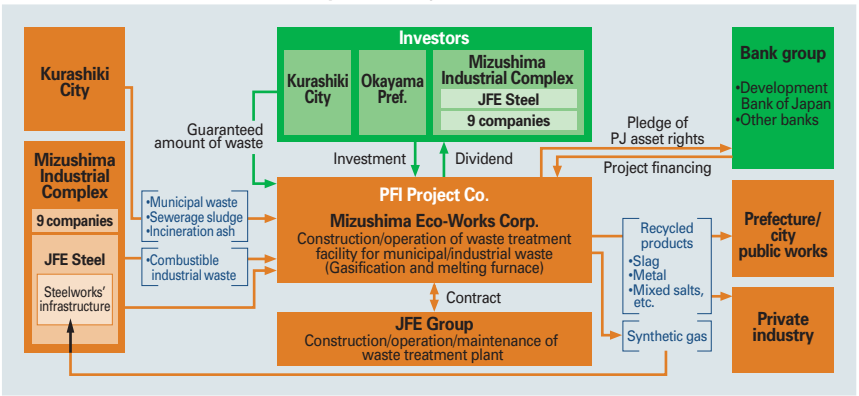

Town Building Solutions: Example 3

## PFI Project at Mizushima Industrial Complex

The JFE Group is constructing a gasification and melting furnace at West Japan Works (Kurashiki) to recycle municipal waste from Kurashiki City and industrial waste from businesses located in the Mizushima Industrial Complex.

This project is being carried out as a PFI*1 project by Okayama Prefecture, Kurashiki City, and the 10 companies which make up the complex, and is attracting attention as a new scheme for recycling local household waste and industrial waste. (Scheduled start of project: April 2005)

**Scheme of Mizushima Industrial Complex PFI Project**




*1) PFI
Private Finance Initiative. Government policy system for improving efficiency, mainly using the private sector, by introducing private-sector capital and management know-how in the creation/operation of social infrastructure which was traditionally in the public sector.

# Purification/Restoration/Protection of the Natural Environment

# Environmental Purification Solutions

The JFE Group has provided numerous environmental solutions, including water and soil purification and environmental diagnosis and monitoring.

Recently, the Group proposed projects utilizing the features of recycled slag products, which were developed as an advanced use for iron and steel slag (p. 25), in marine environment restoration and has carried out model marine purification projects throughout Japan.

The JFE Group is developing "Environmental Purification Solutions" which purify, restore, and protect the natural environment while respecting the ecosystem.

Environmental Purification Solutions: Example 1

## Marine Purification/Sand-Capping Work in Nakaumi Lake Shimane Pref.

A "Marine Purification/Sand-Capping Project" under the auspices of the Ministry of Infrastructure, Land and Transport (MLIT) is being carried out using "Marine Base," a blast furnace granulated slag sand-capping material developed by the JFE Group. As of August 2004, more than 200,000 tons had been placed, contributing to improved water quality.


Marine Purification/Sand-Capping Work

Environmental Purification Solutions: Example 2

## Shallows Creation Model Project at Innoshima Island, Hiroshima Pref.

A model shallows was created at Innnoshima Island, with support from the prefecture. Approximately 1,000 tons of "Marine Base" and 20 "Marine Blocks" were used.

Studies show that a variety of fish have gathered around the shallows, and shellfish, shrimp, and fish are inhabiting the Marine Base, while profuse growth of large seaweeds have been observed in the Marine Blocks, indicating satisfactory results.

# Providing Total Solutions for a Better Environment

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Recycling Businesses Supporting a Recycling-oriented Society

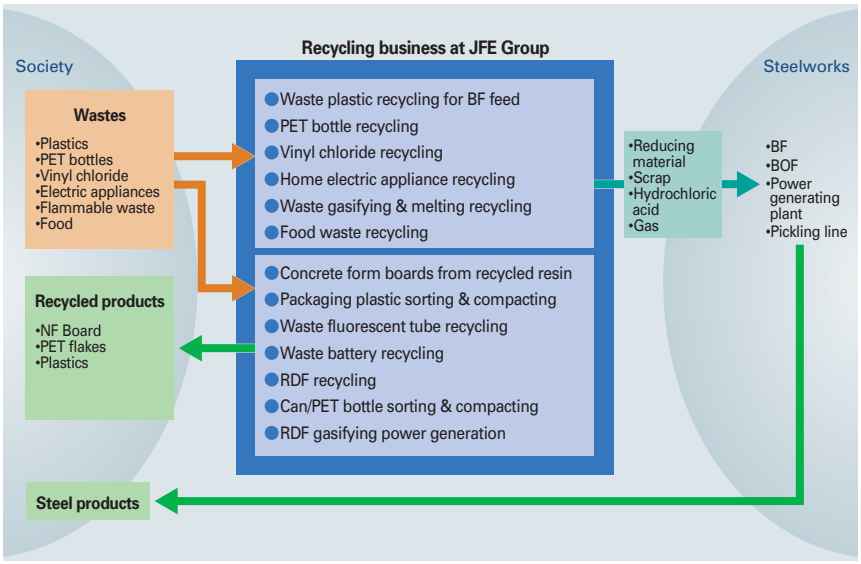
## Recycling Solutions

Through advanced use of steelworks' infrastructure, the JFE Group has created a system for efficient mass recycling of waste, and has developed a wide range of recycling businesses, including use of waste plastic as blast furnace feeding material.

Among recycling businesses which are closely related to local society, JFE Group companies are involved in sorting/collection of waste plastic, recycling of waste as solid fuel, and recycling of used dry-cell batteries.

JFE Group companies receive a wide range of waste materials and perform the most appropriate treatment (material recycling, chemical recycling, thermal recycling), contributing to a recycling-oriented society by providing recycling solutions which minimize landfill disposal.

**Resource recycling solution at JFE Group**




**Primary Recycling Business at JFE**

| Operation | | Started in | Capacity |
|---|---|---|---|
| Waste fluorescent tube recycling | | April 1995 | 6,000 t/yr |
| Waste plastic recycling for BF feed | | October 1996 | 50,000 t/yr |
| Waste gasifying & melting recycling | 1. Chiba | April 2000 | 50,000 t/yr |
| | 2. Kurashiki | April 2005 (scheduled) | 160,000 t/yr |
| RDF gasifying power generation | Fukuyama | April 2004 | 96,000 t/yr |
| Plastic containers & packaging for BF feed | | April 2000 | 120,000 t/yr |
| Plastic containers & packaging gasifyin | | April 2001 | 30,000 t/yr |
| PET bottle recycling | | April 2002 | 10,000 t/yr |
| Concrete form boards from recycled resin | | Sep. 2002 | 2 million/yr (approx. 200 million bottles) |
| Packaging plastic sorting & compacting | 1. Nagoya | Aug. 2000 | 60,000 t/yr |
| | 2. Sendai | Dec. 2000 | 20,000 t/yr |
| | 3. Hiroshima | April 2004 (scheduled) | 40,000 t/yr |
| | 4. Yokohama | April 2005 | 31,000 t/yr |
| Can/PET bottle sorting & compacting | Kawasaki | Sep. 2003 | 5,500 t/yr |
| RDF recycling | 1. Haibara Town, Nara Pref. | Nov. 2000 | 2,500 t/yr |
| | 2. Nogi Town, Tochigi Pref. | Dec. 2002 | 5,500 t/yr |
| Home electric appliance recycling | | April 2001 | 800,000 units/yr |
| Dry cell battery recycling by non-ferrous metal melting furnace | | March 2002 | 1,500 t/yr |
| Dry cell battery recycling by electric furnace | | March 2003 | 1,000 t/yr |
| Food waste recycling | | Aug. 2003 | 8,000 t/yr |

Resource recycling solutions: Example 1

## Waste Plastic Recycling for BF Feed

The JFE Group currently recycles more than 100,000 tons/year of waste plastics by converting industrial waste plastic and plastic packaging into raw material (substitute for coke) for its ironmaking. Because waste plastic recycling for BF feed makes an important contribution to reducing $CO_2$ emissions and saving coal in steel production process, it is a key technology for recycling waste plastic.

Waste plastic recycling for BF feed

Resource recycling solutions: Example 2

## NF Board for Concrete Forms Manufactured from Recycled Plastic

In addition to chemical recycling of plastics, primarily as blast furnace feed, JFE Steel also established a commercial material recycling business in 2002. Use of recycled plastic as a substitute for plywood in NF Board for concrete forms reduces $CO_2$ emissions and helps preserve rain forests. The JFE Group has a system that recycles used NF Board as a raw material for ironmaking, realizing a "Zero Emission product."

NF Board production line

Resource recycling solutions: Example 3

## Vinyl Chloride Recycling

Because vinyl chloride comprises 15% of all plastics, a treatment process for this material is an essential requirement for plastic recycling. The JFE Group has developed a technology for separating chlorine (Cl) from vinyl chloride itself, for example, in pipes and gutters. The separated Cl is also recycled as hydrochloric acid (HCl), which are used in pickling process of steel sheets. The rest hydrocarbon is also used as an ironmaking material.


Vinyl chloride de-Cl process

Resource recycling solutions: Example 4

## PET Bottle Recycling

JFE KANKYO, an affiliate of the JFE Group, operates a PET bottle recycling business at East Japan Works (Keihin). Using PET bottles collected by local municipalities, PET resin flakes are recovered by a process of crushing, classification, washing, etc. and sold to polyester manufacturers and makers of PET sheets for egg cartons and similar packaging. Labels and caps are recycled as material for ironmaking in this distinctive Zero Emission process.

PET bottle recycling plant

Resource recycling solutions: Example 5

## Home Electric Appliance Recycling

Home Appliance Recycling Law requires recycling of refrigerators, washing machines, televisions, and air conditioners. To meet this need, JFE invested in JFE Urban Recycle, an appliance recycling company located in its steelworks, where it efficiently dismantles appliances and recycles most steel and non-ferrous metals and waste plastics to iron and steel production processes.

Waste appliance recycling plant

Resource recycling solutions: Example 6

## Recycling by Waste Gasifying & Melting

Using the JFE THERMOSELECT waste gasifying & melting furnace, the Chiba Recycling Center at East Japan Works (Chiba) completely recycles industrial waste from Chiba Prefecture and the surrounding region, as well as waste plastic collected under the Containers and Packaging Recycling Law, as gas for the steelworks.

Chiba Recycling Center

JFE Engineering has joined Fukuyama Recycling Power Generation Project. Electric power generated by RDF is sold to an electric power company. Slag is also recycled as construction materials.

Resource recycling solutions: Example 7

## Food Waste Recycling

Chiba Biogas Center at East Japan Works (Chiba) uses the BIGADAN process Biogas System (see p.41) to produce gas for the works from food waste by methane fermentation. Residue from the process is recycled to the JFE THERMOSELECT plant at the Chiba Recycling Center, achieving zero-emission 100% recycling.

Chiba Biogas Center

## Providing Total Solutions for a Better Environment

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

# Creating a Next-generation Clean Energy Society

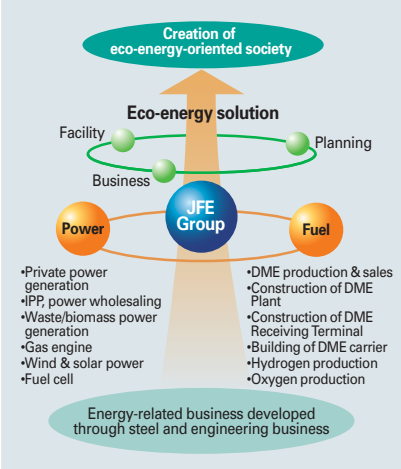
## Eco-Energy Solutions

JFE Group is providing various eco-energy solutions based on highly efficient and advanced energy technology developed through its steel and engineering business, thus to contribute to the society.

Concretely, this includes power wholesaling/retailing businesses on an annual scale of 1.5 billion kWh using high efficiency private power plants, a recycling power business using general waste as fuel (RDF), a wind power engineering business which now has a record of 124 units with an output of 92,000 kW (end of March 2004), and participation in wind power generation businesses.

In addition to these solutions, the JFE Group is developing a next-generation clean fuel, "DME" (dimethyl ether), and high efficiency DME-fueled generating systems, and is also developing solid oxide fuel cells (SOFC: see p. 53). In the longer term, the JFE Group intends to realize the optimum eco-energy environment demanded by local communities and society by developing customer-oriented businesses utilizing the power- and energy-related know-how and technologies gained through these efforts.

**Concept of eco-energy solution**




### Eco-energy solutions: Example

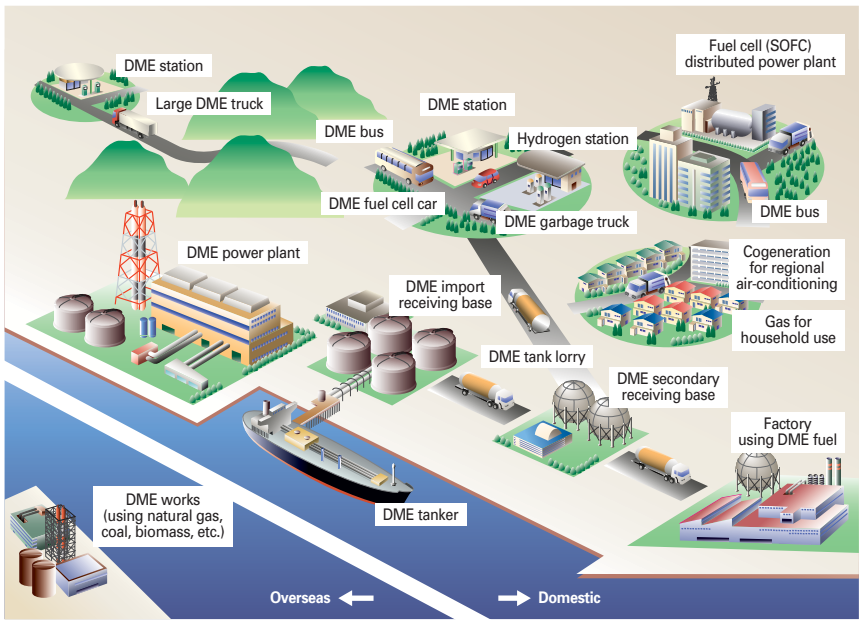
## DME Project

DME can be produced from a variety of hydrocarbon materials such as natural gas, coal, biomass, etc. and generates no sulfur oxides (SOx) or particulate matter (PM) during combustion. Considering these environmental advantages, it has attracted much attention as a form of next-generation clean energy.

Because DME is non-toxic and easy to handle, a wide range of applications is expected, including use as fuel for power generation at thermal power plants, substitute for LPG and other fuels in social use, fuel for transportation, for example, as diesel automobile fuel, and hydrogen energy source for fuel cells, making DME the "leading contender" for practical application as a form of next-generation clean energy.

In 2001, the JFE Group established DME International Corporation jointly with 9 other companies and is studying commercialization, centering on marketing activities. Also in 2001, an R&D company called DME Development Co., Ltd. was established jointly by 10 companies with the aim of commercializing a DME direct synthesis technology, and is carrying out R&D on production/application technologies with a 100 tons/day DME direct synthesis pilot plant (p. 53). To popularize DME, in 2004, the JFE Group established the DME Promotion Center jointly with 6 other companies to carry out technical development of applications, surveys, and popularization and education activities.

**Concept of applications of DME**




Activities supporting introduction of DME are also underway at the national government level. The Agency for Natural Resources and Energy of the Ministry of Economy, Trade and Industry has created the Fuel Policy Planning Office to handle DME and is establishing concrete directions for DME in national energy policies. At the same time, the High Pressure Gas Safety Institute of Japan and the Japan Oil, Gas and Metals National Corporation (JOGMEC) are engaged in research on the safety of DME and technical development of applications.

The JFE Group is devoting great energy to marketing, development of production technology, and studies of commercialization, including overseas production, aimed at early practical application of DME.

# International Cooperation through Environmental/ Energy Technologies

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## Providing Energy Saving and Greenhouse Gas Reducing Technologies

The problem of global warming due to emissions of greenhouse gases (GHG), and particularly $CO_2$, is becoming increasingly urgent and requires solutions at the global level.

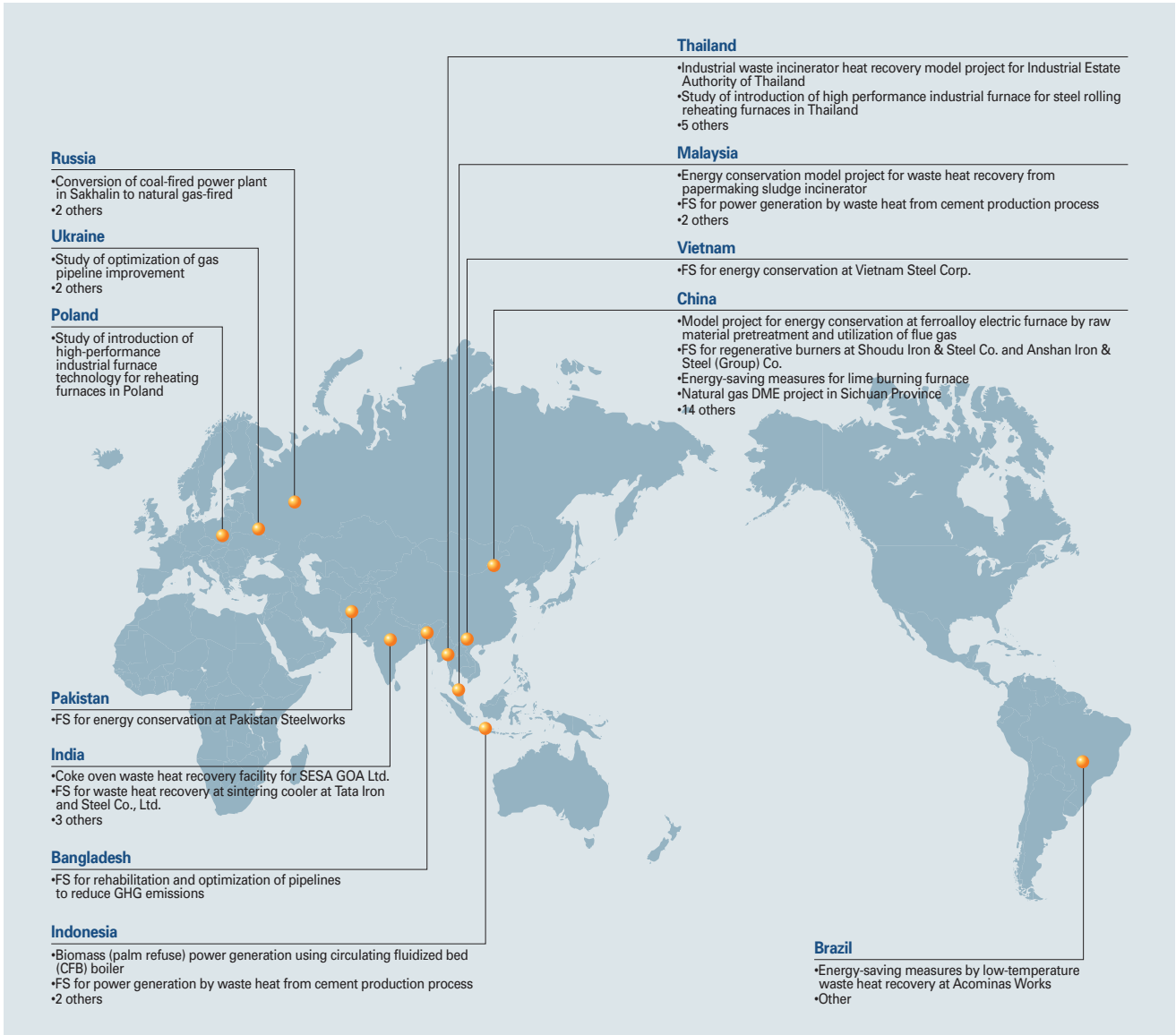
To contribute to sustainable growth in the developing nations, the JFE Group has already participated in many energy saving and GHG reduction projects, and is contributing to prevention of global warming at the international level by supplying the world's most advanced energy saving and environmental protection technologies and operation guidance for facilities. The JFE Group is working to transfer and popularize environmental protection technologies across national boundaries through CDM*1 and JI*2 under the Kyoto Mechanism.*3

*1) CDM
Clean Development Mechanism. Mechanism supporting sustainable development and achievement of targets of the Framework Convention on Climate Change by signatory developing nations and achievement of quantitative targets by signatory advanced nations. Under CDM, the developing nation receives a monetary profit from implementation of projects which reduce emissions of GHG, and the advanced nation uses the reduction achieved by the project to achieve its target.

*2) JI
Joint Implementation. Mechanism for achieving the target quantitative values for emissions of global warming gases as specified under the Kyoto Protocol. In cases where a signatory advanced nation carries out a reduction project in another advanced nation, part of the emission reduction achieved by the project is counted as a reduction in the first nation.

*3) Kyoto Mechanism
Mechanisms for preventing global warming adopted in the Kyoto Protocol. Main types are joint implementation (JI), emissions trading, and the clean development mechanism (CDM). Also called "flexibility mechanism."

**World Map of International Cooperation Projects by JFE Group**




Environmental Performance Report IV

# Research and Development of Environmental Technologies

## For the Future, New Environmental Technologies with Large Potential

# Research and Development System

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

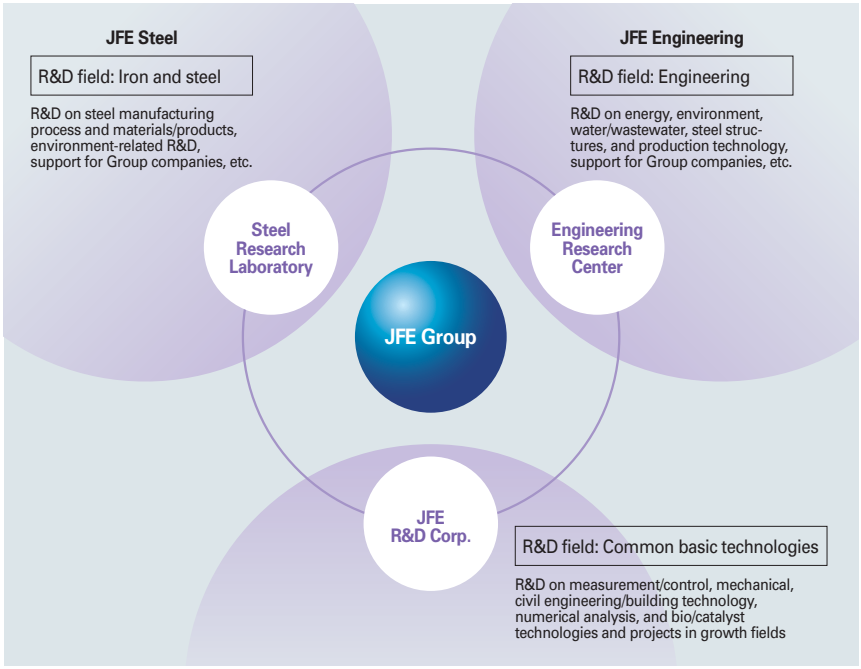
## Concept of the 3 Research Organization System in the JFE Group

JFE Group organized the three-laboratory system in April 2003 with the Steel Research Laboratory, the Engineering Research Center, and JFE R&D Corporation.

The Steel Research Laboratory and the Engineering Research Center were organized in JFE Steel and JFE Engineering respectively with the aim of integrating the three functions of development, manufacturing, and sales. To maximize synergies in the JFE Group as whole, R&D on basic technologies common to steel and engineering is concentrated in JFE R&D Corporation.

The goals of R&D in the JFE Group are to develop "Only 1" and "No. 1" products/technologies and explore advanced R&D topics which will provide the foundation for future businesses.

### JFE Group R&D Organization




### Research and Development System of JFE Group

| Development Completed (Already Commercialized) | Under Development |
|---|---|
| **●Preventing Global Warming**<br>• High tensile strength steel sheets(NANO HITEN) (780MPa grade)<br>• High purity silicon ingot for solar cells<br>• Environment-friendly regenerative burner<br>• Clathrate hydrate slurry (CHS) latent heat air-conditioning system<br>• Circulating fluidized bed (CFB) furnace for sewerage sludge<br>**●Building a Recycling-oriented Society**<br>• High-temperature waste gasifying & direct melting<br>• JFE THERMOSELECT gasifying & melting<br>• Electric resistance municipal waste incinerator ash melting<br>• Plasma ash melting<br>• Next-generation stoker furnace (Hyper 21 Stoker System)<br>• JFE hybrid activated carbon with high thermal conductivity<br>• Waste plastic recycling system for BF feed<br>• Waste-to-resource recycling system<br>• RDF*1 (Refuse Derived Fuel) carbonizing system<br>• Effective use of landfill site/gasification and melting of disposed waste<br>• Acid fermentation system of sewage sludge<br>**●Reducing Environmental Loads**<br>• Fly ash dioxin treatment (Hi-Clean DX)<br>• Reducing technology for dioxins in flue gas (Gas-Clean DX)<br>• Environment-friendly high-efficiency arc furnace (ECOARC)<br>• Advanced sewage treatment system using microorganism carriers (Bio-Tube, Pegasus)<br>• Lake & river purification equipment (River-Float)<br>• Accelerated oxidizing treatment system (AOP more)<br>• Simulation of biological reactions<br>• Soil contamination 3-D imaging system<br>• Slag recycling technologies<br>• Low-dioxin combustion control system<br>• Waste incinerator operation training simulator<br>• Dioxin precursor analyzer<br>• New dioxin analysis method<br>• Automatic monitoring system for heavy metals | **●Developing Clean Energy**<br>• Mass production technology for new clean energy source - DME<br>• High efficiency fuel cell - SOFC<br>• Natural gas hydrate<br>**●Building a Recycling-oriented Society**<br>• New activated coke production process<br>• 100% recycling technology for waste stainless steel pickling acid<br>• Biomass CFB gasification and power generating technology<br>• Sludge solubilization system<br>**●Preventing Global Warming**<br>• New low-$CO_2$ sintering process<br>• High tensile strength steel sheets (NANO HITEN) (980MPa grade, etc.)<br>• Refrigeration system powered by low grade waste heat<br>• Slag recycling technology (Marine Block)<br>• Innovative ironmaking technology using Float Smelter<br>**●Reducing Environmental Loads**<br>• Low-sludge biological water treatment technology |

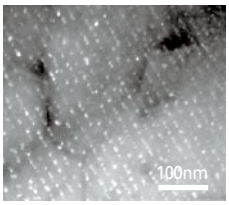
*1) RDF (Refuge Derived Fuel) Solid fuel made from flammable waste after crushing and compression forming

# Efforts at Steel Research Laboratory

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## High Tensile Strength Steel Sheet- NANO HITEN, the world first application of nanotechnology

Improved fuel consumption by reducing auto body weight is indispensable for protecting the global environment. However, simply reducing the thickness of steel sheets to reduce body weight would cause safety and performance problems. Steel Research Laboratory was the first steelmaker in the world to apply nanotechnology to the development of a high strength sheet, called "NANO HITEN," which makes it possible to reduce sheet thickness without sacrificing essential functions. The properties of NANO HITEN are dramatically improved by controlling the microstructure at the nano level ($10^{-9}$ meter), breaking the conventional micron ($10^{-6}$ meter) barrier.



Nano precipitation

This makes it possible to use thinner sheets than with conventional high strength sheets, while also maintaining crashworthiness. NANO HITEN satisfies both high strength and high formability requirements and contributes to improved fuel economy through auto weight reduction.


Example of application of NANO HITEN

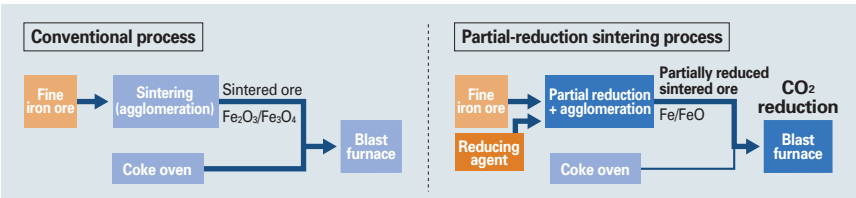
## New Sintering Process for Low-$CO_2$ Emissions

The ironmaking process, centering on the blast furnace, accounts for more than half of all $CO_2$ emissions in steel manufacturing.

Since FY2002, the Steel Research Laboratory has been developing an "Innovative Sintering Process for Reducing $CO_2$ Emissions" under METI's "Rational Energy Use Technology Development Support Project (Development of Innovative Technologies for Preventing Global Warming)" (currently under NEDO). Based on the existing sintering plant, in the new process, agglomeration and high-rate partial reduction of fine iron ore are performed simultaneously by adding excess coke fines as reducing agent. The product greatly reduces the consumption of carbon materials for reducing agent in the blast furnace. The potential of the new process has already been proved in the basic test at pilot plant.

By using the continuous sintering simulator (max. production capacity:3.0 ton/hr), the Steel Research Laboratory plans to confirm the reduction rate and productivity for application to actual processes, and will study items to improve in existing sintering plants.

**Conventional process and partial-reduction sintering process**




## "New Activated Coke Production Process" to Reduce Energy Consumption

Activated coke is expected to see increasing use as a carbon adsorbent in flue gas/water treatment. However, many commercial activated coke products use coal as a material, and large quantities of fuel are consumed in the carbonization/activation processes. In particular, it had been considered difficult to reduce fuel consumption for activation because this process is critical for determining the properties of activated coke.

Since 2002, the Steel Research Laboratory has been carrying out R&D on a new activated coke production process as a "Practical Industrial Technology Development Support Project (Oil-substitute Energy Technology Development Support Project)" under NEDO. As raw materials, various organic wastes, including wood from construction, waste paper, and waste plastic are used in place of coal, making it possible to omit the activation process, which had been essential in the conventional coal-based process. Fuel consumption is also greatly reduced by employing a rocking-type carbonizing kiln which is capable of utilizing the combustible carbonization gas generated by the organic waste itself as energy for carbonization.


Activated coke

The high-calorie gas generated during precarbonization can be recovered and used effectively as a heat source, either in the coke process itself or in other steelworks processes. After use as an absorbent for flue gas/water treatment, the activated coke can be used as a reductant for iron ore in a cascade-type recycling process.


Rocking-type carbonizing kiln

# Efforts at JFE Engineering Research Center

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## High Speed Mass-Production Technology for Natural Gas Hydrate

Natural gas hydrate*1 (NGH) offers various advantages in comparison with liquefied natural gas (LNG). Because NGH can be transported/stored at near room temperature (-10 to -20°C), equipment specifications are simpler and a much smaller cooling capacity is required, reducing construction costs, which is essential for economical development of unexploited small and medium gas fields. However, problems remained to be solved, including removal of heat (cooling) generated in the NGH formation process and more efficient gas-liquid contact. Thus, establishment of a high speed, mass-production process, aimed at upscaling to the industrial level, has been desired.

In 2001, the Engineering Research Center started the research for "High Speed Mass-Production Technology for Natural Gas Hydrate" in order to improve production speed. Basic experiments using propane as a simulation gas have reached production rates 60 times faster than the conventional process.


Bench-scale experiment facility

In research commissioned by Japan Oil, Gas and Metals National Corporation (JOGMEC), the Engineering Research Center developed a high speed mass-production process for hydrate. Using methane, which is the main component of natural gas, JFE set a world record for hydrate formation rate in bench-scale experiments.

In the future, JFE Engineering plans to carry out R&D aimed at establishing a total NGH system, including production, transportation, and regasification, as a new long-distance transportation/storage system for natural gas, complementing LNG.

***1) Gas hydrate**
Crystal substance which forms when methane gas or other small gas molecules and water are placed under low temperature, high pressure conditions. When methane is converted to hydrate, its volume is reduced to approximately 1/170 that of the gas.

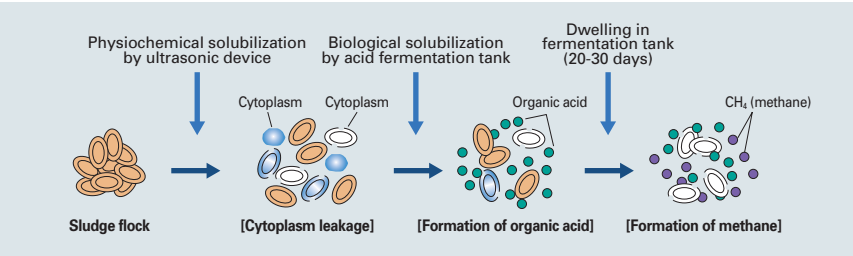
## Promoting Biomass Utilization with Methane Fermentation Technology: "Sludge Solubilization System"

The Engineering Research Center developed an anaerobic digestion process for methane fermentation which generates a larger quantity of biogas than conventional technologies while reducing fermentation residue.

The "Sludge Solubilization System*1" is incorporated in this process as a preliminary process for the digestion tank where the organic matter in sludge is decomposed. Part of the sludge in the acid fermentation tank is subjected to ultrasonic treatment to destroy the cell membranes, and the organic matter (colonies of microorganisms), which is the main component of the sludge, is efficiently solubilized. This greatly increases the decomposition rate of organic matter in the digestion tank, while also reducing fermentation residue treatment requirements by reducing the concentration of solid matter in the residue.

***1) Sludge Solubilization System**
Solubilization is a process in which organic matter in sludge (in sewerage sludge, mainly colonies of microorganisms) is liquefied by physiochemical and/or biological treatment. This system was developed on consignment from the Japan Science and Technology Agency (JST) and has been certified as successful.

**Total recycling system for sewerage sludge**




## Biomass CFB Gasification and Power Generating Process

In recent years, biomass has attracted attention as a carbon neutral form of renewable energy. Although practical direct-combustion power generating systems using a boiler/steam turbine have been developed for effective use of biomass energy, these systems have the drawback of low efficiency except in large plants. As biomass sources tend to be small in scale and widely distributed, biomass collection costs frequently make direct-combustion boiler/turbine systems uneconomical.

To solve this problem, JFE's Engineering Research Center is developing a "Biomass CFB Gasification and Power Generating System" for high efficiency generation in medium- and small-scale plants using the circulating fluidized bed (CFB) process, which has a wide record of use in combustion in gasification furnaces. With CFB, high efficiency gasification of biomass can be expected due to the mixing/stirring effect in a high speed fluidization condition.

Development of a low-cost dry-type gas refining technology for the generated gas is being carried out under NEDO's "Biomass Energy Conversion Element Technology Development" program, aiming at early practical application of a biomass gasification and power generating system based on the CFB gasification furnace.


CFB test device (biomass treatment capacity: 150 kg/hr)

# Efforts at JFE R&D /Research on Next-Generation Clean Energy

| JFE Holdings | | | | |
|---|---|---|---|---|
| JFE Steel | JFE Engineering | Kawasaki Microelectronics | JFE Urban Development | JFE R&D |

## "Low-Sludge Biological Water Treatment System" for Reducing Excess Sludge

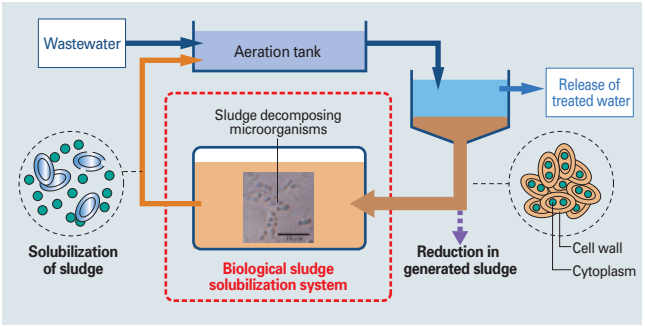
JFE R&D is carrying out research and development on a low-maintenance, low-cost "Low-sludge Biological Water Treatment System" at the Tsugawa-machi Water Purification Center (Niigata Pref.) as an economical technology for reducing excess sludge treatment in medium- and small-scale public sewerage treatment plants and has substantially reduced sludge generation in full-scale experiments.

By nature, sludge contains large numbers of various microorganisms. JFE R&D began research on these microorganisms in 1999 and, based on DNA analysis, identified 11 kinds with high solubilization capacities in 2002.

Microorganisms with high solubilization capacities (sludge solubilization bacteria) decompose organic matter in the sludge into low molecular substances in the biological reaction tank, and the solubilized sludge component is completely decomposed into $CO_2$ in the sewerage treatment plant, greatly reducing sludge generation. This reduces excess sludge generation, making it possible to reduce the scale of sewerage plant equipment such as dehydrators, and thus greatly reducing total construction costs and maintenance/operation costs.

This system is applicable not only to medium- and small-scale public sewerage treatment plants, but also to extremely small wastewater treatment plants such as rural sewerage treatment facilities, as well as to private-sector wastewater treatment facilities.

**Low-sludge Water Treatment System**




## Research on Next-Generation Clean Energy

### Research for Practical Application of DME Production/Application Technologies

The JFE Group was among the first to recognize the superiority of DME (dimethyl ether) and began research on a direct synthesis technology for DME in 1989. At present, with support from METI's Agency for Natural Resources and Energy, the JFE Group is engaged in "Development of Technology for Environmetal Load Reducing Fuel Conversion" jointly with partner companies. In 2003, the JFE Group constructed a 100 ton/day DME direct synthesis pilot plant (Shiranuka-cho, Hokkaido), which is the world's largest operational plant, and conducted a successful test run of the pilot plant in January 2004. In the next three years, repeated test runs and pilot-scale experiments will be carried out as part of R&D for establishing a low-cost, commercial scale (approx. 3000 tons/day) production technology.

In addition, JFE Engineering, together with two other companies, is involved in a "Programs for the Development of Machinery Using DME Fuels" for METI's Agency for Natural Resources and Energy, aiming at practical application of a revolutionary distributed power generating system which will substantially reduce emissions of environmental pollutants such as particulate matter (PM), nitrogen oxides (NOx), and sulfur oxides (SOx), while maintaining at least the same performance as conventional diesel power generating systems, by using DME in large diesel systems.

Pilot-scale DME direct synthesis plant (100 t/d; Shiranuka-cho, Hokkaido)

### Research for Practical Application of High-efficiency Fuel Cell Power Generation: "SOFC"

Fuel cells, which convert the chemical energy of fuels directly to electricity, are a next-generation power generating system which offers one solution to global warming and other environmental problems. In comparison with internal combustion engine systems, fuel cells have higher generating efficiency and discharge virtually no NOx or SOx.

The solid oxide fuel cell (SOFC) is the leading candidate for fixed generating equipment, as it has the highest generating efficiency among fuel cells and excellent durability.

JFE Engineering was quick to notice the superiority of SOFC and began R&D in 1987. In 1992, the company began joint development with Seimens Westinghouse Power Corporation (SWPC) in the United States, which is the world leader in technical development of SOFC. In 2003, JFE Engineering also began pilot-scale research aimed at early practical application of a 5 kW CHP system as an SOFC generating system for households and small businesses with Fuel Cell Technologies, Ltd. of Canada, and is also studying practical application of a 125 kW CHP system with a target date of 2006-2007.

SOFC generating system

Current research includes a combination technology using an SOFC generating system and DME or biogas fuel.

# External Awards Received (since 1999)

## National Invention Award

2003 Invention Award
Development of 3-channel polarized light steel sheet surface inspection equipment (Delta-Eye)

2001 Prime Minister's Invention Award
Development of producing method of ultra-low carbon steel by combined blowing basic oxygen in RH degasser

2001 Invention Award
Development of organic coated steel excellently resistant to corrosion after forming

2000 Japan Federation of Economic Organizations Chairman's Invention Award
Environment-friendly regenerative low-NOx combustion technology

1999 Invention Award
Development of high efficiency, multi-size rolling technology for high dimensional accuracy wire rod material and steel bars

## Okochi Prize

The prize given to companies and individuals who have made significant contribution to industrial production

2003 Memorial Production Award
Establishment of waste plastic recycling technology for blast furnace feed

2002 Memorial Technology Award
Development and industrialization of critical cooling rate on-line accelerated cooling technology (Super OLAC)

2002 Memorial Production Award
Realization of ultra-short period blast furnace relining by innovative large capacity BF relining technology

2001 Memorial Technology Award
3-channel polarized light surface inspection equipment (Delta-Eye)

2000 Memorial Technology Award
Development of environment-friendly new steelmaking process by zero-slag BOF operation

2000 Memorial Production Award
Development of world's first endless hot strip rolling process and commercialization of new products

## Iwatani Memorial Prize

2002 Development and industrialization of critical cooling rate on-line ac celerated cooling technology (Super OLAC)

1999 Development and world's first commercialization of gradient high-silicon magnetic steel sheet

## Ichimura Industrial Award

1999 Contribution Award
Development of endless rolling technology in hot rolling

## Energy Conservation Award

2003 Energy Conservation Center Chairman's Award
Development of ETL and TFS base steel sheet detergent for degreasing

2000 METI Minister's Award
Development and application of technology utilizing waste plastics as blast furnace feed

2000 Energy Conservation Center Chairman's Award
Energy conservation through activities to maximize equipment efficiency of oxygen plant

1999 MITI Minister's Award
Minimization of iron and steel making energy through development of new technology for measuring hot metal temperature

1999 Energy Conservation Center Chairman's Award
Activities for reducing oxygen gas dissipation

1999 Energy Conservation Center Excellence Award
Introduction of regenerative burners in Chita small-diameter seamless pipe rotary furnace

## Minister's Award for Global Warming Prevention (Environment Agency)

1999 Minister's Award
Recycling of waste plastics for blast furnace feed

## Excellent Energy Conserving Equipment Award

2000 METI Minister's Award
High-speed continuous annealing and heating system applying high-temperature rotary regenerative heat exchanger

## New Energy Award (award for new energy equipment for the 21st century)

2002 New Energy Foundation Chairman's Award
Floating-type solar power generation system

2000 Resources & Energy Agency Director General's Award
Project to produce fuel from wastes by gasifying & melting method in steelworks

## Resource Recycling Technology & System Award (Clean Japan Center)

2002 METI Industrial Technology & Environment Bureau Director General's Award
Application of steel slag hydration hardening substance as materials for port & harbor construction

2001 Clean Japan Center Chairman's Award
Technology for cascading & recycling of washing chemical fluorine nitric acid

2000 METI Industrial Technology & Environment Bureau Director General's Award
Technology for recycling stainless steel making dust using smelting reduction method

1999 Clean Japan Center Chairman's Award
Suppression of waste discharge in a casting plant (NIPPON KOKAN PIPE FITTING MFG. CO., LTD.)

## Japan Society of Mechanical Engineers Award

2002 Japan Society of Mechanical Engineers Award (Technology)
Development and practical application of high-temperature waste gasifying & direct melting furnace

2001 Japan Society of Mechanical Engineers Award (Technology)
Continuous rolling mill of steel bar, section, and wire rod

1999 Japan Society of Mechanical Engineers Award (Technology)
Development of equipment for changing running direction of cold rolled steel sheet by air floatation

## Combustion Society of Japan Award

2003 Technology Award
Development of next-generation stoker type waste incineration technology utilizing high temperature air combustion control technology

2000 Technology Award
High-temperature waste gasifying & direct melting technology

## The Society of Materials Science, Japan Award for Technical Developments

2002 Development of hot rolled high strength steel sheet-780MPa grade NANO HITEN by controlling nano-size ultra minute precipitates

## The Society of Chemical Engineers, Japan Technology Award

2003 Development of waste polyvinyl chloride resin recycling technology

## Surface Finishing Society of Japan Award

2002 Technology Award
Environment-friendly high-performance chomium-free steel sheet "Geo-Frontier Coat"

## Japan Coating Technology Association Award

2001 Technology Award
Rust stabilization agent for weathering steel CUPTEN COAT M

## Japan Society for the Promotion of Machine Industry Award

2001 Chairman's Award
Development of equipment for changing running direction of cold rolled steel sheet by air floatation

## Excellent Environmental Equipment Award (Japan Society of Industrial Machinery Manufacturers)

2003 Chairman's Award
Fly-ash dioxin volatilizing and separating equipment (Hi-Clean DX)

2002 Chairman's Award
Automatic sorting system for plastic bottles

2002 METI Industrial Technology & Environment Bureau Director General's Award
Small-scale incinerator using carbonizing & gasifying method (Kawatetsu Machinery Co., Ltd.)

## Japan Institute of Energy Award

2002 The JIE Award in Technical Division
Development of slurry bed dimethyl ether synthesis technology

## Japan Ozone Association Award

2002 Technology Award
Practical high-flux filtration system using ozone resistant microfiltration module

2000 Recommended Technology Award
Promotive implementation of U-tube ozone contact equipment

## Japan Society on Water Environment Award

2002 Technology Award
Bio-tube system

## Competition for Specialized Greening Technology for Rooftops, Wall Facings and New Green Spaces (Organization for Landscape and Urban Greenery Technology Development)

2003 The Minister of Land, Infrastructure and Transport Prize
The first prize for Rooftop Greening Technology
ORTO YOKOHAMA

## Shinagawa Greening Award

2001 CITYWINDS SHINAGAWA GARDEN COURT

## The Japan Industrial Techniques Grand Prix

2003 The Special Award by The Examination Committee
Development and practical application of new on-line accelerated cooling technology (Super OLAC)

## Recycling Award (NPO Recycle Solutions)

2001 First Planning Award
Marine Blocks (carbonated large solid block of slag for use in artificial reefs for seaweed and fish farming)

# Environmental Businesses Network of JFE Group Companies

The JFE Group includes approximately 50 companies which supply environment-friendly products and are engaged in environmental businesses ranging from environmental surveys/measurement and support of ISO14001 certification to waste management/recycling, design and construction of environmental plants, and soil remediation. The JFE Group companies provide integrated solutions from the initial proposal and planning to introduction, operation, and maintenance of equipment in a wide variety of fields, contributing to a better environment.

| Company | Business |
|---|---|
| **Field** | **Environmental surveys, analysis, and consultation** |
| JFE Net Corporation | Consultation on development of environmental management systems; ISO-based environmental training; seminars for in-house environmental monitoring personnel; internal environmental auditing. |
| JFE TECHNO-RESEARCH CORP. | Environmental and energy-related measurement, surveys, and analysis (air and soil quality, etc.); consultation on environmental issues (environmental management systems, ISO14001 certification, PPD of overseas CDM etc.); consigned life cycle assessment; environment information collection and surveys; consigned development and testing; manufacture and operation of experimental devices; management and evaluation of R&D projects; survey and management of patents. |
| Japan Technomate Corporation | Manufacture of experimental equipment for marine environment remediation (reefs for fish/seaweed farming, slag sand capping, aeration, sea water purification, etc.); implementation and consultation of hydraulic/oceanic experiments and numerical simulations; environmental and energy-related measurements, surveys and analysis (water/atmospheric temperature, wind, wave, airborne salt, corrosion resistance of environmental plant, anti-corrosion measures, inspection/measurement/diagnostics, analytical simulation, etc.); manufacture/maintenance of blades for wind power generation. |
| **Field** | **Waste treatment and recycling** |
| JFE URBAN RECYCLE CORP. | Recycling of waste electric appliances under the Appliance Recycling Law (4 designated categories: televisions, air conditioners, refrigerators, washing machines); recycling of household appliances used in business, OA equipment, vending machines, etc.; collection and transportation of industrial waste (including transshipment and storage). |
| JFE KANKYO CORP. | Waste treatment and recycling (waste plastics, wastewater and sludge, waste construction materials, fluorescent lamps, batteries, etc.); collection and transportation of wastes; environmental measurement and analysis, environmental measurement certificates; consultation on waste treatment and recycling. |
| JFE LOGISTICS CORP. | Marine transportation of waste plastics, industrial wastes and waste construction soil; collection of toner cartridges and fluorescent lamps; transportation of industrial wastes; removal and transportation for recycling of business automation devices; environmental cleanup (industrial washing and cleanup etc.); collection, transportation, and intermediate treatment of industrial wastes; construction, operation, maintenance, dismantling, and washing of environmental equipment. |
| JFE MINERAL CO., LTD. | Recycling of iron and steel making slag (granulated slag, BF slag powder); technological development for effective use of slag; development of high-value-added slag products (SCP method for improving soil quality by slag piling, solid slag blocks for marine construction); recycling business (recycling of waste concrete into concrete/asphalt aggregate, recycling of molding sand); soil and underground water pollution surveys and cleanup work; geothermal water surveys and development; production and sale of environment-friendly products (slag sand, magnesium hydrate, etc.). |
| JFE LIFE CORP. | Collection and transportation of industrial wastes; design, installation, sale, and maintenance of building and industrial air conditioner filter; recovery of chlorofluorocarbon gas from vending machines. |
| JAPAN RECYCLING CORP. | Industrial waste treatment; recycling of waste containers and packaging; sale of by-products from waste treatment; operation and maintenance of municipal and industrial waste treatment facilities. |
| DAIWA STEEL CORP. | Intermediate treatment of wastes (melting of dry batteries, etc. in electric furnace). |
| **Field** | **Environmental plant and equipment** |
| JFE S-Tec Corporation | Manufacture, installation, and maintenance of waste treatment and water treatment equipment; operation and maintenance of waste incinerators. |
| JFE PRECISION CO., LTD. | Manufacture, installation, and maintenance of water treatment and waste treatment equipment. |
| JFE Soldec Corporation | Design of waste treatment equipment; development of planning and operation management support systems for environmental equipment; design of environmental protection systems related to combustion exhaust gas; development, design, and manufacture of VOC treatment systems for responding PRTR; development support for production and use systems related to environment-friendly fuels (DME, hydrogen, palm ester, etc.); energy-saving consultation by equipment diagnosis. |
| JFE Technos Corporation | Manufacture, installation, and maintenance of water treatment and waste treatment equipment; experimental fabrication and testing related to research and development (DME diesel engine, countermeasures for dioxins, etc.). |
| JFE SHOJI HOLDINGS, INC. | Overall sales of environmental plants, equipment, commodities, and services; overseas afforestation. |
| JFE Plant & Service Corporation | Construction, modification, and maintenance of waste treatment and water treatment equipment. |
| GECOSS CORP. | GSS method for recycling soil generated from soil-cement continuous wall construction, reducing industrial wastes more than 50% than conventional method. |
| JFE ADVANTECH CO., LTD. | Manufacture and sale of measuring instruments for waste treatment facilities, sewage system, and waterworks (industrial weighing scale, measuring devices of water level, quality, flow rate, etc.). |

| Company | Business |
|---|---|
| **Field** | **Environmental plant and equipment** |
| JFE ELECTRICAL & CONTROL SYSTEMS, INC. | Design, installation, and maintenance of electrical systems and instrumentation of waste treatment facilities; design and manufacture of photovoltaic power generation systems; design and installation of energy-saving system. |
| JFE MECHANICAL CORP. | Design, manufacture, installation, and maintenance of environment-related and recycling equipment; manufacture and sale of light scale incinerators of dry-distillation and waste gasification ; dismantling of incinerator using technologies of countermeasures for dioxins; design, manufacture, installation, and maintenance of water treatment equipment. |
| JFE Eletech Corporation | Design and installation of electrical systems and instrumentation of various plants such as water treatment plants and incinerators. |
| Tohoku Dock Tekko Co., Ltd. | Design, manufacture, installation, and maintenance of waste treatment equipment (incinerators, recycling centers, etc.); design, manufacture and sales of raw garbage treatment plants. |
| JFE Environment Service Corporation | Consigned operation of environment-related plants such as waste treatment and water treatment equipment. |
| JFE Koken Corporation | Prevention of soil contamination; restoration of contaminated soil; installation of various water treatment equipment; environment-friendly construction method (no-trenching method). |
| JFE PIPE FITTING MFG. CO., LTD. | Design, manufacture, and installation of molding sand recycling equipment (energy-saving fluidized calcination furnace etc.). |
| NIPPON CHUZO K.K. | Manufacture and sale of heat and wear resistant castings (grate, etc.) for waste incinerators; molding sand recycling equipment; slag crusher. |
| Nippon Chutetsukan K.K. | Design, manufacture, and turnkey execution of water environment engineering projects. |
| Recycling Management Japan, Inc. | Consigned municipal and industrial waste treatment; operation and maintenance of waste treatment facilities; production and sale of RDF and compost; design, manufacture, and sale of production facilities for RDF and compost fuel. |
| JFE Mie Tec Service Corporation | Manufacture, installation, trial run, and maintenance of waste/water treatment equipment. |
| **Field** | **General environmental protection** |
| JFE G.S. CORP. | Collection and transportation of municipal and industrial wastes; operation and maintenance of waste incinerating plants, etc.; design and execution of landscape planting; environmental measurement, analysis, and certificates of air and water quality; environmental measurement certificates; waste treatment (recycling); consultation on environmental greening and environmental surveys. |
| KEIYO CITY SERVICE CORP. | Design and construction of gardens and civil works; maintenance of gardens and planted areas; consultation on environmental greening; green plant leasing; washing of waste collection containers; washing and leasing of restaurant kitchen filter. |
| FUKUYAMA STEEL TECHNOLOGY CORP. | Collection and transportation of municipal wastes. |
| FUKUYAMA TECHNO-RESEARCH CO., LTD. | Recycling of used power cables; landscape planting; environment- and energy-related measurement; energy-saving diagnosis; consultation on environmental ISO and energy saving. |
| MINAMIAICHI TOWN SERVICE CORP. | Design and construction of gardens and civil works; maintenance of gardens and planted areas; consultation on environmental greening; green plant leasing; recycling of vending machines. |
| **Field** | **Environment-friendly products** |
| JFE CHEMICAL CORP. | Plastic recycling; gas refining; by-products recovery (ammonium sulfate, liquid ammonia); $CO_2$ recovery and reuse (dry ice, etc.); water treatment chemicals (caustic soda, sulfuric acid, iron sulfide, hydrated lime, etc.) |
| JFE METAL PRODUCTS & ENGINEERING INC. | Development of highly functional architectural and civil engineering products with low environmental loads; environment-friendly construction materials (sound barrier and guardrail using photocatalyst). |
| JFE GALVANIZING AND COATING CO., LTD. | Development of new applications for coated steel sheets with low environmental loads; production of environment-friendly steel products (raindrop-stain resistant prepainted steel sheet for roofing, siding, and sound insulating, heat insulating prepainted steel sheet, acid resistant prepainted steel sheet). |
| JFE CIVIL ENGINEERING & CONSTRUCTION CORP. | Environment-friendly construction method (steep slope road widening method: Metal Road). |
| JFE ROCKFIBER CORP. | Manufacture of rock wool and its products from BF slag (heat-resistant materials, thermal insulation, and sound-absorbing materials for energy-saving and better housing environment). |
| JFE CONTAINER CO., LTD. | Manufacture and sale of reusable drum cans (Eco-drum, S Open drum can); new drum and used drum can recovery service using comprehensive distribution system; manufacture and sale of various high pressure gas containers. |
| CHIBA RIVERMENT AND CEMENT CORP. | Production of slag powder as mixed cement material, BF cement designated by the Green Procurement Law, and Eco-Mark product (Riverment). |
| MIZUSHIMA RIVERMENT CORP. | Production of slag powder as mixed cement material, and BF cement designated by the Green Procurement Law. |


## JFE Holdings, Inc

1-1-2, Marunouchi Chiyoda-ku, Tokyo 100-0005, Japan
http://www.jfe-holdings.co.jp

**Contact** Environmental Solutions Center
TEL: +81-3-3217-3038 FAX: +81-3-3214-3141
E-mail: kankyo@jfe-holdings.co.jp





JFE Environmental Report 2004 was printed on 100% recycled paper with 87% white chromaticity using vegetable soy oil ink to minimize VOC (volatile organic compound) emissions.

Published: Dec. 2004

# We always welcome your opinions and comments on "JFE Environmental Report 2004"

## Fax No. : +81-3-3214-3141

Thank you for taking your time to read the JFE Environmental Report 2004.
We would appreciate your comments and opinions on this report for reference on our future environmental activities and revisions of this report.
The content of the report is also available on the JFE website at:
http//www.jfe-holdings.co.jp/en/environment/

### Q1 After reading the report, what is your impression?

A. Total impression

☐ Fully satisfactory ☐ Ordinary
☐ Unsatisfactory ☐ No comment

B. Readability or understandability

☐ Readable ☐ Ordinary ☐ Unreadable

### Q2 Which articles in the report particularly interested you?

☐ Introduction ☐ A Message from Top Management
☐ Responsibilities of Technology Ⅰ
☐ Responsibilities of Technology Ⅱ
☐ History of Environmental Measures in the JFE Group
☐ Environmental Management
☐ Environmental Performance Report Ⅰ :
Reducing Environmental Loads in Production Activities
☐ Environmental Performance Report Ⅱ :
Contributing through Environment-friendly Products and Technologies
☐ Environmental Performance Report Ⅲ :
Contributing to Environmental Improvement in Local and International Society
☐ Environmental Performance Report Ⅳ :
Research and Development of Environmental Technologies
☐ Others

### Q3 Please describe any opinions in relation to JFE's policy on environmental issues.

☐ Excellent ☐ Poor ☐ No comment

Please describe further opinion here :

### Q4 Which of the following best describes your position when you read the report?

☐ JFE's customer ☐ Shareholder/Investor
☐ Resident in neighborhood of JFE's works or offices
☐ National or local government/its associated organization
☐ Environmental NGO/NPO
☐ Environment specialist at company or organization
☐ Media ☐ Academic or educational organization
☐ Student
☐ Employee/employee s family of JFE Group
☐ Other ( )

### Q5 Where did you hear about this report?

☐ Newspaper/Magazine
☐ Seminar/Lecture/Exhibition
☐ JFE's website ☐ Other website ☐ JFE's employee
☐ JFE's publicity activities, i.e., plant tour
☐ Other ( )

### Q6 Please enter any opinions or requests for a future JFE Environmental Report.

Thank you for your cooperation. The following details would be much appreciated.

Name Telephone number (home/office)

Address (home/office)

E-mail

**Private information handling**

Your opinions or details will only be used as reference for our future environmental activities and revisions of this report, and never be used for other than these purposes. Please note private information will not be published in any case.

JFE Holdings, Inc. Environmental Solutions Center,
Address: 1-1-2 Marunouchi, Chiyodaku, Tokyo 100-0005, Japan
TEL: +81-3-3217-3038 FAX: +81-3-3214-3141 E-mail: kankyo@jfe-holdings.co.jp