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Editorial Policy

This “JFE Environmental Report 2003” is based on the actual performance of the JFE Group in environment-related activities during fiscal year 2002 (April 1, 2002 to March 31, 2003). Examples of activities also include some items continuing into fiscal 2003.

Every effort has been made to maintain the continuity of the content and to improve the level of an information disclosure while promoting broader understanding of the efforts and philosophy of the JFE Group to contribute to sustainable growth with the world’s most innovative technology.

This Report has been prepared and edited in accordance with the guidelines of Japan’s Ministry of the Environment (MOE), the Global Reporting Initiative (GRI), and other relevant standards.
What is the JFE Group?
The JFE Group consists of five operating companies, JFE Steel Corp., JFE Engineering Corp., JFE Urban Development Corp., Kawasaki Microelectronics, Inc., and JFE R&D Corp. under a holding company, JFE Holdings, Inc.

Scale of Business Operations

<table>
<thead>
<tr>
<th>(billions of yen)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consolidated net sales, FY 2002</td>
<td>¥ 2,426.8</td>
</tr>
<tr>
<td>(Breakdown)</td>
<td></td>
</tr>
<tr>
<td>Steel</td>
<td>¥ 1,755.7 (72.3%)</td>
</tr>
<tr>
<td>Engineering</td>
<td>¥ 520.8 (21.5%)</td>
</tr>
<tr>
<td>Other businesses</td>
<td>¥ 150.3 (6.2%)</td>
</tr>
<tr>
<td>Stockholders’ equity</td>
<td>¥ 594.5</td>
</tr>
<tr>
<td>No. of employees</td>
<td>54,100</td>
</tr>
</tbody>
</table>

(out as of March 31, 2003)

Outline of Businesses

JFE Steel Corporation (steel business)
To create a production system with the world’s highest competitiveness through integrated management of neighboring steel-works, four sites (Chiba Works / Keihin Works, Kurashiki Works / Fukuyama Works) were reorganized into two works (East Japan Works, West Japan Works) in a 2 works / 1 plant system (including Chita Works).
- Manufacture and sale of iron and steel products (sheets, plates, shapes, pipes and tubes, stainless steel, electrical steel sheets, bars and wire rods, iron powder, etc.)
- Recycling business

JFE Engineering Corporation (total engineering business)
To respond quickly to changes in the business environment, promote common business strategies, and maximize consolidated profit in each field. JFE Engineering has adopted a “division company” system consisting of its business divisions and affiliated companies responsible for specific functions.
- Energy industries engineering
- Environmental industries engineering
- Water and waste water engineering
- Steel structure engineering
- Steel engineering
- Solution engineering
- Machinery center

JFE Urban Development Corporation (urban development business)
Responsibly for development of large scale land holdings owned by the JFE Group and expansion of the Group’s condominium business. Emphasizes efficient development of land holdings utilizing accumulated urban development know-how.
- Large-scale complex urban development
- Condominium construction and sales
- Asset utilization

Kawasaki Microelectronics, Inc. (semiconductor business)
Manufactures and sells system LSIs for image processing in digital cameras, copiers, etc., and LSIs for image control in liquid crystal displays for personal computers, cell phones, and liquid crystal televisions.
- ASICs (application specific integrated circuits)

JFE R&D Corporation
Conducts research and development in core technologies common to the steel and engineering businesses (measurement & control, mechanical, civil engineering, building technology, numerical analysis, bio / catalyst) 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.

Main Works in Japan

<table>
<thead>
<tr>
<th>JFE Steel – West Japan Works</th>
<th>JFE Steel – East Japan Works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fukuyama / Kurashiki</td>
<td>Keihin / Chiba</td>
</tr>
<tr>
<td>JFE Steel Chita Works</td>
<td>JFE Steel – West Japan Works</td>
</tr>
<tr>
<td>JFE Engineering – TSU Works</td>
<td>JFE Engineering – Shimizu Works</td>
</tr>
<tr>
<td>JFE Engineering – Tsurumi Engineering and Manufacturing Center</td>
<td>JFE Engineering – Chita Works</td>
</tr>
<tr>
<td>Kawasaki Microelectronics – Utsunomiya Works</td>
<td>JFE Holdings, Inc.</td>
</tr>
</tbody>
</table>
Toward Sustainable Growth

JFE has historically placed high priority on environmental protection in all aspects, including not only protection of air and water quality, but also recycling and prevention of global warming. We are proud to be among the world’s leaders in this field. With the creation of the JFE Group in 2002, we renewed our commitment to the environment by making global environmental protection a priority management task and are working to further improve our environmental performance through companywide efforts encompassing all JFE Group companies. As a technology-oriented business group, JFE has developed many unique technologies and is continuing to apply these to environmental protection in all its business activities. At the same time, we understand that providing products and services that help create a better global environment is an important mission for a manufacturing company such as ours. In particular, we are contributing to environmental protection in the following areas:

1) Advanced and innovative steel ecological products
2) Engineering services which reduce environmental loads in society
3) Recycling through a synergy of steel and engineering technologies

We also believe that earning recognition as a good corporate citizen which merits the trust of society is essential for the continuing growth of JFE, and to this end, we maintain close communication with society at every level. JFE’s Environmental Report 2003 is part of this effort.

As representatives of the management and employees of the JFE Group, we are confident that our continuing efforts to improve the global and regional environment will create new value in JFE, while also contributing to sustainable growth for future generations.

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 of 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 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.
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   JFE contributes to environmental protection activities at the global level through active involvement in international cooperation in the form of technology transfer, etc.
### Transition of Environmental Measures

#### Social Trends

**JFE Toward Sustainable Society**
JFE has a long history of leadership in environmental protection and possesses a wealth of technology and know-how in the field. Recognized in Japan as the “first name in technology,” JFE is contributing to sustainable growth with the world’s most innovative technology.

#### Energy-saving Activities

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Period</td>
<td>Energy saving by operational improvements such as fuel consumption by reducing inventory, etc.</td>
</tr>
<tr>
<td>2nd Period</td>
<td>Process optimization to improve efficiency and save on fuel costs</td>
</tr>
<tr>
<td>3rd Period</td>
<td>Energy-saving measures for global warming prevention</td>
</tr>
<tr>
<td>4th Period</td>
<td>Introduction of environment-friendly regeneration processes</td>
</tr>
</tbody>
</table>

#### Supply of Ecological Steel Products & Equipment

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Period</td>
<td>Steel high-strength sheets</td>
</tr>
<tr>
<td>2nd Period</td>
<td>Stainless steel tubes</td>
</tr>
<tr>
<td>3rd Period</td>
<td>80 Steel-frame houses</td>
</tr>
<tr>
<td>4th Period</td>
<td>80 Development of Super-QLAC technology for shape control</td>
</tr>
</tbody>
</table>

#### Supply of Clean Energy-saving Technologies

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Period</td>
<td>Start-up of NG storage tank</td>
</tr>
<tr>
<td>2nd Period</td>
<td>80 Start-up of circulating fluidized bed (CFB) boiler furnace</td>
</tr>
<tr>
<td>3rd Period</td>
<td>80 Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>4th Period</td>
<td>80 Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
</tbody>
</table>

#### Supply of Environmental Protection Equipment

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Period</td>
<td>Start-up of sludge incineration plant</td>
</tr>
<tr>
<td>2nd Period</td>
<td>80 Start-up of circulating fluidized bed (CFB) boiler furnace</td>
</tr>
<tr>
<td>3rd Period</td>
<td>80 Development of an optimal fly ash recycling system</td>
</tr>
<tr>
<td>4th Period</td>
<td>80 Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
</tbody>
</table>

#### General Measures

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>Establishment of Environmental Control Section in Head Office Technology Dept.</td>
</tr>
<tr>
<td>1986</td>
<td>Establishment of Environmental Management Committee</td>
</tr>
<tr>
<td>1987</td>
<td>Establishment of Environmental Management Dept.</td>
</tr>
<tr>
<td>1988</td>
<td>Establishment of Environmental control regulations</td>
</tr>
</tbody>
</table>

#### Measures at JFE

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>Establishment of Basic Pollution Control Law</td>
</tr>
<tr>
<td>1990</td>
<td>Implementation of Air Pollution Control Law and Noise Regulation Law</td>
</tr>
<tr>
<td>1991</td>
<td>Establishment of Basic Pollution Control Law</td>
</tr>
<tr>
<td>1992</td>
<td>Implementation of 14 pollution-related laws</td>
</tr>
<tr>
<td>1993</td>
<td>Establishment of Basic Environment Plan</td>
</tr>
</tbody>
</table>

#### Supply of Ecological Products, Equipment

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>Stainless steel tubes and tubes for auto exhaust system</td>
</tr>
<tr>
<td>1995</td>
<td>Ni-added high performance weathering steel</td>
</tr>
<tr>
<td>1996</td>
<td>BF cement / BF granulated slag</td>
</tr>
</tbody>
</table>

#### Energy-saving Activities

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>Start-up of circulating fluidized bed (CFB) boiler furnace</td>
</tr>
<tr>
<td>1998</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>1999</td>
<td>Development of a new-type heat recovery system</td>
</tr>
</tbody>
</table>

#### Measures at JFE

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>Establishment of Global Environmental Charter by Keidanren (Japan Business Federation)</td>
</tr>
<tr>
<td>1991</td>
<td>Establishment of Global Environmental Charter by Keidanren (Japan Business Federation)</td>
</tr>
<tr>
<td>1992</td>
<td>Establishment of Global Environmental Charter by Keidanren (Japan Business Federation)</td>
</tr>
<tr>
<td>1993</td>
<td>Establishment of Global Environmental Charter by Keidanren (Japan Business Federation)</td>
</tr>
</tbody>
</table>

#### Supply of Clean, Energy-saving Technologies

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>Start-up of in-ground LNG storage tank</td>
</tr>
<tr>
<td>1995</td>
<td>80 Start-up of circulating fluidized bed (CFB) boiler furnace</td>
</tr>
<tr>
<td>1996</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>1997</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
</tbody>
</table>

#### Supply of Ecological Products, Equipment

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>BF cement / BF granulated slag</td>
</tr>
<tr>
<td>1999</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2000</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2001</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
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</table>

#### Energy-saving Activities

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2003</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
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</tbody>
</table>

#### Measures at JFE

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2005</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2006</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2007</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
</tbody>
</table>

#### Supply of Clean, Energy-saving Technologies

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2009</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2010</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2011</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
</tbody>
</table>

#### Supply of Ecological Products, Equipment

<table>
<thead>
<tr>
<th>Period</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2013</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2014</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
<tr>
<td>2015</td>
<td>Development of energy-saving air conditioning systems using water/air heat exchangers</td>
</tr>
</tbody>
</table>
JFE Technologies for Sustainable Growth

Responding to heightened social needs for energy conservation and environmental preservation, JFE supplies products and services which help prevent global warming, reduce environmental loads, and support the creation of a recycling-oriented society. These pages are a brief summary of JFE’s wide-ranging environmental and energy-related technologies.
Environmental Management System (EMS)

JFE’s IT-based “Environmental Management Network System”

In parallel with the Environmental Committee system, JFE created a system which enables common use of environment-related information on the Group intranet to support more complete environmental management. Information is shared among persons in charge of the environment at JFE Holdings, the five operating companies, and Group affiliates by transmitting news on environmental trends to the individual employee level, improving the effectiveness of environmental management in the Group as a whole.

Environmental Management System (EMS)

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 Affiliate Company Environmental Committees at affiliates under each of the operating companies. The JFE Environmental Committee is chaired by the President of JFE Holdings, Inc., 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. As a support function for the 3-tiered committee system, 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 share information in practical work 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 affiliates.

Environmental Management Network System

JFE Group Environmental Committee

Chairman: President, JFE Holdings, Inc.

Affiliates: Responsible for environmental matters of Group companies

JFE Steel Corp. Environmental Committee

JFE Engineering Corp. Environmental Committee

JFE Urban Development Corp. Environmental Committee

Kawasaki Heavy Industries, Inc. Environmental Committee

JFE R&D Corp. Environmental Committee

Members: Presidents of JFE Holdings and five operating companies

Affiliates Environmental Liaison Committee

Affiliate A

Affiliate B

Affiliate C

1st meeting of the JFE Environmental Committee

Activities in 2002 / Future Objectives

Based on its performance to date, JFE sets new objectives for improvement of global environmental activities.

<table>
<thead>
<tr>
<th>Aims of JFE Group</th>
<th>Future objectives</th>
<th>Results in FY2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion of environmental management</td>
<td>Strengthening of systems and improved level of environmental management</td>
<td>ISO14001 certification / JFE Urban Recycling Corp.</td>
</tr>
<tr>
<td>Environmental management and communication</td>
<td>Strengthening of communication</td>
<td>Future objectives: Group Environmental Report in Japanese and English</td>
</tr>
</tbody>
</table>
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JFE’s IT-based “Environmental Management Network System”

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Environmental Management Network System

JFE Group Environmental Committee

Chairman: President, JFE Holdings, Inc.

Affiliate A

Affiliate B

Affiliate C

Affiliates: Persons responsible for environment at JFE Holdings and each operating company

Affiliated companies: Environmental Liaison Committees

Activities in 2002 / Future Objectives

Based on its performance to date, JFE sets new objectives for improvement of global environmental activities.

Results in FY2002

<table>
<thead>
<tr>
<th>Aims of JFE Group</th>
<th>Future objectives</th>
<th>Results in FY2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Prevention of environmental damage</td>
<td>Strengthening of systems and improved level of environmental management</td>
<td>ISO14001 certification for JFE Urban Recycle Corp.</td>
</tr>
<tr>
<td>2. Prevention of air pollution</td>
<td>Strengthening of communication</td>
<td>JFE Environmental Report and homepage</td>
</tr>
<tr>
<td>3. Prevention of water pollution</td>
<td>Contributing to cleaning up riverbeds and implementing water pollution prevention measures</td>
<td>Contributions to cleaning up riverbeds and implementing water pollution prevention measures</td>
</tr>
<tr>
<td>4. Prevention of noise and vibration</td>
<td>Contributing to cleaning up riverbeds and implementing water pollution prevention measures</td>
<td>Contributions to cleaning up riverbeds and implementing water pollution prevention measures</td>
</tr>
</tbody>
</table>

JFE Environmental Report 2003
Promoting Environmental Management

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. JFE, in addition to external inspection by certification authorities, holds 19 in-house environmental auditors 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.

Status of the JFE Environmental Management System

JFE 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.

ISO 14001 Certification Certified in

<table>
<thead>
<tr>
<th>JFE</th>
<th>Certified in</th>
<th>Certified in</th>
</tr>
</thead>
<tbody>
<tr>
<td>JFE Steel East Japan Works (Kehin)</td>
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Affiliated companies

| NKK STEEL SHEET & STRIP | May 1997 | JFE CIVIL ENGINEERING & CONSTRUCTION |
| JFE WELDED PIPE MANUFACTURING | May 1997 | TOYODA STEEL |
| NKK TUBES | May 1997 | JFE METAL PRODUCTS & ENGINEERING |
| JFE CHEMICAL | Jul. 1998 | KAWASAKI |
| KAWAITECH | Jul. 1998 | JFE Electric |
| KAWAITECH | Jul. 1998 | JFE | 
| KAWAITECH | Jul. 1998 | JFE Koken |
| KAWAITECH | Jul. 1998 | Fuji Koko |
| JFE KANKYO | Jul. 1998 | Philippine Sinter Corporation |
| JFE MATERIAL | Feb. 2000 | JFE Environmental Service |
| JFE Sided | Feb. 2000 | NKK BARS & SHAPES |
| NKK MARINE & LOGISTIC | Mar. 2000 | JFE URBAN RECYCLE |
| JFE CONTAINER | Mar. 2000 | JFE URBAN RECYCLE |

Terminology

Environmental Management System (EMS): Management system for reducing the environmental impacts of business activities, under which the organization establishes an environmental policy, prepares and implements plans based on that policy, checks progress and reviews plans, and voluntarily endeavors to achieve continuous progress.

JFE 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. 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.

Green Purchasing

JFE has created a common set of Green Purchasing Guidelines for the group, which apply not only to office supplies but also to parts and materials for production, and refers to these Guidelines when making purchasing decisions. Application is currently being expanded to affiliated companies.

Environment Month Activities

Each year, East Japan Works (Kehin) holds a contest for environmental slogans. This year, the number of entries showed a large increase, reaching 867. The following were selected as winning entries.

- “Think before you throw – Your idea makes the difference between waste and resources.”
- “Your little cooperation helps to stop warming of our precious globe.”
- “Your trash is a resource too – Let’s recycle!”
- “Just a minute – before you throw it away!”

To strengthen environmental education, JFE introduced an Environmental Management Network System in June 2003, 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 from the homepage.

Examples of green purchasing:

- Introduction of hybrid car
- Examples of green purchasing:
  - Recycled oil, solvent containers, packaging materials, electric/natural gas/hybrid vehicles.

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.

Prize for Excellence in Environmental Slogans

- May 2000
- Sep. 2000
- Nov. 2000
- Feb. 2001
- Sep. 2001
- Dec. 2001
- Dec. 2002
- May 2003
Promoting Environmental Management

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.

Status of the JFE Environmental Management System

JFE 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.

ISO 14001 Certification

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Environment Month Activities

As part of its environmental management system, JFE voluntarily conducts a program of Environment Month Activities in June of each year to raise employee awareness of the environment. This year’s activities began with a message from the President of JFE Holdings and included public road cleanup operations and others, as follows:

- [Public Road Cleanup Operations]
- [Lectures on the environment]
- [Works Environmental Patrols]
- [Environmental Education under ISO14001]

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- “Your little cooperation helps to stop warming of our precious globe.”
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- “Just a minute – before you throw it away!”
- “Have a think and put the Eco-mark on your heart.”

Environmental Education

JFE 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. 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) for general employees, employees engaged in designated work, etc. as part of its environmental management system.

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- Examples of green purchasing:
  - Recycled oil, solvent containers, packaging materials, electric/natural gas/hybrid vehicles.

Introduction of hybrid car
Environmental Accounting
Over the past three decades, JFE has invested huge sums in environmental protection, including measures to prevent air and water pollution, reduce noise, treat waste, and create greenbelts. JFE has also put great effort into energy-saving investment, achieving the world's highest level of energy efficiency. It should be noted that JFE's current environmental activities were developed in the course of fulfilling its corporate mission of creating industrial and social infrastructure, and its current environmental costs include the large ongoing financial burden of maintaining this accumulated investment. In particular, when evaluating annual expenses and results, it is important to consider these past efforts and their continuing benefits. As one measure of management performance, JFE evaluates its environmental activities based on environment-related data. As an example of this investment and expenses are included in the Environmental Report.

Investment in Energy Conservation
JFE embarked on an aggressive program of energy conservation following the first Oil Crisis in 1973. After the second Oil Crisis in 1979, 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. Today, JFE is maintaining its position as a world leader in energy efficiency. Cumulative investment since 1990 has now reached approximately ¥934 billion. Representative investments in FY2001-2002
- Measures to improve power plant efficiency
- Construction of new private power plant
- Installation of energy-saving regenerative burners at plate mill reheating furnaces

Investment in Environmental Protection
Because JFE operates steelworks in the environs of large metropolitan areas, it 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 ¥476 billion since 1973, JFE's clean steelworks boast the world's highest levels of environmental performance. In recent years, JFE has actively invested in measures to recycle byproducts of its steelworks and apply iron and steel making processes as infrastructure for recycling in society at large, thus leading the movement toward a recycling-oriented society. Representative investments in FY2001-2002
- Modernization of sintering machine flue-gas treatment equipment
- Modernization of incinerator flue-gas treatment equipment
- Improvement of steelmaking shop dust collection

Main Results
The main results of environment- and energy-related capital investment and expenses are summarized on the following pages.

2002 Totals
Investment in environment-related facilities was ¥9.4 billion, which accounted for approximately 10% of total capital investment for the year. Expenses were ¥70.6 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. Investment in energy conservation following the first Oil Crisis in 1973. After the second Oil Crisis in 1979, 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. Today, JFE is maintaining its position as a world leader in energy efficiency. Cumulative investment since 1990 has now reached approximately ¥934 billion. Representative investments in FY2001-2002
- Measures to improve power plant efficiency
- Construction of new private power plant
- Installation of energy-saving regenerative burners at plate mill reheating furnaces

The totals mentioned above were calculated on the following basis:
- Period: April 2002 to March 2003
- Scope: Environment-related investment and expenses at JFE's steelworks, but in the case of research and development, on a companywide basis. Calculations do not include presumed effects based on estimates or risk avoidance benefits.

Future Challenges
In maintaining and promoting environmental accounting, an accurate grasp and correct evaluation of the actual status of environmental activities are necessary. However, there are cases where existing methods are inadequate, for example, items which cannot be quantified and problems in determining the applicable scope of effects. JFE is continuing to develop more appropriate concepts and methodologies for maximizing the effectiveness of environmental accounting in environmental management.
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Representative investments in FY2001-2002

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In fiscal 2002, JFE Steel achieved a recycling rate of 99.9%. Energy-saving benefits were equivalent to ¥2.2 billion.

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JFE 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 involve local governments, JFE 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 CO₂ and suppressing dust and noise.

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

JFE holds annual open-house events at each of its works for the enjoyment of area residents. To encourage better understanding in the surrounding community, JFE 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 can recycling and voluntary cleanup activities in areas where works are located.

JFE’s Environment & Energy Liaison Center was established in 2001 to create new ideas and concepts for activating environmental businesses, conduct environmental and energy-related R&D, and provide information through cooperation with other industries, government agencies, universities, and local communities. It currently sponsors the Environment and Energy Network Research Committee, which is composed of businesses in the Keihin Coastal Area, promoting recycling among different types of industries. The Center is active in information exchanges with national and local governments, businesses, and private citizens, and serves as a forum for communication on energy and the environment.
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Environment-related Support and Assistance
The JFE Steel 21st Century Foundation is responsible for the JFE Group’s direct social contribution. Concretely, the Foundation provides support for environmental purification and has prepared English and Japanese educational resources on the latest technologies and energy-saving technologies, which it donates to universities in Japan and other countries as part of its effort to make Japanese technology available to the world for global environmental protection. Information on these educational resources and other activities can be found at the Foundation’s homepage.

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Cooperation with NPO in Oceanographic Survey
Together with NKK Marine & Logistics Corporation, JFE is cooperating with the NPO (nonprofit organization) VOS Nippon in a voluntary oceanographic survey by installing automatic monitoring equipment on ocean-going vessels operated by NKK Marine. Data are collected each time vessels return to Japan and made available to interested researchers.

Links with Wider Society
Participation in Kanagawa Riverhead Forest Partnership
As a water consumer, JFE 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, contributing to the creation of riverhead forests.

Coexistence with Local Communities
JFE believes that it is important to raise social awareness of the environment through communication. Environmental communication is also a tool for change within the JFE Group, for example, by heightening the awareness of managers and employees and deepening understanding between divisions.

Opening the Works to the Public
JFE holds annual open-house events at each of its works for the enjoyment of area residents. To encourage better understanding in the surrounding community, JFE has also established Visitors’ Centers in its works and opens its plants to four groups of local elementary and middle school students and the general public. Other programs include can recycling and voluntary cleanup activities in areas where works are located.

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Efforts at JFE Steel

Resource and Energy Recycling in the Steel Production Process

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

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

Voluntary Action Plan by Nippon Keidanren (Japan Business Federation)

In anticipation of the Kyoto Protocol, Nippon Keidanren established a Voluntary Environmental Action Plan in July 1997. This plan targets voluntary CO₂ reductions in the industrial and energy conversion sectors to 1990 levels by 2010. Under Japan’s Guidelines for Measures to Prevent Global Warming, results are reviewed annually in the Industrial Structure Council. In 2001, CO₂ emissions showed a 3.2% reduction from the 1990 baseline. Recognizing this achievement, a third-party assessment report for 2002 praised participating businesses for “doing everything in their power, in the face of various difficult circumstances.”

Voluntary Action Program for Environmental Protection by Japanese Steelmakers

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

Environmental Contribution of LCA-based Products

JFE is contributing to energy conservation by developing high-performance steel products which reduce both material consumption in the manufacturing process and final product weight. An LCA assessment of six high-performance steel products estimated that CO₂ emissions can be reduced by 3.1 million tons in manufacturing and 6.5 million tons in use, for a total of 9.6 million tons-CO₂, by adopting high-performance products (estimate for FY2000, entire Japanese steel industry).

CO₂ emissions originating from energy consumption

Environmental burden of CO₂ emissions in the manufacturing process of steel products

Effect of reducing CO₂ emissions in view of LCA through using highly functional steel products

Product types surveyed are:
- High-tensile steel plate for shipbuilding
- High-strength steel sheet for auto bodies
- Stainless steel sheet for railway carriages
- High-tensile steel plate for shipbuilding
- Electrical steel sheet for transformers
- Stainless steel sheet for railway carriages

Terminology

PJ
Petajoule, joule (heat unit) x 10¹⁵ (1000 trillion)

LCA
Life Cycle Assessment. Method of assessing the total environmental load (resource depletion, energy consumption, waste, pollutants, etc.) over the entire product life cycle from raw material extraction through manufacture, use, recycling, and waste.
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One distinctive feature of Japan’s steel industry, in comparison with the U.S. and Europe, is remarkably wide adoption of energy-saving equipment, giving Japanese mills the world’s highest energy efficiency. Reflecting Japan’s technical capabilities, in December 1996, the Japan Iron and Steel Federation established a Voluntary Action Plan, which targets a 10% reduction in energy consumption in 2010 against a 1990 baseline. As a supplementary goal, a 1.5% reduction by using waste plastic in blast furnaces (assuming creation of an adequate collection system) was later incorporated in the Plan. In 2001, energy consumption was 8.5% below the 1990 baseline, demonstrating the success of voluntary action.

**Environmental Contribution of LCA-based Products**

JFE is contributing to energy conservation by developing high-performance steel products which reduce both material consumption in the manufacturing process and final product weight. An LCA assessment of six high-performance steel products estimated that CO₂ emissions can be reduced by 3.1 million tons in manufacturing and 6.5 million tons in use, for a total of 9.6 million tons-CO₂, by adopting high-performance products (estimate for FY2000, entire Japanese steel industry).

**Reducing Environmental Loads in Business Operations**

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

**Terminology**

- **PJ** Petajoule, joule (heat unit) x 10¹⁵ (1000 trillion)
- **LCA** Life Cycle Assessment: Method of assessing the total environmental load (resource depletion, energy consumption, waste, pollutants, etc.) over the entire product life cycle from raw material extraction through manufacture, use, recycling, and waste.
Building a Recycling-oriented Society

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

Zero Waste Activities in the Steelworks

JFE has implemented a program of “Zero-Waste” activities for steelworks byproducts, which include slag, dust, sludge, waste oil, etc., and has already achieved 99.5% recycling. Landfill disposal has decreased to about 1/16 its 1990 level, meeting the Japan Iron and Steel Federation target of 1/3 the 1990 level by 2010. This result includes a 10,000 ton increase in surplus dust in 2003 due to a downturn in cement production. Future measures will include on-site recycling equipment.

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

Water Recirculation

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

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

Waste Plastic Recycling

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

Slag Reduction and Recycling

Slag generated by blast furnaces, BOFs, and electric furnaces accounts for about 80% of steel manufacturing byproducts. JFE Steel has a long record of reducing steel slag by applying hot metal pretreatment and on-site reuse. Thanks to JFE’s efforts to develop product manufacturing technologies and encourage standardization under the Japan Industrial Standard (JIS), more than 99% of slag is now effectively used as roadbed material, aggregate for concrete, material for cement, etc. Cement using BF slag powder also contributes to energy saving and CO2 reduction.

Development of Advanced New Applications for Slag (Example)

- Use of slag to restore shoreline environments
  - (1) Use of BF slag as sand capping material/shallow construction material for improvement of the marine environment
  - (2) Artificial reefs (Marine Block) for seaweed/fish farming using CO2-absorbed slag solids
  - (3) Breakwater blocks and other marine structures using hydration hardening reaction (Ferro-Form)

- Heat Island-Mitigating Paving Material
  - The heat-island effect can be mitigated by using a water-retaining, sand composed 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.

- Slow-release Potassium Silicate Fertilizer
  - Slag fertilizer is released slowly into soil over a long period.
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Recycling results at JFE (dry base)

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Sales of JFE slag in FY2002

<table>
<thead>
<tr>
<th>Concrete aggregate</th>
<th>On-site use</th>
<th>Roadbed material for civil engineering</th>
<th>Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland cement BF slag powder</td>
<td>570,000 kcal/t</td>
<td>570,000 kcal/t</td>
<td>570,000 kcal/t</td>
</tr>
<tr>
<td>Energy-saving effect of BF slag cement</td>
<td>570,000 kcal/t</td>
<td>570,000 kcal/t</td>
<td>570,000 kcal/t</td>
</tr>
</tbody>
</table>

Energy-saving effect of BF slag cement

<table>
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<tr>
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Slow-release Potassium Silicate Fertilizer

<table>
<thead>
<tr>
<th>Slag fertilizer</th>
<th>Slow release period</th>
</tr>
</thead>
</table>
Historically, JFE Steel has developed or introduced numerous technologies to reduce loads on the atmosphere, water, and soil, and is now responding to recent requirements to control and reduce releases of chemical substances, for example, under the PRTR system. JFE is reducing environmental loads while also developing new technologies which satisfy the needs of both business and the environment.

### Control of Chemical Substances

#### PRTR

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

#### Substances reported under PRTR (FY2002, JFE steel division)

<table>
<thead>
<tr>
<th>Substance</th>
<th>Releases</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Air</td>
<td>Public waters</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>NOx</td>
<td>42.3</td>
<td>0</td>
</tr>
<tr>
<td>SOx</td>
<td>14.0</td>
<td>0</td>
</tr>
<tr>
<td>VOCs</td>
<td>14.0</td>
<td>0</td>
</tr>
<tr>
<td>SVOCs</td>
<td>14.0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Benzene and Other Volatile Organic Compounds

Beginning in 2001, the steel industry adopted a second stage voluntary control plan for atmospheric releases of benzene and other volatile organic compounds, continuing from its first stage plan (FY1997-99), with the aim of achieving further reductions. JFE set a target of reducing benzene releases by 80% from the 1998 baseline by 2003 through company-wide improvement activities, and had achieved a 70% reduction by 2002. JFE is also reducing releases of tetrachloroethylene and dichloromethane. In addition to voluntary controls by industry unit, it is also participating in a new voluntary control plan for benzene by regional unit, which began in 2001, and is working to reduce benzene releases in cooperation with neighboring businesses in other industries.

#### Dioxins

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

### Terminology

#### PRTR

Pollutant Release and Transfer Register. A system of reporting to the government the amounts of designated chemical substances released into the environment and transferred as waste. Annual reporting of the amounts is required, beginning in FY2002.
Protecting the Environment

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

Air Quality

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

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

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

Water Quality

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

Soil Quality

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

Terminology

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

Distribution-related environmental impacts include CO₂, NOₓ, and SPM generated by fuel combustion during product transportation. Because these are all factors in global warming and/or air pollution, distribution is an important environmental issue at JFE Steel. JFE endeavors to reduce environmental load through well-considered selection of transportation modes, reduction in distance, improvements in load efficiency, and introduction of information technology ahead of the steel industry. JFE is responding to stricter regulations on SPM in metropolitan areas beginning in October 2003 with a modal shift.

Efficient On-site Transportation

Large on-site transportation vehicles such as the 100t U-frame vehicle and 160t carrier can carry larger single-trip loads than conventional trucks, helping to reduce CO₂ emissions.

Innovative Marine Transportation

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

FERO Ship
Similar to ferries, FERO ships are designed to carry loaded pallet carriers and are used in scheduled service between JFE's steelworks and major cities.

IT Applications and the Effect of the JFE Merger

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

Optimized Ship Operation Management (JFE Coastal Ship Control System)
An integrated system, for control of ship status and loading/unloading progress at JFE's works, reduces deadheading and ensures more efficient coastal transportation by optimizing ship operation management.

Effect of the JFE Merger

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

Terminology

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

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

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

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Efforts at JFE Engineering

Preventing Global Warming
In its works and offices, JFE Engineering has introduced wide-ranging energy and electricity conservation measures through education, adoption of energy-saving lighting systems, and other measures, resulting in continuing CO₂ reductions since 1997.

Building a Recycling-oriented Society
JFE Engineering implements waste control, reduction, and recycling in accordance with the industrial waste control sheet (manifest) system and large volume release business control system of the Waste Management Law, and Construction Recycling Law.

Reducing landfill disposal rate of works waste
Examples of recycling in works include effective use of slag and shot scrap as mixed material, effective use of leftover paints (use of liquid component as recycled thinner), and conversion of waste lumber to chips. The landfill disposal rate in FY2002 was reduced to 48%.

Reducing landfill disposal rate of construction sites waste
Waste reduction / recycling efforts at construction sites include separated collection and reduction of mixed waste to reduce incineration and enable easy recycling, use of intermediate treatment contractors, etc. As a result, landfill disposal rate in FY2002 was reduced to 26%.

Reducing Environmental Loads
Under the PRTR Law, JFE Engineering has implemented measures to control and reduce releases / transfers of designated chemical substances.

Efforts at Kawasaki Microelectronics

Preventing Global Warming
Utsunomiya Works is a modern plant which began operation in October 1990 with a 2300-ton heat storage tank and a large number of inverter-type air conditioning units. In addition to improved control measures, Kawasaki Microelectronics is continuing to introduce energy-saving equipment and retrofit inverter-type equipment. Since 1998, unit energy consumption/sales, which is a control index used in the semiconductor industry, has decreased steadily, reaching about half the 1998 level in 2002.

Reducing Environmental Loads
Some industrial chemicals used in semiconductor manufacturing and utilities contain PRTR substances. To lessen these loads, Kawasaki Microelectronics is reducing consumption and switching to substitutes. The company has been especially positive in adopting substitutes, and succeeded in totally phasing-out four PRTR substances in 2002.

Efforts at JFE Urban Development

Preventing Global Warming
The “heat island effect” of abnormally high air temperatures in urban areas has become a problem in recent years. JFE Urban Development stresses environment-friendly urban development measures such as high water-permeability pavement, rooftop greening, etc.

Building a Recycling-oriented Society
Materials and equipment are selected with priority to environmental considerations, and recycled materials are effectively used by adopting paving materials which contain municipal waste molten slag, etc.

Reducing Environmental Loads
JFE Urban Development was quick to introduce measures for the “sick house syndrome,” and provides pleasant, durable housing using JIS / JAS premium-grade materials and products.
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Building a Recycling-oriented Society
Recycling of wastes includes material recycling by separated collection, use of waste oil as fuel, conversion to raw material for cement, etc. Kawasaki Microelectronics’s landfill disposal rate in 2002 was less than 2%.

Efforts at JFE Urban Development

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Contributing through Products and Technologies

JFE provides a large number of products, technologies, and services which contribute to the environment. In addition to its in-company environmental protection program, JFE is working to develop products and services which minimize environmental impacts in society as a whole while meeting diverse customer needs.

Contributing through Steel Products and Technologies

JFE has a long history of developing steel products to meet customer requirements for higher performance, including high strength, toughness, ductility, and corrosion resistance, elimination of toxic substances, and recycling. Applying the concept of Life Cycle Assessment (LCA), JFE is making important contributions to energy conservation and reduced environmental loads in society at every stage of product use.

Responding to Customers’ Green Procurement Programs

In addition to ecological products R&D, JFE has strengthened its marketing and created a marketing system for ecological products. It is also actively responding to the entire range of customer needs related to ecological 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.

JFE’s Approach to the Automotive Product Life Cycle

JFE has a long history of developing steel products to meet customer requirements for higher performance, including high strength, toughness, ductility, and corrosion resistance, elimination of toxic substances, and recycling. Applying the concept of Life Cycle Assessment (LCA), JFE is making important contributions to energy conservation and reduced environmental loads in society at every stage of product use. JFE has created a Green Procurement Network 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).

Life Cycle Assessment for Steel and Engineering Products

JFE has participated in studies of LCA in the International Iron and Steel Institute (IISI) since 1995 and in the MIT (now METI) LCA Project since 1996 as part of an effort to establish reliable methodologies and collect data. Data for 13 types of steel products have been compiled, and work to further expand product data and research on use of LCA data is continuing. In engineering, LCA is applied to environment-related plants as an engineering product, and independent databases have been constructed to support high-environmental performance plant design.

Terminology

- **Eco-products**: JFE defines ecological products as products which contribute to energy saving and/or environmental protection in society, including the full resources of the JFE Group. Examples include products and services which respond to social and customer needs for resource and energy conservation, recyclability, low waste, long life, and/or low environmental loads, with environment-friendly eco-design and eco-processes as a precondition.

- **Non-oriented electrical steel sheets**: Electrical sheets are steel sheets in which magnetic properties are improved by silicon addition, etc., and are used in transformers and motors. Non-oriented electrical sheets are a class of electrical steel with a highly random crystallographic axis orientation.
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Steel Ecological Products

Preventing Global Warming

High Strength Automotive Steel Sheets (HITEN)

High strength steel makes it possible to reduce part thickness without sacrificing strength. JFE’s full line of high strength automotive steel sheets (HITEN) contributes to improved fuel efficiency through body weight reduction while also improving collision safety. Galvannealed HITEN for inner and outer body panels includes virtually all grades and features excellent press formability, coating adhesion, spot weldability, and fatigue strength.

Tailor Welded Blank

Example of application of HITEN (Short panel test products with 1200t press at JFE)

TMCP High Strength Steel

The trend toward larger structures in construction and shipbuilding requires high-strength, high-toughness steel plates and high-efficiency welding and other processes. TMCP (Thermo-Mechanical Control Process) high strength steel plates satisfy both of these performance requirements. JFE possesses the world’s most advanced

Terminology

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Non-oriented electrical steel sheets

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Steel-framed House

JFE produces grain-oriented electrically steel sheets with the world’s highest magnetic properties, and exports more than half of these products to foreign markets. Because core loss in high efficiency grain-oriented electrical steel sheets has improved by 20-30% in the last 30 years, substantial long-term energy savings can be expected in iron cores.

Alloy Steel Powder for Sinter-hardening

The trend toward higher strength levels in sintered mechanical parts, particularly for automotive applications, requires heat treatment after sintering. However, energy saving in heat treatment processes is also needed. JFE therefore developed an alloy steel powder which uses after sintering as a heat treatment process (sinter-hardening). Eliminating conventional heat treatment results in substantial energy savings in part manufacture.

Solar Grade Silicon (High-purity Silicon for Solar Cells)

The trend toward higher strength levels in sintered mechanical parts, particularly for automotive applications, requires heat treatment after sintering. However, energy saving in heat treatment processes is also needed. JFE therefore developed an alloy steel powder which uses after sintering as a heat treatment process (sinter-hardening). Eliminating conventional heat treatment results in substantial energy savings in part manufacture.

Building a Recycling-oriented Society

Heat-treated Rails

Using a unique heat-treatment process, JFE has dramatically improved the hardness and wear resistance of railway rails, which show improvement of approximately 60% in wear tests. The extended rail life resulting from improved wear resistance reduces energy consumption and waste accompanying rail maintenance and replacement. These heat-treated rails have been commercialized for Japanese railways and heavy axle-load railways in North America and elsewhere.

Steel-framed House

JFE’s steel-framed house offers excellent earthquake resistance, safety, and durability. With its extremely long life, this environment-friendly housing product contributes to forest preservation and protection of the global environment.

Blunt Furnace Cement (Granulated BF slag)

JFE produces high quality blast furnace slag powder from water-granulated BF slag, which is a byproduct of ironmaking. Used as an admixture in cement, it displays outstanding properties including strengthening, reduced heat of hydration, and improved chemical resistance. Environmental advantages include energy and resource saving, effective use of resources, and reduction of greenhouse gases.

Weathering Steels

Oka-Aso Bridge constructed using weathering steel Weathering steels, which use rust to prevent rust to possess good corrosion resistance without painting because the steel is designed to form a protective rust film. Widely used in civil engineering and construction, and particularly in bridges, weathering steels extend the life of steel structures to 50-100 years without painting. JFE has also developed Ni-added high performance weathering steels for use in environments with high airborne salt concentrations, which was impossible with conventional weathering steels, expanding the range of applications and contributing to global environmental preservation.

Rust Stabilizer for Weathering Steels

Rust stabilizers preserve the good appearance of structures by preventing rust streaks on weathering steel. For environmental protection, JFE developed a new rust stabilizer which is 100% free of chrome, lead, and other heavy metals and meets a variety of requirements for formation of a dense protective rust layer, helping expand the application of environment-friendly weathering steels.

Reducing Environmental Loads

Chromate-free Coated Steel Sheet

The EU has set a deadline of July 2006 for replacing hexavalent chrome, lead, mercury, and cadmium with substitutes. Because exported appliances must meet this requirement and similar regulations are expected in Japan in the near future, JFE developed a coated steel sheet which contains no chrome (VI) but still offers excellent corrosion resistance, surface conductivity, paintability, anti-fingerprint property, and lubricity. 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.

Stainless Steel Sheets and Tubes for Automotive Exhaust Systems

In the form of sheets and tubes, JFE manufactures much of the ferritic stainless steel which is now used in automotive exhaust system components such as exhaust manifolds, converter cases, and mufflers. In particular, JFE manufactures a unique high oxidation resistance stainless steel, which the company itself developed, as a metal honeycomb catalyst material for the catalytic converter used to remove CO and NOx from exhaust gas, and has won high marks from users for many such devices.

Martensitic Stainless Steel Tubes

Natural gas is enjoying rising demand as a countermeasure for global warming, but development of this resource requires steel tubes with high corrosion resistance in high temperature environments. Martensitic stainless steel (CrTiG) (oil country tubular goods) and Inconel can be used in these environments without inhibitors (corrosion prevention agents), contributing to environmental protection.
Steel-framed House

JFE produces steel-framed houses with the world’s highest magnetic properties, and exports more than half of these products to foreign markets. Because core loss in high efficiency steel sheets has improved by 20-30% in the last 30 years, substantial long-term energy savings can be expected in iron cores.

Alloy Steel Powder for Sinter-hardening

The trend toward higher strength levels in sintered mechanical parts, particularly for automotive applications, requires heat treatment after sintering. However, energy saving in heat treatment processes is also needed. JFE therefore developed an alloy steel powder which uses after sintering as a heat treatment process (sinter-hardening). Eliminating conventional heat treatment results in substantial energy savings in part manufacture.

Solar Grade Silicon (High-purity Silicon for Solar Cells)

To meet the rapidly-growing demand for solar cells, JFE developed the world’s first mass-production technology for manufacturing solar cell substrates from molten metallic silicon by a metallurgical refining process. The product silicon is more than 99.99999% pure and achieves 14.16% conversion efficiency in solar cells. Commercial production of silicon blocks for substrates began in April 2001 on a 200 t/yr scale and was expanded to 400 t/yr in October 2002.

Weathering Steels

Dkou-Aso Bridge constructed using weathering steel

Weathering steels, which use rust to prevent rust to possess good corrosion resistance without painting because the steel is designed to form a protective rust film. Widely used in civil engineering and construction, and particularly in bridges, weathering steels extend the life of steel structures to 50-100 years without painting. JFE has also developed Ni-added high-performance weather steels for use in environments with high airborne salt concentrations, which was impossible with conventional weathering steels, expanding the range of applications and contributing to global environmental preservation.

Reducing Environmental Loads

Chromate-free Coated Steel Sheet

The EU has set a deadline of July 2006 for replacing hexavalent chrome, lead, mercury, and cadmium with substitutes. Because exported appliances must meet this requirement and similar regulations are expected in Japan in the near future, JFE developed a coated steel sheet which contains no chrome (VI) but still offers excellent corrosion resistance, surface conductivity, paintability, anti-fingerprint property, and lubricity. 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.

Martensitic Stainless Steel Tubes

Martensitic stainless steel OCTGs (oil country tubular goods) and linepipes can be used in these environments without inhibitors (corrosion prevention agents), contributing to environmental protection.

Stainless Steel Sheets and Tubes for Automotive Exhaust Systems

In the form of sheets and tubes, JFE manufactures much of the ferritic stainless steel which is now used in automotive exhaust system components such as exhaust manifolds, converter cases, and mufflers. In particular, JFE manufactures a unique high oxidation resistance stainless steel, which the company itself developed, as a metal honeycomb carrier material for the catalytic converter used to remove CO and NOx from exhaust gas, and has won high marks from users for many such devices.

Lead-free Sheets for Fuel Tanks

Recognizing the need to reduce lead use, JFE developed a 100% lead-free steel sheet as a replacement for the lead-in coated steel sheet long used in auto fuel tanks. Features of the Pb-free sheet include a special two-side organic film coating which gives excellent press formability, weldability, corrosion resistance, and resistance to gasoline-induced degradation.

Heat-treated Rails

Using a unique heat-treatment process, JFE has dramatically improved the hardness and wear resistance of railway rails, which show improvement of approximately 60% in wear tests. The extended rail life resulting from improved wear resistance reduces energy consumption and waste accompanying rail maintenance and replacement. These heat-treated rails have been commercialized for Japanese railways and heavy axle-load railways in North America and elsewhere.

Clad Steel Plates

Clad steel plates consist of a surface clad layer of stainless steel or titanium, which provides improved corrosion resistance, over a high-strength carbon steel plate. Clad steel contributes to saving energy consumption through saving rare earth metals.

Grain-oriented Electrical Steel Sheets for High Efficiency Transformers

JFE produces grain-oriented electrical steel sheets with the world’s highest magnetic properties, and exports more than half of these products to foreign markets. Because core loss in high efficiency steel sheets has improved by 20-30% in the last 30 years, substantial long-term energy savings can be expected in iron cores.

Heat-treated rails

Blast Furnace Cement (Granulated BF Slag)

JFE produces high quality blast furnace slag powder from water-granulated BF slag, which is a byproduct of ironmaking. Used as an admixture in cement, it displays outstanding properties including strengthening, reduced heat of hydration, and improved chemical resistance. Environmental advantages include energy and resource saving, effective use of resources, and reduction of greenhouse gases.

Martensitic Stainless Steel Tubes

Natural gas is enjoying rising demand as a countermeasure for global warming, but development of this resource requires steel tubes with high corrosion resistance in high temperature environments. Martensitic stainless steel OCTGs (oil country tubular goods) and linepipes can be used in these environments without inhibitors (corrosion prevention agents), contributing to environmental protection.

Building a Recycling-oriented Society

Heat-treated rails

Martensitic Stainless Steel Tubes

JFE Environmental Report 2003
Water-permeable Steel Sheet Pile

Water-permeable steel sheet piles are a novel type of sheet pile with precut water-passage holes. In revetments and embankments, they maintain water circulation between the land and water sides approaching that in nature, preserving, creating, and restoring the complex ecological systems around such structures. Placing mattress works on the front side and gabion works or stones on the back produces a synergistic ecological preservation effect. This type of composite construction can already be seen in projects for creation of rivers richly-endowed with nature at the Niagra River, where it has proven its effectiveness in preserving the ecosystem.

Lead-free Free-cutting Steel for Machine Structural Use

JFE developed a lead-free free-cutting steel offering a combination of good machinability and cold forging properties, which had been consid- ered impossible without Pb addition. In spite of its high carbon composi- tion, this steel has an excellent cold forging property, and at the same time, has better machinability than Pb-added free-cutting steel because a graphite, which has a lubricant effect, is used in place of lead. It has a good balance of fatigue strength after quenching and temper- ing, giving it a particularly out- standing combination of properties as an automotive steel material for processing by cold forging – machining – heat treatment.

Circulation of Steel in Japan

Each year, Japan produces approxi- mately 100 million tons of steel, which is used in construction, machinery, and auto industry, and other fields. When products reach the end of their useful life, virtually all of this steel is recycled to the steel industry, including materials with long lives of 100 years or more. Recovered steel is used in various forms, demonstrating that steel is well- suited as a basic material for a recy- cling-oriented society. This total accumu- lation of steel in Japan is now more than 1.2 billion tons and is a resource which can be passed on to future generations.

District Heating and Cooling (DHC) by Sewage Heat

CHS is a new thermal transportation and storage medium first developed by JFE as a substitute for cold water. In comparison with conventional cold-water air conditioning, trial calculations show that a year-round energy saving of approximately 50% is pos- sible with CHS, offering great prom- ise as an energy saving / CO2 reduc- tion technology for general use. CHS is a two-phase fluid comprised of fine particles of clathrate hydrate and its aqueous solution and holds latent heat in the same temperature range (5–12°C) as water for air conditioning, but its thermal density is more than double that of cold water. As a result, the pumping flow rate can be reduced by at least half, reducing pumping power consumption by up to 80% and thermal storage tank size by 50% or more.

Energy Saving Air Conditioning System Using Clathrate Hydrate Slurry (CHS)

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Wind Power Generation

Wind power generation has drawn considerable attention as form of clean energy and has been intro- duced rapidly in recent years. JFE manufactures 750kW units fea- turing a variable rotor speed, direct drive transmission, synchronous gen- erator in Japan and supplies total en- gineering for wind power plants from site selection through design, manu- facture, construction, and mainte- nance. JFE is Japan’s leader in the field, with a record of orders received for 121 units, mainly of the 750kW class, and a total installed capacity of 84,000kW (end of March 2003). As a clean power producer, JFE is par- ticipating in wind power projects in Hokkaido and Miy Prefecture to en- courage wider use, and has also in- troduced a large-scale 2,000kW wind power generator from Gamesa (Spain), giving it a strong presence in the large-generator sector.

Preventing Global Warming

Gas Engine Cogeneration

Since JFE delivered its first gas engine cogeneration system in 1981, it has supplied systems with out- standing reliability and durability using the WAKUESHA gas engine, which has earned an extremely high reputation with users around the world. Because this is a high efficiency system which greatly reduces CO2 emissions, and furthermore, burns clean gas made from natural gas, it generates no dust or SOx, while NOx is minimized using various reduction technologies.

Environment-friendly Regenerative Burner

The environment-friendly regenera- tive burner heating system is an innova- tive “world’s first” technology which realizes large energy savings in re- heating furnaces (30% or more) and at the same time, large reductions in flue-gas NOx concentration (60% or more). As a combustion system which makes a significant contribu- tion to both environmental protection and global warming prevention, it is winning wide acceptance among users in Japan and other countries.

Wind power plant
**Water-permeable Steel Sheet Pile**

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**Fire Resistant Steel Products for Building Structures**

Because conventional foundation piles are placed during or after ground excavation, a large volume of surplus soil is deposited on the surface. JFE’s Tsuuba Pile is a steel pipe pile with a screw-like wing plates at the bottom end and is placed by turning the pile. Dis- placed soil is compressed by the wing plates and accumulates around the pile, solving the problem of surplus soil, which is among the greatest problems in pile-driving work. As an additional advantage, the pile-turning machine does not cause the noise and vibration, re- sulting in a quieter environment dur- ing construction work.

**Demonstration**

CHS

In comparison with conventional cold-water air conditioning, trial calculations show that a year-round energy saving of approximately 50% is pos- sible with CHS, offering great prom- ise as an energy saving / CO₂ reduc- tion technology. CHS is a two-phase fluid comprised of fine particles of clathrate hydrate and its aqueous solution and holds latent heat in the same temperature range (5–12°C) as water for air conditioning, but its thermal density is more than double that of cold water. As a result, the pumping flow rate can be reduced by at least half, reducing pumping power consumption by up to 80% and thermal storage tank size by 50% or more.

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**Contributing through Engineering Products and Technologies**

JFE is contributing to a low environmental load and recycling-oriented society by developing engineering businesses in clean/recycled energy, water purification, soil preservation, and waste treatment and recycling.
Reducing Environmental Loads

In waste incinerator demolition, pre-
venting environmental impacts in neigh-
borhood areas and securing the safety of personnel have become
important corporate missions. JFE is par-
icularly well-prepared for this role,
having constructed more than 100 incineration plants, as well as ex-
panding and renovating many others.
In the process, JFE has also performed demolition project man-
gement with safety as its first priority.
For new demolition projects, it has developed a comprehensive environ-
mental technology capability for total reduc-
tion in environmental loads, which includes advanced measure-
ment and evaluation of dioxins, re-
moval of pollutants and sealing of work areas, high-temperature detox-
ification of dust and waste (On-site Dio-Buster, Hi-Clean DX), and safe
disposal of waste. As one notable ac-
complishment, Kawasaki Machinery, a JFE Group company, established a
completely flawless demolition technology and was the first company in
Japan to carry out a dioxin-free	incinerator demolition project.

Oxides are removed to the exhaust
gas by heating the fly ash under an air flow to volatilize and separate dioxins, detoxifying the ash. At the same time, other organic compounds which cause re-reactivation of dioxins are also volatilized and separated from the fly ash, eliminating the need for a rapid cooling process, which had been essential with conventional technologies, and saving plant space. Oxides and organic com-
pounds in the exhaust gas stream are decomposed and detoxified by a high-performance oxidizing catalyst.
This technology has won high praise around the world and received the Japan Industrial Machinery Associa-
tion’s Chairman’s Prize, “29th Excel-
lent Environmental Equipment Award.” A new plant for a regional	waste treatment association was completed in March 2003 and is now operating smoothly at 345kg-
fly ash/hr.

Demolition of Waste Incineration Plants

JFE is contributing to attainment of a	better water environment through comprehensive	engineering which ranges from water purification to waste water treatment, live-
stock waste treatment facilities and methane fermentation plants for
food residue. JFE is also active in
efforts to curb polluted water pre-
vent pollution in rivers, lakes, other
closed water area and sea by sup-
plying equipment for physical, chemical and biological treatment processes. JFE’s water purification and sewage
treatment equipment includes advanced biotechnology purification processes using microorganisms, an automatic dry powdered activated carbon injection system and ad-
vanced membrane filtration technolo-
gies which effectively remove toxic substances from raw water at
waterworks. Treatment of sewage sludge includes methane fermenta-
tion, phosphorus recovery, and pro-
cessing of molten slag as a construc-
tion material. These technologies demonstrate JFE’s philosophy of total recycling.

Detoxification Technology for Dioxins in Waste Incineration Fly Ash

As a promising new method of ef-
efectively using waste, JFE has created a system for reducing loads on the environment, including study of developed products in Life Cycle Assessments (LCA), and is re-
sponding to advanced requirements for environmental protection with mini-
mal secondary pollution in processes from incineration through melting.
Features of the CFB boiler include wide compatibility with various fuels and high combustion efficiency, ena-
blering substantial reductions in NOx, SOx, and other environmental polli-
tants. In addition to anthracite, semi-
anthracite, bituminous coal, lignite, and low-grade coal, this system can also accommodate oil coke, bio-
mass, wood chips, plastic waste, etc., meeting the diverse needs of a recycling-oriented society.

Waste Recycling Systems

As part of its response to the growing
number of recycling laws enacted in
recent years, JFE is actively involved in	waste sorting technology and en-
gineering such as automatic high-
speed sorting systems for recycling
plazas, which sort steel and alumi-
num cans, bottles, and plastic bottles by color and material. Other contri-
butions include waste biomass pow-
er generating systems and high-
speed composting systems.

Low-temperature liquefied gases, begin-
ing with LNG, LPG, and ethy-
lene, are widely used as fuels for elec-
tric power generation and general use and as feedstock for various
industrial materials. In particular, LNG is expected to enjoy strong
growth as the fuel with the least environmental impact. JFE is actively involved in a wide range of cryogenic technologies, and considers LNG
storage (above-ground and under-
ground tanks) and other LNG facili-
ties as a core business in the energy
engineering division and is continu-
ing to accumulate new technologies and enhance its business capabili-
ties.

LNG Storage

Building a Recycling-oriented Society

As part of its response to the growing
trends in recycling, JFE has developed and introduced numerous next-genera-
tion technologies for waste treatment plants, fea-
turing advanced combustion tech-
nologies such as the stoker-type	waste incinerator with fuzzy com-
turbation control and the fluidized	bed-type incinerator, as well as the	high temperature gasifying & direct	melting furnace and JFE THERMO-
SELECT gasifying & melting furna-
ces. JFE’s electric resistance-type	and plasma-type ash melting furna-
ces recycle incinerator ash as	clean, metal-free slag which can be used in roadbed material, life, and acoustic panels. JFE has also	developed an RDF (Refuse Derived Fuel) system technology, which is used to select combustibles from refuse for recycling as solid fuel (RDF).

Waste Treatment

To final sedimentation tank
Mixed liquor return
Return sludge
Demolition of Waste
Incineration Plants

Driftwood Recycling

Waste Recycling Systems

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Power Generation using Circulating Fluidized Bed (CFB) Boiler

In 1990, JFE signed a license agree-
ment with the German company Steinhmüller and began manufacture and sales of circulating fluidized bed (CFB) boilers as an environment friendly, energy-saving power gener-
ation system. The most significant features of the CFB boiler include wide compatibility with various fuels and high combustion efficiency, ena-
blering substantial reductions in NOx, SOx, and other environmental pollu-
tants. In addition to anthracite, semi-
anthracite, bituminous coal, lignite, and low-grade coal, this system can also accommodate oil coke, bio-
mass, wood chips, plastic waste, etc., meeting the diverse needs of a recycling-oriented society.

Driftwood Recycling

Up to now, driftwood which flowed into dam reservoirs as a result of floods and avalanches was simply in-
cinerated, but this practice is undesir-
able for environmental preservation because it generates CO2, a factor in
global warming, as well as dioxins.
Considering this driftwood a valuable wood resource, JFE developed effec-
tive use techniques such as conver-
tion to charcoal or use as fiber for live-
stock or mulch to prevent weeds in flowerbeds, or to charcoal for water purification, contri-
buting to recycling and environmental protection.

Detoxification Technology for Dioxins in Waste Incineration Fly Ash

As a current problem in dioxin
countermeasures for waste incinera-
tors, it is necessary to achieve a	broad reduction in dioxin releases from the facility as a whole. Because	fly ash accounts for more than 60% of
dioxin releases, JFE recognized that the need for a high-efficiency dioxin removal technology for fly ash and developed a fly ash detoxification
techology called Hi-Clean DX.

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Driftwood Recycling plant
Structure of Hi-Clean DX

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Reducing Environmental Loads

**Demolition of Waste Incineration Plants**
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**Protecting the Water Environment**
JFE is contributing to attainment of a better water environment through comprehensive engineering which ranges from water purification to waste water treatment, such as, water pipeline construction, operation, management, waste purification, sewage treatment, river and little soil and landfill waste water treatment, livestock waste treatment facilities and methane fermentation plants for food residue. JFE is also active in efforts to purify polluted water and prevent pollution in rivers, lakes, other closed water area and sea by supplying equipment for physical, chemical and biological treatment processes. JFE recognized that the need for a high-efficiency dioxin removal technology for fly ash and developed a fly ash dioxin detoxification technology, called Hi-Clean DX.

**Protecting the Soil Environment**
With the enactment of new environmental legislation and rising public awareness of environmental issues, pollution of soil and groundwater has become urgent problems in some localities. Making full use of the experience and know-how gained in its wide-ranging engineering business, JFE provides total solutions for soil protection, from survey and evaluation to proposal and implementation of purification measures and monitoring.

**LNG Storage**
Low-temperature liquefied gases, beginning with LNG, LPG, and ethylene, are widely used as fuels for electric power generation and general use and as feedstock for various industrial materials. In particular, LNG is expected to enjoy strong growth as the fuel with the least environmental impact. JFE is actively involved in a wide range of cryogenic technologies, and considers LNG storage (above-ground and underground tanks) and other LNG facilities as a core business in the energy engineering division and is continuing to accumulate new technologies and enhance its business capabilities.

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As part of its response to the growing number of recycling laws enacted in recent years, JFE is actively involved in waste sorting technology and engineer such as automatic high-speed sorting systems for recycling plazas, which sort steel and aluminum cans, bottles, and plastic bottles by color and material. Other contributions include waste biomass power generating systems and high-speed composting systems.

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**Dam Sediment Removal**

A variety of problems arise when the sediment transport in rivers is blocked by a dam reservoir, including reduced dam reservoir capacity, loss of downstream riverbeds, and coastline erosion. As a simple and effective solution, JFE developed a comprehensive sediment transport management technology based on the concept that the entire sediment transport region from the headwaters of a river basin to the coastline forms a “sediment transport system.” JFE proposes a hydro-pipe sediment removal technology which dredges sediment from the dam reservoir and releases it into the downstream region. By combining a sediment dredging pipe (hydro-pipe), which uses the hydraulic pressure to suck sediment from the reservoir, and sediment flush gate, this system enables efficient discharge of sediment over a wide area without large reductions in the dam water level.occasion.

**Seawater Exchange-Type Dam Sediment Removal**

Breakwaters interrupt seawater circulation and form a closed marine area in ports and harbors. In such areas, water quality may deteriorate. For seawater exchange to improve water quality, outside fresh seawater is let into ports and harbors so far. JFE’s seawater exchange-type hybrid caissons have the system to control the flow of water in the fixed direction by a wave sluice plate. This system produces not only efficient seawater exchange but calm water condition. As an economical breakwater system, wide adoption of this structure is expected. Occasion.

**Dam and River Water Quality Preservation**

To prevent algal bloom due to eutrophication in rivers, dam reservoirs, and other enclosed water bodies, JFE developed the destratification system. This device, called “Mousumashi,” improves shallow-level and total-level water quality by using a propeller stirring method to generate a circulating flow by lifting bottom water with the propeller and releasing it in a dispersed flow at the surface. Because power consumption is low, the system can be powered by a solar battery. Occasion.

**Conducting through Microelectronic Products and Technologies (Reducing Environmental Loads)**

As a member of the JFE Group, Kawasaki Microelectronics, Inc. (KMI) contributes to progress in IT technology with low-environmental load Pb-free semiconductors.

**Development of Pb-free Semiconductor Devices**

To respond to customer requirements for high quality and quick delivery of highly-integrated high-performance system LSIs with low power consumption while positively addressing the needs of customers’ green procurement programs, KMI has strengthened control of designated chemical substances contained in semiconductors. For example, conventional semiconductor devices use solder, which contains lead, in bore and overload external connections, but KMI has replaced this with Pb-free materials. During FY2003, KMI also plans to complete a phase-out of halogens by replacing the small amount of bromine compound flame retardants added to mold resins with a substitute. Occasion.

**Innovative Approaches to the Environment**

**Key Technical Development Subjects**

- Preventing global warming
  - High purity silicon for solar cells
  - Environment-friendly regenerative burner
  - Dihydrate hydrate slurry (CHS) air conditioning system (high-density cooling medium)

- Reducing Environmental Loads
  - Fly ash disposal treatment (Hi-Clean DX)
  - Environment-friendly high-efficiency arc furnace (ECONARC)
  - Advanced sewage treatment system using microorganism carriers (Bio-Tube, Pegasus)

- Building a Recycling-oriented Society
  - High-temperature waste gasifying & direct melting
  - JFE THERMOSELECT gasifying & melting
  - Electric resistance municipal waste incinerator ash melting
  - Plasma ash melting
  - Next-generation stoker furnace
  - JFE hybrid activated carbon with high thermal conductivity
  - Waste plastic recycling system for BF feed
  - Waste-to-resource recycling system
  - RDF (Refuse Derived Fuel) carbonizing system

- JFE places special importance on advanced global warming technologies and certain key technologies which envision JFE’s core businesses in the long-term future. In many cases, these overlap, including DME and high-efficiency fuel cells (SOFC) in the field of clean energy and the low-CO₂ emission in ironmaking (*4)

- Note: For iron and steel materials, see Ecological Products, pp. 30–33.

**To date, JFE has developed a wide variety of products which reduce environmental loads. Following the creation of the three-laboratory system in April 2003, the JFE Group is now focusing its energies on the development of world’s Only 1 products and No. 1 products which strengthen its ties with customers, process technologies, and leading technologies.**

*See pp. 39-40.*
Research and Development

With its three-laboratory R&D system, which includes the laboratories at JFE Steel, JFE Engineering and JFE R&D Corporation, JFE is developing the world’s most advanced technologies for global environmental preservation in response to social trends and needs.

Innovative Approaches to the Environment

Key Technical Development Subjects

- **Development Completed (Already Commercialized)**
  - Preventing Global Warming
    - High-purity silicon for solar cells
    - Environment-friendly regenerative burner
    - Catharate hydrate slurry (CHS) air conditioning system (high-density cooling medium)
  - Reducing Environmental Loads
    - Fly ash disposal treatment (Hi-Clean DX)
    - Environment-friendly high-efficiency arc furnace (ECONARC)
    - Advanced sewage treatment system using microorganism carriers (Bio-Tube, Pegasus)
    - Lake & river purification equipment (River-Float)
    - Accelerated outwashing treatment system (ATP more)
    - Simulation of biological reactions
    - Soil contamination 0-D imaging system
    - Slag recycling technologies (hard island-irrigating pavement, Ferro-Foam)
    - Low-dioxin combustion control system
    - Waste incinerator operation training simulator
    - Blast furnace analyzer
    - New dioxin analysis method
    - Automatic monitoring system for heavy metals

- **Under Development**
  - Developing Clean Energy
    - Mass production technology for new clean energy source – DME (*1)
    - High efficiency fuel cell-SSFC (*2)
    - Natural gas hydrate (*3)
    - High-efficiency hydrogen production technology using sensible heat of ironmaking processes
    - Economical hydrogen production technology
  - Preventing Global Warming
    - Innovative process for reducing CO2 emission in ironmaking (*4)
    - High strength steel sheets (NANOHITEN) (*5)
    - Natural gas hydrate (*3)
    - Refrigeration system powered by low grade waste heat
    - Slip recycling technology (Marine Block)
    - Innovative ironmaking technology using Float Smelter

- **Building a Recycling-oriented Society**
  - Economical activated coke production technology (*6)
  - 100% recycling technology for waste stainless steel pickling acid (Cost-saving treatment system)
  - RDF (Refuse Derived Fuel) carbonizing system

Note: For iron and steel materials, see Ecological Products, pp. 30–33.

Contributing through Microelectronic Products and Technologies (Reducing Environmental Loads)

As a member of the JFE Group, Kawasaki Microelectronics, Inc. (KMI) contributes to progress in IT technology with low-environmental load Pb-free semiconductors.

**Development of Pb-free Semiconductor Devices**

To respond to customer requirements for high quality and quick delivery of highly-integrated high-performance system LSIs with low power consumption while positively addressing the needs of customers’ green procurement programs, KMI has strengthened control of designated chemical substances contained in semiconductors. For example, conventional semiconductor devices use solder, which contains lead, in bare and outline external connections, but KMI has replaced this with Pb-free materials. During FY2003, KMI also plans to complete a phase-out of halogens by replacing the small amount of bromine compound flame retardants added to mold resins with a substitute.

**Dam Sediment Removal**

A variety of problems arise when the sediment transport in rivers is blocked by a dam reservoir, including reduced dam reservoir capacity, loss of downstream rivulets, and coastline erosion. As a simple and effective solution, JFE developed a comprehensive sediment transport management technology based on the concept that the entire sediment transport region from the headwaters of a river basin to the coastline forms a “sediment transport system.” JFE proposes a hydro-pipe sediment removal technology which dredges sediment from the dam reservoir and releases it into the downstream region. By combining a sediment dredging pipe (hydro-pipe), which uses the hydrostatic pressure to suck sediment from the reservoir, and sediment flush gate, this system enables efficient discharge of sediment over a wide area without large reductions in the dam water level.

**Seawater Exchange-Type Dam Sediment Removal**

Breakwaters interrupt seawater circulation and form a closed marine area in ports and harbors. In such area, water quality may deteriorate. For seawater exchange to improve water quality, outside fresh seawater is let into ports and harbors so far. JFE’s seawater exchange-type hybrid caissons have the system to control the flow of water in the fixed direction by a wave sluice plate. This system produces not only efficient seawater exchange but calm water condition. As an economical breakwater system, wide adoption of this structure is expected.

**Dam and River Water Quality Preservation**

To prevent algal bloom due to eutrophication in rivers, dam reservoirs, and other enclosed water bodies, JFE developed the destratification system. This device, called “Mousumushi,” improves shallow-level and total-level water quality by using a propeller stirring method to generate a circulating flow by lifting bottom water with the propeller and releasing it in a dispersed flow at the surface. Because power consumption is low, the system can be powered by a solar battery.

JFE places special importance on advanced global warming technologies and certain key technologies which envision JFE’s core businesses in the long-term future. In many cases, these overlap, including DME and high-efficiency fuel cells (SSFC) in the field of clean energy and the low-CO2 mitigation process and NAGHTEN high strength steel sheets as global warming countermeasures.

To date, JFE has developed a wide variety of products which reduce environmental loads. Following the creation of the three-laboratory system in April 2003, the JFE Group is now focusing its energies on the development of world’s Only 1 products and No. 1 products which strengthen its ties with customers, process technologies, and leading technologies.
Creating New Energy Sources for the 21st Century

Clean Energy for the 21st Century – DME(1)

Because DME (dimethyl ether) produces absolutely no SOx or dust when burned, it is truly “clean energy for the 21st century.” Wide use is expected as a fuel for power generation and smoke-free diesel engines and as an LPG substitute. Using the world’s first large-scale bench plant (5 tons/day), JFE succeeded in direct synthesis of DME from coal mine gas and has begun work on a 100 tons/day pilot plant project. The first DME-fueled test vehicle in Japan was approved in February 2002 and is now in road tests to utilize this clean energy resource. DME buses are also used in JFE’s steelworks, and a large-scale DME power generating system is under development as part of active efforts to create new applications.

High Strength Steel Sheet – NANOHITEN(5)

Due to its ultra high strength, JANOHITEN is dramatically being adopted by automakers, contributing to the development of small-and medium-sized gas fields. JFE has developed an extremely high-efficiency production technology for natural gas hydrate. Basic experiments using propane as a simulation gas have reached production rates 60 times faster than the conventional process. Equipment was constructed for bench-scale experiments using methane, which is the main component in natural gas, and the experiments are now in progress.

High-Strength Steel Sheet – NANOHITEN(5)

NANOHITEN is dramatically improved by controlling the microstructure at the nano level (10-9 meter), breaking the conventional micro (10-6 meter) barrier. NANOHITEN is being adopted by automakers, contributing to global warming prevention.

Economical Activated Coke Production Technology(4)

JFE is developing a economical production system for activated coke as an adsorbent for flue gas treatment and water purification. The system can use a variety of organic wastes as raw materials, including waste wood, and waste plastic. Organic wastes are first subjected to preliminary carbonization (precarbonization). The porous material obtained in this step is formed into briquettes by wet forming and then carbonized again to produce the activated coke product. 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.

Low-sludge Biological Water Treatment Technology(7)

JFE has developed an economical, easily maintained and operated, low-sludge water treatment process for small- and medium-scale sewage treatment plants. The system greatly reduces sludge generation by effectively combining aeration treatment and biological treatment and can be adapted to conventional water treatment facilities with excellent results, avoiding excessive capital investment.

Reducing Environment Loads

Innovative Process for Reducing CO2 Emission in Ironmaking(14)

More than half of all CO2 emissions in steel manufacturing are discharged from the ironmaking process, and the countermeasures are indispensable. As one solution, JFE is developing a process for pre-reduced agglomerates production in which iron ores are reduced simultaneously with agglomeration by adding a reducing agent to the iron ore and other raw materials. With this new pretreatment process and control of the atmosphere in the sintering machine, reduction efficiency and load of reduction on the blast furnace are improved. A 13% reduction in total CO2 emissions from the ironmaking process is expected.

Building a Recycling-oriented Society

Reduced Environment Loads

In cooperation with Siemens Westinghouse Power Corporation (SWPC) in the U.S., JFE is commercializing and developing markets for solid oxide fuel cell (SOFC) systems which enable high-efficiency power generation at the 50% level at 250kW and more than 60% at multi-MW outputs. This technology is especially attractive as a distributed power system technology which contributes to the global environment. JFE is also actively involved in developing and popularizing small-scale fuel cell power generation, and entered into a tie-up with Fuel Cell Technologies Ltd. (Canada) in December 2001 to commercialize systems with outputs of 50kW and under for households and small businesses. Because internal reforming is possible with SOFC, a variety of fuels can be used. To take advantage of this feature, research on combination technologies involving DME and biomass is underway.

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Nanohiten is dramatically improved by controlling the microstructure at the nano level (10^-9 meter), breaking the conventional micron (10^-6 meter) barrier. Nanohiten is being adopted by automakers, contributing to global warming prevention.

The first DME-fueled test vehicle in Japan was approved in February 2002 and is now in road tests to popularize this technology. JFE is also developing a large-scale DME power generating system as part of active efforts to create new applications.

In cooperation with Siemens Westinghouse Power Corporation (SWPC) in the U.S., JFE is commercializing and developing markets for solid oxide fuel cell (SOFC) systems which enable high-efficiency power generation at the 50% level at 250kW and more than 60% at multi-MW outputs. This technology is especially attractive as a distributed power system technology which contributes to the global environment. JFE is also actively involved in developing and popularizing small-scale fuel cell power generation, and entered into a tie-up with Fuel Cell Technologies Ltd. (Canada) in December 2001 to commercialize systems with outputs of 50kW and under for households and small businesses. Because internal reforming is possible with SOFC, a variety of fuels can be used. To take advantage of this feature, research on combination technologies involving DME and biogas is underway.

Building a Recycling-oriented Society

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Reducing Environment Loads

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JFE has developed an economical, easily maintained and operated, low-sludge water treatment process for small- and medium-scale sewage treatment plants. The system greatly reduces sludge generation by effectively combining algal treatment and biological treatment and can be added to conventional water treatment facilities with excellent results, avoiding excessive capital investment.

High Strength Steel Sheet – Nanohiten

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. JFE is the first steelmaker in the world to apply nanotechnology to the development of a high strength sheet, called “Nanohiten,” which makes it possible to reduce sheet thickness without sacrificing essential functions. The properties of Nanohiten are dramatically improved by controlling the microstructure at the nano level (10^-9 meter), breaking the conventional micron (10^-6 meter) barrier. Nanohiten is being adopted by automakers, contributing to global warming prevention.

Creating New Energy Sources for the 21st Century

Clean Energy for the 21st Century – DME

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High-efficiency Fuel Cell Power Generation – SOFC

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Natural Gas Hydrate

Natural gas hydrate is a promising new energy source. It is composed of gas molecules bound together with water molecules and has a much higher energy density than natural gas or coal. The hydrate is stable at cryogenic temperature (–162°C), and in contrast, natural gas hydrate can be transported and stored in short-term form at temperatures of –10 to –20°C, much closer to room temperature. This greatly simplifies equipment and lowers the cost of transportation and storage. This also contributes to the development of small-and medium-sized gas fields. JFE has developed an extremely high-efficiency production technology for natural gas hydrate. Basic experiments using propane as a simulation have reached production rates 60 times faster than the conventional process. Equipment was constructed for bench-scale experiments using methane, which is the main component in natural gas, and the experiments are now in progress.

Innovative Process for Reducing CO2 Emission in Ironmaking

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Providing Total Solutions for a Better Environment

JFE is leading the effort to build environment-friendly cities and towns in cooperation with the government, and universities. Through its networks with society at all levels, JFE provides total solutions for a better environment.

Keihin Coastal Area Environmental City Concept (Kawasaki Eco-Town)

Since designation as an Eco-Town in 1997, Kawasaki has created a Zero Emissions Industrial Park and a variety of recycling businesses. JFE has recycling facilities for plastics, appliances, and other materials which are recycled in steel production. Because the Keihin Coastal Area includes basic materials, petrochemicals, energy, and other industries, it is creating a recycling system for heterogeneous industries. Cooperating with local government and other industries in its environmental solution activities, JFE is playing a leading role in revitalizing Kawasaki as an environment-friendly city.

Soga Ecology Park Concept (Chiba Eco-Town)

Chiba City has created a group of recycling facilities for waste paper and timber, end-of-life vehicles and other waste collecting in the region in the 48th Soga Designated Facilities District. The area also has environmental education facilities. As part of this urban-type environmental base, JFE’s recycling businesses include the JFE THERMOSELECT gasifying & melting plant, which recovers fuel gas from waste for use at JFE’s steelworks and the high-efficiency BIGIDAN-type biogas plant which recovers biogas from organic wastes.

Contributing through Clean Electric Power and Other Eco-Energy Solutions

JFE intends to play a leading role in the “clean energy society” of the 21st century by providing total solutions encompassing both energy and the environment. The JFE Group has a wealth of technology and know-how related to the environment, electric power, and energy, and is positioned to provide eco-energy solutions not available from any other company. JFE already has a high-efficiency power business which meets the needs of improved service in conventional power supply, and is commercializing new energy sources such as clean fuel, DME and fuel cell power generation to satisfy the growing need for clean energy and maximize its energy-related services.

Terminology

@Eco-Town Project

Projects for realizing the “Zero Emissions Concept” by utilizing waste from one industry as material in another field under a program created by the then-Ministry of International Trade and Industry (now METI) and Ministry of Health and Welfare in 1997.
Building Environment-Friendly Towns

JFE possesses the technologies and know-how to provide total solutions for the many problems now confronting the global and regional environment. By applying the combined technical capabilities developed in its steel and engineering businesses, JFE is contributing to a recycling-based, clean energy society.

Providing Total Solutions for a Better Environment

JFE is leading the effort to build environment-friendly cities and towns in cooperation with industry, the government, and universities. Through its networks with society at all levels, JFE provides total solutions for a better environment.

Building Eco-Towns

A representative example of JFE’s comprehensive environmental solutions is the effort to build environment-friendly towns in cooperation with local government. Based on its wealth of steel manufacturing and engineering technology and know-how, JFE is actively involved in Eco-Town building from the planning stage and is encouraging environmental coexistence through cooperation with industry, the government, and universities.

Keihin Coastal Area Environmental City Concept (Kawasaki Eco-Town)

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Soga Ecology Park Concept (Chiba Eco-Town)

Chiba City has created a group of recycling facilities for waste paper and timber, end-of-life vehicles and other waste collecting in the region in the 46ha Soga Designated Facilities District. The area also has environmental education facilities. As part of this urban-type environmental base, JFE’s recycling businesses include the JFE THERMOSSELECT gasifying & melting plant, which recovers fuel gas for waste from use at JFE’s steelworks and the high-efficiency BIGDAN-type biogas plant which recovers biogas from organic wastes.

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Projects for realizing the “Zero Emissions Concept” by utilizing waste from one industry as material in another field under a program created by the then-Ministry of International Trade and Industry (now METI) and Ministry of Health and Welfare in 1997.
Leading the Recycling-oriented Society with a Recycling Business

Ensuring smooth recycling is a key requirement for building a recycling-oriented society. JFE is meeting this need with advanced recycling businesses which apply a variety of unique technologies, beginning with waste plastic recycling as blast furnace feed, utilizing steel plant facilities as an infrastructure for recycling.

Waste Plastic Recycling for BF Feed

JFE currently recycles more than 100,000 tons/year of waste plastics by converting industrial waste plastic into raw material (substitute for coke) for its ironmaking. Because waste plastic recycling for BF feed makes an important contribution to reducing CO₂ emissions and saving coal, it is a key technology for recycling waste plastic.

PET Bottle Recycling

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.

Primary Recycling Operations at JFE

<table>
<thead>
<tr>
<th>Operation</th>
<th>Started in</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste fluorescent tube recycling</td>
<td>April 1995</td>
<td>6,000 t/yr</td>
</tr>
<tr>
<td>Waste plastic recycling for BF feed</td>
<td>October 1996</td>
<td>50,000 t/yr</td>
</tr>
<tr>
<td>Waste gasifying &amp; melting recycling</td>
<td>April 2000</td>
<td>50,000 t/yr</td>
</tr>
<tr>
<td>Plastic containers &amp; packaging for BF feed</td>
<td>April 2000</td>
<td>160,000 t/yr</td>
</tr>
<tr>
<td>Plastic containers &amp; packaging gasifying</td>
<td>April 2001</td>
<td>120,000 t/yr</td>
</tr>
<tr>
<td>PET bottle recycling</td>
<td>April 2002</td>
<td>30,000 t/yr</td>
</tr>
<tr>
<td>PET bottle sorting &amp; compacting</td>
<td>Sept. 2002</td>
<td>10,000 t/yr</td>
</tr>
<tr>
<td>Can/PET bottle sorting &amp; compacting</td>
<td>Sept. 2003</td>
<td>2 million t/yr</td>
</tr>
<tr>
<td>RSD recycling</td>
<td>Nov. 2000</td>
<td>90,000 t/yr</td>
</tr>
<tr>
<td>RSD recycling</td>
<td>Dec. 2000</td>
<td>20,000 t/yr</td>
</tr>
<tr>
<td>RSD recycling</td>
<td>April 2003</td>
<td>40,000 t/yr</td>
</tr>
<tr>
<td>RSD recycling</td>
<td>Sept. 2003</td>
<td>5,500 t/yr</td>
</tr>
<tr>
<td>Home electric appliance recycling</td>
<td>April 2001</td>
<td>600,000 units/yr</td>
</tr>
<tr>
<td>Dry cell battery recycling by non-ferrous metal melting furnace</td>
<td>March 2002</td>
<td>15,000 t/yr</td>
</tr>
<tr>
<td>Dry cell battery recycling by electric furnace</td>
<td>March 2003</td>
<td>1,000 t/yr</td>
</tr>
<tr>
<td>Food waste recycling</td>
<td>Aug. 2003</td>
<td>10,000 t/yr</td>
</tr>
</tbody>
</table>

Food Waste Recycling

Chiba Bigas Center at East Japan Works (Chiba) uses the BIGADAN process to produce fuel gas for the works from food waste by methane fermentation. Residues from the process is recycled to the Thermoselect plant at the Chiba Recycling Center, achieving zero-emission 100% recycling.

Proof Test of Vinyl Chloride Dechlorination System

Because vinyl chloride comprises 15% of all plastics, a treatment process for this material is an essential requirement for plastic recycling. In addition to a technology for separating and removing vinyl chloride from container and packaging plastics, JFE has also developed a technology for separating chlorine (Cl) from vinyl chloride itself, for example, in pipes and gutters. This enables Cl-free recycling in blast furnaces. The separated Cl is also recycled as hydrochloric acid (HCl). This technology is now in the proof test stage, aiming at commercialization.

Home Electric Appliance Recycling

Japan’s Electric Household Appliance Recycling Law requires recycling of scrapped refrigerators, washing machines, televisions, and air conditioners. To meet this need, JFE invested in an appliance recycling business 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. Thus, the steelworks is an indispensable part of the infrastructure for a recycling society.

Recycling by Waste Gasifying & Melting (Municipal / Industrial Waste, Shredder Dust)

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 fuel gas for the steelworks. At West Japan Works (Kurashiki), JFE invested in a PRI business called Mizushima Eco-Works, which is now constructing a JFE THERMOSELECT plant for municipal / industrial wastes and shredder dust and is scheduled to start operation in April 2005.

Construction of a zero-emission recycling facility

Chiba Recycling Center
Leading the Recycling-oriented Society with a Recycling Business

Ensuring smooth recycling is a key requirement for building a recycling-oriented society. JFE is meeting this need with advanced recycling businesses which apply a variety of unique technologies, beginning with waste plastic recycling as blast furnace feed, utilizing steel plant facilities as an infrastructure for recycling.

**Waste Plastic Recycling for BF Feed**

JFE currently recycles more than 100,000 tons/year of waste plastics by converting industrial waste plastic into raw material (substitute for coke) for its ironmaking. Because waste plastic recycling for BF feed makes an important contribution to reducing CO₂ emissions and saving coal, it is a key technology for recycling waste plastic.

**PET Bottle Recycling**

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. to produce flakes which are used to produce egg cartons and similar packaging. Labels and caps are also recycled as a raw material for ironmaking, creating a Zero Emission product.

**Home Electric Appliance Recycling**

Japan's Electric Household Appliance Recycling Law requires recycling of scrapped refrigerators, washing machines, televisions, and air conditioners. To meet this need, JFE invested in an appliance recycling business 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. Thus, the steelworks is an indispensable part of the infrastructure for a recycling society.

**NF Board for Concrete Forms Manufactured from Recycled Plastic**

In addition to chemical recycling of plastics, primarily as blast furnace feed, JFE 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 CO₂ emissions and helps preserve rain forests. Because used NF Board can also be recycled as a raw material for ironmaking, it is an environment-friendly, Zero Emission product.

**Recycling by Waste Gasifying & Melting (Municipal / Industrial Waste, Shredder Dust)**

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**Food Waste Recycling**

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Because vinyl chloride comprises 15% of all plastics, a treatment process for this material is an essential requirement for plastic recycling. In addition to a technology for separating and removing vinyl chloride from container and packaging plastics, JFE has also developed a technology for separating chlorine (Cl) from vinyl chloride itself, for example, in pipes and gutters. This enables Cl-free recycling in blast furnaces. The separated Cl is also recycled as hydrochloric acid (HCl). This technology is now in the proof test stage, aiming at commercialization.

**Primary Recycling Operations at JFE**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Started in</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste fluorescent tube recycling</td>
<td>April 1995</td>
<td>6,000 t/yr</td>
</tr>
<tr>
<td>Waste plastic recycling for BF feed</td>
<td>October 1996</td>
<td>50,000 t/yr</td>
</tr>
<tr>
<td>Waste gasifying &amp; melting recycling</td>
<td>April 2000</td>
<td>100,000 t/yr</td>
</tr>
<tr>
<td>Plastic containers &amp; packaging for BF feed</td>
<td>April 2000</td>
<td>120,000 t/yr</td>
</tr>
<tr>
<td>Plastic containers &amp; packaging gasifying</td>
<td>April 2001</td>
<td>30,000 t/yr</td>
</tr>
<tr>
<td>PET bottle recycling</td>
<td>April 2002</td>
<td>10,000 t/yr</td>
</tr>
<tr>
<td>Concrete form boards from recycled resin</td>
<td>Sept. 2002</td>
<td>2 million</td>
</tr>
<tr>
<td>Packaging plastic sorting &amp; compacting</td>
<td>Aug. 2000</td>
<td>50,000 t/yr</td>
</tr>
<tr>
<td>Can/PET bottle sorting &amp; compacting</td>
<td>Dec. 2000</td>
<td>20,000 t/yr</td>
</tr>
<tr>
<td>RIS recycling</td>
<td>Nov. 2000</td>
<td>60,000 t/yr</td>
</tr>
<tr>
<td>Home electric appliance recycling</td>
<td>Dec. 2000</td>
<td>5,000 t/yr</td>
</tr>
<tr>
<td>Dry cell battery recycling by non-ferrous metal metal melting furnace</td>
<td>March 2002</td>
<td>7,000 t/yr</td>
</tr>
<tr>
<td>Dry cell battery recycling by electric furnace</td>
<td>March 2003</td>
<td>1,000 t/yr</td>
</tr>
<tr>
<td>Food waste recycling</td>
<td>Aug. 2003</td>
<td>10,000 t/yr</td>
</tr>
</tbody>
</table>
Contributing to the Global Environment through International Cooperation

The global environment is now a matter of common concern among all nations. JFE participates in projects, supplies technology, and provides guidance which contribute to energy saving and reduced CO₂ emissions in developing countries to ensure that its abundant technologies and know-how are used effectively in environmental protection worldwide.

Anticipating actual introduction of the Kyoto Mechanism, JFE actively participates in government-sponsored programs such as NEDO model projects for rational energy use and feasibility studies (FS) for joint implementation of projects to reduce greenhouse gas (GHG) emissions and JETRO studies for global environmental protection/plant valuation studies in overseas countries.

Model project for energy conservation at ferroalloy electric furnace by raw material pretreatment and utilization of flue gas (China)

This project, commissioned by NEDO, was implemented at the ferroalloy electric furnace at Liaoyang Ferroalloy Co., to reduce unit electric power consumption. Energy savings are achieved by improving air permeability in the furnace to increase the heat exchange efficiency with raw materials. Specifically, this involves size-adjustment and baking of powdery chromium ore to produce 10-15mm diameter pellets, which are charged into the electric furnace in place of conventional Cr powder. In this project, JFE introduced a pelleting technology for powdery Cr ore which it developed over many years. Although heating is required to bake the pellets, gas is recovered from the EAF as a fuel for this purpose. A furnace cover with good sealability was installed on the EAF for gas recovery, and a dust collecting system was constructed for gas purification, simultaneously improving the environment.

Energy conservation model project for waste heat recovery from waste to energy (WTE) plant to treat papermaking sludge (Malaysia)

Under a NEDO commission, JFE constructed a plant which sludge generates energy from papermilling in Malaysia and supplies steam to papermills using the generated heat. This project was implemented as an international model project for rational energy use supporting the self-help efforts of developing nations in the Asia/Pacific region in dealing with energy and environmental problems. Reflecting the outstanding reputation of JFE’s technologies and record in these fields, the company was given the responsibility for the design, construction, and operational guidance of a 110ton/day fluidized bed type WTE plant. Although this papermaker had generated steam by burning fossil fuels, use of papermaking sludge saves energy, reduces CO₂ emissions, and eliminates methane gas leaks from the sludge, which had been buried in a landfill. The plant was completed in March 2003 and is operating smoothly.

Study of introduction of high-performance industrial furnace technology for reheating furnaces (Poland)

This is a study of joint implementation project for energy saving and greenhouse gas (GHGs) reduction by improving industrial furnace performance at a Polish steelworks, using an energy-efficient regenerative burner developed by JFE in the reheating furnaces. Under a NEDO commission, JFE made a study for project planning and evaluation of the energy-saving and GHG reduction effects. JFE is continuing to cooperate with its Polish counterpart toward implementation of the project.

Energy-saving measures by low-temperature waste heat recovery at Açominas Works (Brazil)

This project was planned to achieve energy savings at Açominas Works in Brazil. Using waste heat recovery equipment which circulates water (steam) as a heat medium, combustion air is preheated with the sensible heat of combustion flue gas from the blast furnace hot stoves. While fuel gas is preheated with the sensible heat of combustion flue gas from boilers. Under a NEDO commission, JFE made a study for project planning and evaluation of the energy-saving and GHG reduction effects. JFE plans to exchange information with its Brazilian counterpart and support project implementation as requested by the steelworks.

Country | Project
--- | ---
China | Model project for energy conservation at ferroalloy electric furnace by raw material pretreatment and utilization of flue gas
 | FS for regenerative burners at Shouguo Iron & Steel Co. and Anshan Iron & Steel (Group) Co.
 | Energy-saving measures for lime burning furnace
 | Natural gas DME project in Sichuan Province
Vietnam | FS for energy conservation at Vietnam Steel Corp.
Thailand | Industrial waste incinerator heat recovery model project for Industrial Estate Authority of Thailand
 | Study of introduction of high-performance industrial furnace for steel rolling reheating furnaces in Thailand
 | 5 others
Malaysia | Energy conservation model project for waste heat recovery from WTE plant
 | 2 others
Indonesia | Biomass (palm refuse) power generation using circulating fluidized bed boiler (CFB)
 | 2 others
Bangladesh | FS for rehabilitation and optimization of pipelines to reduce GHG emissions
India | Coke oven waste heat recovery facility for SESA GSA Ltd.
 | FS for waste heat recovery at sintering cooler at Tata Iron and Steel Co., Ltd.
Pakistan | FS for energy conservation at Pakistan Steelworks
Russia | Conversion of coal-fired power plant in Sakhalin to natural gas-fired
 | 2 others
Ukraine | Study of optimization of gas pipeline improvement
 | 2 others
Poland | Study of introduction of high-performance industrial furnace technology for reheating furnaces in Poland
Brazil | Energy-saving measures by low-temperature waste heat recovery at Açominas Works
 | Other
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\end{tabular}

Terminology

NEDO New Energy and Industrial Technology Development Organization

JETRO Japan External Trade Organization

JFE  Environmental Report 2003

JFE Environmental Report 2003
Environmental Businesses of JFE Group Companies

The JFE Group includes approximately 50 companies which supply ecological products and are engaged in environmental businesses ranging from environmental surveys/measurements and support of ISO 14001 certification to waste management/recycling, design and construction of environmental plants, and soil remediation. JFE Group companies provide integrated solutions from the initial planning and preparation to introduction, operation, and maintenance of equipment in a wide variety of fields, contributing to a better environment.

<table>
<thead>
<tr>
<th>Field</th>
<th>Company</th>
<th>Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental surveys, analysis and consulting</td>
<td>JFE Net Corporation</td>
<td>Consultation on development of environmental management systems; ISO-based environmental training; assistance for on-site environmental monitoring; internal environmental auditing.</td>
</tr>
<tr>
<td></td>
<td>KAWASAKI STEEL TECHNO-RESEARCH CORP.</td>
<td>Environmental and energy-related measurement, surveys, and analyses (industrial, residential, environmental). Consultation on development of environmental management systems, and environmental technologies; environmental information collection and surveys.</td>
</tr>
<tr>
<td></td>
<td>KOKAN MINING CO., LTD.</td>
<td>Soil and underground water pollution surveys and clean-up work; geothermal water surveys and development; asphalt and concrete recycling; production and sale of biological products (slag sand, magnesium hydrate, etc.).</td>
</tr>
<tr>
<td></td>
<td>KOKAN REKODA K.K.</td>
<td>Environmental and energy-related measurement, surveys, and analyses (industrial, residential, environmental). Agricultural chemicals, oil products, oil-soluble thickening agents, soil surveys and analysis. Energy-saving diagnostic); consultation on environmental assessment; conceptual development and testing; manufacture and operation of experimental devices; consultation related to these activities.</td>
</tr>
<tr>
<td></td>
<td>NITTO TECHNICAL SERVICE CORP.</td>
<td>Surveys on environmental technologies; oversees environmental surveys; environmental surveys and analysis; consultation on environmental ISO certification; consigned lifecycle assessment; consultation on environmental stagnation and green procurement.</td>
</tr>
<tr>
<td>Waste treatment and recycling</td>
<td>JFE URBAN RECYCLE CORP.</td>
<td>Recycling of waste electric appliances under the Electric Waste Appliance Recycling Law (designated categories: batteries, air conditioners, refrigerators, washing machines, recycling of household appliances used in business (OA equipment, vacuum machines, etc.); collection and transportation of industrial wastes(including disposal and storage).</td>
</tr>
<tr>
<td></td>
<td>JFE KAWBCO CORP.</td>
<td>Waste treatment and recycling waste plants, wastewater and sludge, waste construction materials, recovered lamp, battery, etc.; collection and transportation of industrial waste; environmental monitoring and analysis, environmental measurement certificates; evaluation on waste treatment and recycling.</td>
</tr>
<tr>
<td></td>
<td>NIK MARINE &amp; LOGISTICS CORP.</td>
<td>Marine transportation of waste plastics, industrial wastes, and waste construction materials; collection of waste materials; transportation of industrial wastes; removal and transportation for recycling of automotive business facilities.</td>
</tr>
<tr>
<td></td>
<td>KAWATETSU MUNDING CO., LTD.</td>
<td>Recycling of waste and waste material (granulated slag, fast salt, 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 residue for marine construction); recycling businesses (recycling of waste concrete into concrete aggregate; recycling of recycling sand).</td>
</tr>
<tr>
<td></td>
<td>KAWATETSU LIFE CORP.</td>
<td>Recycling businesses (production and recycling of asphalts); collection and transportation of electrical waste; design, installation, sale, and maintenance of buildings and industrial air conditioners.</td>
</tr>
<tr>
<td></td>
<td>JAPAN RECYCLING CORP.</td>
<td>Industrial waste recycling, recycling of waste containers and packaging; sale of products from waste treatment; operation and maintenance of municipal and industrial waste treatment facilities.</td>
</tr>
<tr>
<td></td>
<td>JFE S-Toh Corporation</td>
<td>Manufacturing, installations and maintenance of waste treatment and water treatment equipment; operation and maintenance of waste incinerators.</td>
</tr>
<tr>
<td></td>
<td>JFE PRECISION CORP.</td>
<td>Manufacturing, installation, and maintenance of waste treatment and water treatment equipment.</td>
</tr>
<tr>
<td></td>
<td>JFE Solips Corporation</td>
<td>Design of waste treatment equipment; development of planning and operation management support systems for environmental equipment; design of environmental correction systems related to construction exhaust gas; development, design, and manufacture of VOG treatment systems for responding to PFTE and development support for production and use systems related to environmental-friendly floors (CWE, Nite, aikuo, etc.); energy saving consultation by equipment diagnosis.</td>
</tr>
<tr>
<td></td>
<td>JFE Technology Corporation</td>
<td>Manufacturing, installations and maintenance of waste treatment and water treatment equipment; experimental fabrication and testing related to research and development (DME diesel engine, environment for divers, etc.).</td>
</tr>
<tr>
<td></td>
<td>JFE TRADING INC.</td>
<td>General sales of environmental plants, equipment, construction, and services.</td>
</tr>
<tr>
<td></td>
<td>JFE Plant &amp; Service Corporation</td>
<td>Construction, modifications, and maintenance of waste treatment and water treatment equipment.</td>
</tr>
<tr>
<td></td>
<td>KAWATETSU GEODIS CORP.</td>
<td>Development of environmental-friendly ship-construction methods; GPS method for recycling soil generated from ship-cleaning waste collection.</td>
</tr>
<tr>
<td></td>
<td>KAWATETSU ADVANCECHI CO., LTD.</td>
<td>Manufacture and sale of measuring instruments for waste treatment facilities; survey, and environment (industrial weighing scale, measuring devices of water and waste, plant incineration, etc.).</td>
</tr>
<tr>
<td></td>
<td>KAWATETSU ELECTRIC ENGINEERING CO., LTD.</td>
<td>Design, installation, and maintenance of electrical systems and instrumentation of waste treatment facilities; design and manufacture of photovoltaic power generation systems.</td>
</tr>
</tbody>
</table>

Field | Company | Business
--- | --- | ---
Environmental plant and equipment | NIK G.S. CORP. | Collection and transportation of municipal and industrial wastes; operation and maintenance of waste treatment and water treatment facilities; auxiliary plants and auxiliary equipment; landscape planning; environmental measurement and measurement certifications; environmental surveys, evaluation, and consultation. |
| | NIKAWAI CORP. | Overseas utilization. |
| | KAWATETSU TRANSPORTATION & TECHNICAL CO., LTD. | Environmental clearance (high-pressure water washing, cutting, and peeling of machinery and containers; industrial washing and cleaning); collection, transportation, and intermediate treatment of industrial waste; construction, operation, maintenance, dismantling, and washing of environmental equipment. |
| | KOKA OTORI SERVICE CORP. | Design and construction of facilities and civil works; maintenance of systems and plants; consultation on environmental greening; green plant leasing; recycling of waste collection containers; maintenance and cleaning of leisure facilities. |
| | TAKAYAMA STEEL TECHNOLOGY CORP. | Collection and transportation of municipal wastes. |
| | TAKAYAMA RESEARCH-TECHNO CORP. | Recycling of solid waste; recycling of industrial waste; recycling of industrial waste in urban areas; recycling of construction and demolition waste; recycling of industrial waste. |
| | MIZUMAWA TOWN SERVICE CORP. | Design and construction of gardens and civil works; maintenance of gardens and planned areas; consultation on energy saving; green planning; recycling of industrial waste. |
| | MENTEC KIKO CORP. | Recycling of containers and packaging (plastics, bottles, PET film, sheet, and paper containers); destruction of waste, installation, maintenance, and modifications of waste treatment and water treatment equipment. |
| | JFE CHEMICAL CORP. | Plastics recycling, gas refining, high-temperature recovery (dust removal, granules, powder, 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 load; environment-friendly construction materials (wood panel and podarol using photosynthesis). |
| | KAWATETSU KONDOU INC. | Development of environment-friendly steel products (painted steel sheets); construction of environment-friendly steel products (painting steel resistant paint coated steel) for roofing, siding, and soundproofing; paint coating of glass and plastic composite. |
| | JFE ENGINEERING & CONSTRUCTION CORP. | Environment-friendly construction methods (sheet metal clad facade system). |
| | JFE ROOFCORP CORP. | Manufacture of roof sheets and roof products from BF slag (acid-resistant materials, thermal insulation, and sound-absorbing materials for energy saving and better housing environment). |
| | JFE CONTAINER CO., LTD. | Manufacture and sale of reusable drums (Eco-drum, S Open drum can); manufacture and sale of drums and drums for recovery service using comprehensive distribution systems; manufacture and sale of various high-pressure gas containers. |
| | CHISA RIVERMENT AND CEMENT CORP. | Production of slag powder as recycled cement material; BF cement designated by the Green Procurement Law; Eco-Mark product (Riverment). |
| | NEZUKUWA RIVERMENT CORP. | Production of slag powder as recycled cement material; BF cement designated by the Green Procurement Law. |
Environmental Businesses of JFE Group Companies

The JFE Group includes approximately 50 companies which supply ecological products and are engaged in environmental businesses ranging from environmental surveys/measurement and support of ISO 14001 certification to waste management/recycling, design and construction of environmental plants, and soil remediation. 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.

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<td>Consultation on development of environmental management systems; ISO-based environmental management training, as personnel for in-house environmental management; internal environmental auditing.</td>
</tr>
<tr>
<td></td>
<td>KAWASAKI STEEL TECHNO-RESEARCH CORP.</td>
<td>Environmental and energy-related measurement, surveys, and analysis (acids, endocrine disruptors, agricultural chemicals, air pollutants, soil-fouling substances, soil surveys, energy-saving diagnosis); consultation on development of environmental management systems, and environmental technologies; environmental information collection and surveys.</td>
</tr>
<tr>
<td></td>
<td>KOKAN MINING CO., LTD.</td>
<td>Soil and underground water pollution surveys and cleanup work; geothermal water surveys and development; artificial ground concrete; production of steel and industrial products.</td>
</tr>
<tr>
<td></td>
<td>KOKAN RESEARCH &amp; ENG. CO., LTD.</td>
<td>Environmental and energy-related measurement, surveys, and analysis (acids, endocrine disruptors, agricultural chemicals, oil pollutants, soil-fouling substances, etc.); soil surveys and analysis; energy-saving diagnosis; environmental information collection and surveys.</td>
</tr>
<tr>
<td></td>
<td>WATANABE CORPORATION</td>
<td>Consultation on development of environmental management systems; ISO-based environmental management training, as personnel for in-house environmental management; internal environmental auditing.</td>
</tr>
</tbody>
</table>

| Wastes treatment and recycling | JFE URBAN RECYCLE CORP. | Recycling of waste electric appliances under the Electric Appliances Recycling Law of designated categories (electronics, air conditioners, refrigerators, washing machines, recycling of household appliances used in business, OA equipment, vending machines, etc.); collection and transportation of industrial wastes (industrial waste, commercial waste). |
| | JFE KAMYO CORP. | Waste treatment and recycling (waste plastic, municipal waste, construction materials, household waste, industrial waste, etc.); collection and transportation of industrial waste (industrial waste, commercial waste). |
| | MIN MINING & LOGISTICS CORP. | Marine transportation of waste plastic; industrial waste, and waste construction materials; collection of waste plastic, used batteries, etc.; collection and transportation of waste. |
| | KAWASAKI MINING CORP., LTD. | Recycling and reprocessing of iron scrap; recycling of iron scrap (grain, slag, etc.); development of recycling technology effective for use of scrap, development of high-value-added scrap products (DSP method for capturing high-quality scrap, solid slag inductance for marine construction); recycling business (recycling of waste concrete, etc.); recycling of steel scrap. |
| | JAPAN RECYCLING CORP. | Industrial waste recycling; recycling of waste containers and packaging; soliciting of by-products from waste treatment; operation and maintenance of municipal and industrial waste treatment facilities. |
| | JFE-S-Tex Corporation | Manufacture, installation, and maintenance of waste treatment and waste treatment equipment; operation and maintenance of waste incinerators. |
| | JFE PRECISION CORP. | Manufacture, installation, and maintenance of waste treatment and waste treatment equipment. |
| | JFE Solids Corporation | Design of waste treatment equipment; development of planning and operation management support systems for environmental equipment; design of environmental protection equipment related to construction exhaust gas, environmental design, and design of HVAC system for treatment systems for respirators and FIBS, development support for production and sales systems related to environmentally friendly huts (OMV, techniques, palm, etc.); energy-saving consultation by equipment diagnosis. |
| | JFE Teknos Corporation | Specialization in the design, manufacture, and installation of waste treatment equipment; experimental fabrication and testing related to research and development (R&D) diesel engine, measurement equipment for diverse industries. |
| | MGK TRADING INC. | General sales of environmental equipment, equipment; connection, and services. |
| | JFE Plant & Service Corporation | Construction, modification, and maintenance; installation of waste treatment and waste treatment equipment. |
| | KAWASAKI GEOSYS CORP. | Design and installation of environmental friendly water construction methods; GIS method for recycling solid generated from soil erosion prevention wall construction. |
| | KAWASAKI ADVANCEC CO., LTD. | Manufacture and sale of measuring instruments for waste treatment facilities, sewage system, and waterworks (industrial weighing scale, monitoring devices of water outlet, etc.). |
| | KAWASAKI ELECTRIC ENGINEERING CO., LTD. | Design, installation, and maintenance of electrical systems and instrumentation of waste treatment facilities; design and manufacture of photovoltaic power generation systems. |

<table>
<thead>
<tr>
<th>Field</th>
<th>Company</th>
<th>Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental plant and equipment</td>
<td>KANAGAWA MACHINE CO., LTD.</td>
<td>Design, manufacture, installation, and overall maintenance of environmental equipment; manufacture of HDPE, plastic film.</td>
</tr>
<tr>
<td></td>
<td>JFE ELECS Corporation</td>
<td>Design and installation of electrical systems and instrumentation of various plants such as waste treatment plants and incinerators.</td>
</tr>
<tr>
<td></td>
<td>Tsuchioka-Dovu Densha Co., Ltd.</td>
<td>Design, manufacture, installation, and maintenance of waste treatment equipment (incinerators, recycling centers, etc.).</td>
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<tr>
<td></td>
<td>JFE Environment Service Corporation</td>
<td>Consultation of operation of environmentally related plants such as waste treatment and waste water treatment equipment.</td>
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<td></td>
<td>JFE KABE Corporation</td>
<td>Prevention of soil contamination; restoration of contaminated soil; restoration of waste treatment equipment operation (incineration equipment for tire gasification treatment plants, environmental health construction method, etc.).</td>
</tr>
<tr>
<td></td>
<td>JFE PIPE FITTING MFG. CO., LTD.</td>
<td>Design, manufacture, and installation of recasting small recycling equipment (energy-saving facilities, construction fences, etc.).</td>
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<tr>
<td></td>
<td>NIPPON CHUZO K.K.</td>
<td>Manufacture and sale of hot- and cold-resistant glasses (safety glass) for waste incinerators; recasting small recycling equipment.</td>
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<td></td>
<td>NIPPON CHUBUZU K.K.</td>
<td>Design, manufacture, and sales division of environmental engineering projects.</td>
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<tr>
<td></td>
<td>Recycling Management Asia, Inc.</td>
<td>Consultation on 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 (RDF compost bag).</td>
</tr>
<tr>
<td></td>
<td>Mizushime Green and Oasis Service Corporation</td>
<td>Operation and maintenance of industrial waste treatment equipment.</td>
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<tr>
<td></td>
<td>W.K.S. CORP.</td>
<td>Collection and transportation of municipal and industrial waste, operation and maintenance of waste incinerating plants and auxiliary equipment; environment planning, environment measurement and certification systems; environmental surveys, evaluation, and consultation.</td>
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<td></td>
<td>AKAWASHI CORP.</td>
<td>Overseas operation.</td>
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<td></td>
<td>KAWASAKI TRANSPORTATION TECHNOLOGY CO., LTD.</td>
<td>Environmental cleanup (high-pressure water washing, cutting, and peeling of machinery and container, industrial washing and cleaning), collection, transportation, and intermediate treatment of industrial waste; collection, operation, maintenance, demolition, and washing of environmental equipment.</td>
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<tr>
<td></td>
<td>KENSHO CITY SERVICE CORP.</td>
<td>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.</td>
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<tr>
<td></td>
<td>TANSHIN SCIENCE TECHNOLOGY CORP.</td>
<td>Collection and transportation of municipal waste.</td>
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<tr>
<td></td>
<td>TANSHIN KAINES RESEARCH CO., LTD.</td>
<td>Recycling of solid waste, plastic waste, landscape environment, and energy-related measurement; energy-saving diagnosis; consultation on environmental ISO certification and energy saving.</td>
</tr>
<tr>
<td></td>
<td>MINAMISAN TOWN SERVICE CORP.</td>
<td>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.</td>
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<tr>
<td></td>
<td>MENETS HIRO CORP.</td>
<td>Recycling of containers and packaging (glass bottles, PET bottles, plastic and paper containers, etc.); design, manufacture, installation, and maintenance of waste treatment equipment.</td>
</tr>
<tr>
<td></td>
<td>JFE CHEMICAL CORP.</td>
<td>Plastic recycling; refining; hydrogen recovery (sodium silicate water treatment, amino agent, pigments, CO recovery and reuse (iron, etc.), waste treatment chemicals (acids, salts, sulfuric acid, vinyl sulfonic acid, etc.).</td>
</tr>
<tr>
<td></td>
<td>JFE METAL PRODUCTS &amp; ENGINEERING INC.</td>
<td>Development of highly functional antibacterial and oil engineering products with low environmental load; environmental friendliness construction materials (sandless basement and underpinning using photocatalysis).</td>
</tr>
<tr>
<td></td>
<td>KAWASAKI-DAIMOKU CO., LTD.</td>
<td>Development of products (tire gasification treatment plants, new environmental waste products, production of environmentally friendly steel products (nontoxic zinc coated steel plate) for reusing and recycling, and environmental friendly waste products).</td>
</tr>
<tr>
<td></td>
<td>JFE ENGINERING &amp; CONSTRUCTION CORP.</td>
<td>Environmentally friendly construction method (sheet metal road underlining method: Metal Road).</td>
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<tr>
<td></td>
<td>JFE ROROPPER CORP.</td>
<td>Manufacture of non-wood and its products from BP and waste materials; thermal insulation, and sound-absorbing materials for energy-saving and better housing environment.</td>
</tr>
<tr>
<td></td>
<td>JFE CONTAINER CORP., LTD.</td>
<td>Manufacture and sale of recycling drums (EcoDrum, S EcoDrum) for general and used drums care; recovery service using comprehensive distribution systems; manufacture and sale of various high pressure gas containers.</td>
</tr>
<tr>
<td></td>
<td>CHIBA RIVERMENT AND CEMENT CORP.</td>
<td>Production of slag powder as recycled cement material; BF cement designated by the Green Procurement Law; and EcoMark product (Renewal).</td>
</tr>
<tr>
<td></td>
<td>MIZUSHIME RIVERMENT CORP.</td>
<td>Production of slag powder as recycled cement material, and BF cement designated by the Green Procurement Law.</td>
</tr>
</tbody>
</table>
External Evaluation of JFE’s Activities

External Evaluation of JFE’s Activities Received (since 1998)

- **Japan Government Award**: 2002
- **Invention Award**: Invention of high-strength, high-formability titanium alloy with low-temperature superplasticity
- **Japan Federation of Economic Organizations Chairman’s Invention Award**: Environment-friendly large NOx reduction combustion technology
- **Invention Award**: Development of high efficiency, multi-size rolling technology for high dimensional accuracy for material and sheet tops
- **Japan Institute of Invention & Innovation Chairman’s Award**: Industrial production technology for 6.5%-silicon sheet by continuous CVD

- **Chisso Prize**: The prize given to companies and individuals who have made significant contributions to industrial production.
- **Memorial Award**: 2002
- **Technology Award**: Development and industrialization of critical cooling rate on-line accelerated cooling technology (Super OLAC)
- **Memorial Production Award**: Realization of ultra-short period blast furnace retinning by innovative large capacity BF retinning technology
- **Memorial Technology Award**: Development of environment-friendly new steelmaking process by zero-slag BOF operation
- **Memorial Production Award**: Development of world’s first endless hot strip rolling process and core carbon reduction technologies
- **Memorial Award**: Development and industrialization of environment-friendly regenerative burner system
- **Memorial Technology Award**: Development of high-efficiency production process for environment-friendly, high-purity stainless steel
- **Osada Memorial Prize**: 2002
- **Development and Industrialization of Critical Cooling Rate on-line Accelerated Cooling Technology (Super OLAC)**
- **1999 Development and World’s first commercialization of gradient high-silicon magnetic steel sheet**
- **Energy Conservation Award**: 2003
- **METI Minister’s Award**: Development and application of technology utilizing waste plastics as plastic surface material
- **Energy Conservation Center Chairman’s Award**: Energy conservation through refit activities to maximize equipment efficiency of oxygen plant
- **METI Minister’s Award**: Minimization of iron and steel making energy through development of new technology for measuring and multi-tube temperature
- **Energy Conservation Center Chairman’s Award**: Activities for reducing oxygen gas dissipation
- **Energy Conservation Center Excellence Award**: Introduction of regenerative burners in Chiba small-diameter seamless pipe rotary furnace
- **1995 METI Minister’s Award**: Development of regenerative burner and application to large heating furnaces
- **METI Regional Bureau Director General’s Award**: Application of model control for BF hot top
- **Minister’s Award for Global Warming Prevention (Environment Agency)**: 1999
- **Minister’s Award**: Recycling of waste plastics to blast furnace feed
- **Excellent Energy Conservation Equipment Award**: 2003
- **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**: Finding hot solar power generation system
- **Resource Recycling Technology & System Award (Clean Japan Center)**: Technology for recycling & recycling of washing chemical by radionuclide acid
- **METI Industrial Technology & Environment Bureau Director General’s Award**: Technology for recycling stainless steel making dust using smelting reduction method
- **Clean Japan Center Chairman’s Award**: Suppression of waste discharge in a casting plant (NIPPON KOKAN PIPE FITTING METS CO., LTD.)
- **Japan Society of Mechanical Engineers Award**: 2001
- **Japan Society of Mechanical Engineers Award (Technology)**: Continuous rolling mill of stainless steel, and wire rod
- **Combustion Society of Japan Award**: 2000
- **Technology Award**: High-temperature waste gasifying & direct melting technology
- **Recycling Award (NPO Recycle Solutions)**: 2001
- **First Planning Award**: Marine Blocks (Carbide large solid block of slag for use in artificial reefs for seaweed and fish farming)
- **Surface Finishing Society of Japan Award**: 2000
- **Technology Award**: Environment-friendly high-performance stainless-steel sheet “Geo-Frontier Coat”
- **Japan Coating Technology Association Award**: 2001
- **Technology Award**: Sheet-formation agent for washing steel “Captan C-Max”
- **Japan Society for the Promotion of Machine Industry Award**: 2001
- **Chairman’s Award**: Development of equipment for ultrasonic detection of electrical discharge
- **Excellent Environmental Equipment Award (Japan Society of Industrial Machinery Manufacturers)**: 2002
- **Chairman’s Award**: Automatic turning system for plastic bottles
- **2002 METI Industrial Technology & Environment Bureau Director General’s Award**: Small-scale incinerator using carbonizing & gasifying method (Kawasaki Machinery Co., Ltd.)
- **Japan Institute of Energy Award**: 2002
- **The JFE Award in Technical Division**: Development of energy based directly/fuel synthesis technology
- **Japan Down Association**: 2002
- **Technology Award**: Practical high-flow injection system using suppressed residual melt filtration module
- **Japan Society on Water Environment Award**: 2002
- **Technology Award**: Bird-watching (Chiba)

JFE Steel East Japan Works (Koajisashi) – Chiba

“Fureai-no-ike” (Friendship Pond), a Gathering Place for Wild Birds

A remarkable natural environment in the Keihin Industrial Zone

Located on Ohgishima (Ohgi Island) in Kawasaki City, “Fureai-no-ike” covers an expanse of 4,100m² in JFE Steel’s East Japan Works-Keihin District. The pond is home to carp and ducks and is a gathering place for many species of wild birds throughout the year, giving visitors a pleasant surprise and a feeling of calm in the midst of a busy metropolitan area.

This quiet spot is actually part of a manmade island which was reclaimed in the 1970s, but at the time, 20% of the total cost of steelworks construction was devoted to environmental protection and greening, resulting in this beautiful park with more than 50 kinds of trees. The northeastern part of the footpath around the pond is now closed to the public to protect the habitats of visiting birds.

On June 10, 2003, NHK TV broadcast a program on efforts to protect a bird called the “Koajisashi” (little tern) at JFE’s East Japan Works-Chiba District. Distinguished by a black head and yellow beak, the “Koajisashi” is a migratory bird which appears in April, breeds, then leaves Japan in August. According to the red data book of birds of Japan’s Ministry of the Environment, it is also a class II endangered species. In April 1993, Chiba invited suggestions for a city bird commemorating its new status as an ordinance-designated city and selected the “Koajisashi” in 1993.

In 2001, large colonies were observed in Chiba’s Chuo and Mihama Winds for the first time in more than 10 years. About 3500 birds were found building nests in roughly 1750 spots. The birds had raised more than 50 fledglings, but the percentage reaching this age was being sharply reduced by crows and birds of prey.

A movement to protect the “Koajisashi” spread among local residents, schools, businesses, and government agencies. At JFE’s Chiba plant, an embankment about 4,000m² was set aside and a gravelly area suitable for ground-breeding birds like the “Koajisashi” and plover was created. To prevent predation, shelters were constructed and decoys made by local middle school students were put out, and members of citizens’ groups in Chiba and other local areas now keep watch over the birds.

Coexistence with Nature—Protecting the Natural World at JFE’s Steel Works

Extending the footprint around the pond is now closed to the public to protect the habitats of visiting birds.

Bird-watching (Chiba)
External Evaluation of JFE’s Activities

External Evaluation of JFE’s Activities Received (since 1998)

- National Invention Award
  2002 Invention Award
  - Invention of high-strength, high-formability titanium alloy with low-temperature superplasticity
  2000 Japan Federation of Economic Organizations Chairman’s Invention Award
  - Environment-friendly innovative low-NOx combustion technology
  1999 Invention Award
  - Development of high efficiency, multi-size rolling technology for high dimensional accuracy of steel material and steel lags
  1998 Japan Institute of Invention & Innovation Chairman’s Award
  - Industrial production technology for 0.6-mm silicon steel by continuous CVD
- Chidori Prize
  (for those who contribute to human society and the environment through technology)
  2002 Memorial Technology Award
  - Development and industrialization of critical cooling rate on-line accelerated cooling technology (Super-OAC)
  - Memorial Production Award
  - Realization of ultra-short period blast furnace refining by innovative large capacity BF melting technology
  2001 Memorial Technology Award
  - Development of environment-friendly new steelmaking process by zero- slag BOF operation
  - Memorial Production Award
  - Development of world’s first endless hot strip rolling process and commeter caliberized steel sheets
  1999 Memorial Award
  - Development and industrialization of environment-friendly regenerative burner system
  - Memorial Technology Award
  - Development of high-efficiency production process for environment-friendly, high purity stainless steel
- Innovation Memorial Prize
  - Development and industrialization of critical cooling rate on-line accelerated cooling technology (Super-OAC)
  - 1999 Development and world’s first commercialization of gradient high-silicon magnetic steel sheet
- Architecture Industrial Award
  - 1998 Contribution Award
  - Development of endless rolling technology in hot rolling
- Energy Conservation Award
  - 2001 METI Minister’s Award
  - Development and application of technology utilizing waste plastics as blast furnace feed material
  - Energy Conservation Center Chairman’s Award
  - Energy conservation through efficient equipment realization and maximum efficiency of oxygen plant
  - 1998 METI Minister’s Award
  - Minimization of iron and steel making energy through development of new technology for measuring and minimizing metal temperature
  - Energy Conservation Center Chairman’s Award
  - Activities for reducing oxygen gas dissipation
  - Energy Conservation Center Excellence Award
  - Introduction of regenerative burners in Chiba small-Diameter seamless pipe rotary furnace
  - 1995 METI Minister’s Award
  - Development of regenerative burner and application to large blast furnaces
  - MTI Regional Bureau Director General’s Award
  - Application of model control for FW hot stove
- Minister’s Award for Global Warming Prevention (Environment Agency)
  - 1993 Minister’s Award
  - Recycling of waste plastics to blast furnace feed
- Excellent Energy Conservation Equipment Award
  - 2003 METI Minister’s Award
  - High-speed continuous annealing and cleaning 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-tide solar power generation system
  - 2000 Ressources & Energy Agency Director General’s Award
  - Projects promoting wind power generation & wind energy technology in steelworks
- Resource Recycling Technology & System Award (Clean Japan Center)
  - 2001 Clean Japan Center Chairman’s Award
  - Technology for consolidating & recycling of chemical fluid to nitric acid
  - 2000 METI Industrial Technology & Environment Bureau Director General’s Award
  - Technology for recycling stainless steel making dust using smelting reduction method
- 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
  - 2001 Japan Society of Mechanical Engineers Award (Technology)
  - Continuous rolling mill of stainless steel, and wire rod
- Combustion Society of Japan Award
  - 2000 Technology Award
  - High-temperature waste gasifying & direct melting technology
- 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 for fishing)
- Surface Finishing Society of Japan Award
  - 2000 Technology Award
  - Environment-friendly high-performance stainless-free steel sheet “Geo-Frontier Coat”
- Japan Coating Technology Association Award
  - 2001 Technology Award
  - Anti-corrosion coating agent for washing steel “Captain-Coat M”
- Japan Society for the Promotion of Machinery Industry Award
  - 2001 Chairman’s Award
  - Development of equipment for changing running direction of cold rolled steel sheet by air inflation
- 2000 Chairman’s Award
  - Development of equipment for ultrasonic detection of electrical discharge
- Excellent Environmental Equipment Award (Japan Society of Industrial Machinery Manufacturers)
  - 2002 Chairman’s Award
  - Automatic turning system for plastic bottles
  - 2002 METI Industrial Technology & Environment Bureau Director General’s Award
  - Small-scale incinerator using carbonizing & gasifying method (Kawatetsu Ichimura Industrial Co., Ltd.)
- Japan Institute of Energy Award
  - 2002 The JIE Award in Technical Division
  - Development of super high temperature/low-temperature technology
- Japan Ozone Association Award
  - 2002 Technology Award
  - Practical high ozone generation system using ozone-resistant micro-oxidation module
- Japan Society on Water Environment Award
  - 2002 Technology Award
  - Bird watching
- Shinagawa Greening Award
  - 2002 Shimizu Shinagawa Garden PARK

Coexistence with Nature—Protecting the Natural World at JFE’s Steel Works

“Fureai-no-ike” (Friendship Pond), a Gathering Place for Wild Birds

A remarkable natural environment in the Keihin Industrial Zone

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Protecting the City Bird of Chiba, the “Koajisashi” (Little tern)

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A movement to protect the “Koajisashi” spread among local residents, schools, businesses, and government agencies. At JFE’s Chiba plant, an embankment was set aside and a gravel area suitable for ground-breeding birds like the “koajisashi” and plover was created. To prevent predation, shelters were constructed and decoys made by local middle school students were put out, and members of citizens’ groups in Chiba and other local areas now keep watch over the birds.

Fureai-no-ike (Matching)

Birdwatching (Chiba)

JFE Steel East Japan Works (Keihin)

JFE Steel East Japan Works (Chiba)
We always welcome your opinions and comments on “JFE Environmental Report 2003”

Thank you for taking your time to read the JFE Environmental Report 2003. 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: URL: http://www.jfe-holdings.co.jp/environment/

After reading the report, what is your impression?

Q1. Fully satisfactory  Ordinary  Unsatisfactory  No comment

Which articles in the report particularly interested you?

Q2. Toward sustainable growth  Environmental accounting  Research and development
     Transition of environmental measures  Communication with society  Others
     JFE technologies for sustainable growth  Reducing environmental loads
     Environmental management system  in business operations
     Activities in 2002 / Future objectives  Contributing through products
     Promoting environmental management and technologies

Please describe any opinions in relation to JFE’s policy on environmental issues.

Q3. Excellent  Poor  No comment

Please describe further opinion here:

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

Q4. JFE’s customer  National or local government / its associated organization
     Shareholder / Investor  Academic or educational organization
     Resident in neighborhood  Student
     Environment specialist at company  Employee / employee’s family of JFE Group
     JFE’s works or offices  Environmental NGO / NPO
     or organization  Others ( )

Where did you hear about this report?

Q5. Newspaper / Magazine  JFE’s employee  JFE’s plant tour
     Seminar / Lecture / Exhibition  JFE’s website
     Other website  Others ( )

Please describe any opinions or requests for a future JFE Environmental Report.

Q6

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

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<thead>
<tr>
<th>Name</th>
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