

A large, stylized graphic of a green leaf or plant branch, composed of several overlapping, curved lines, occupies the left and bottom-left portion of the page.

# 1999 Environmental Report

Attunement of Business  
Activities and the Environment -  
The Eternal Theme  
at Mitsubishi Electric



Ichiro Taniguchi, *President*

**"Creating Together..."  
Fostering a Cyclical Society**

Not until near the dawning of the 21st century did humankind realize that the mass production, mass consumption and mass waste disposal resultant of 20th century socio-economic expansion were, in principle, destroying the natural environment that sustains all life as we know it. The amount of damage surpassed the natural recycling capabilities of the Earth's ecosystem: Humankind exceeded the limits of sustainable development.

One means of contributing to environmental preservation is to improve the cycle by which resources are used in society. By creating an awareness that causes all members of society to make more efficient use of limited natural resources, the level of negative environmental impact can be reduced. The Mitsubishi Electric Group is a strong proponent of this action.

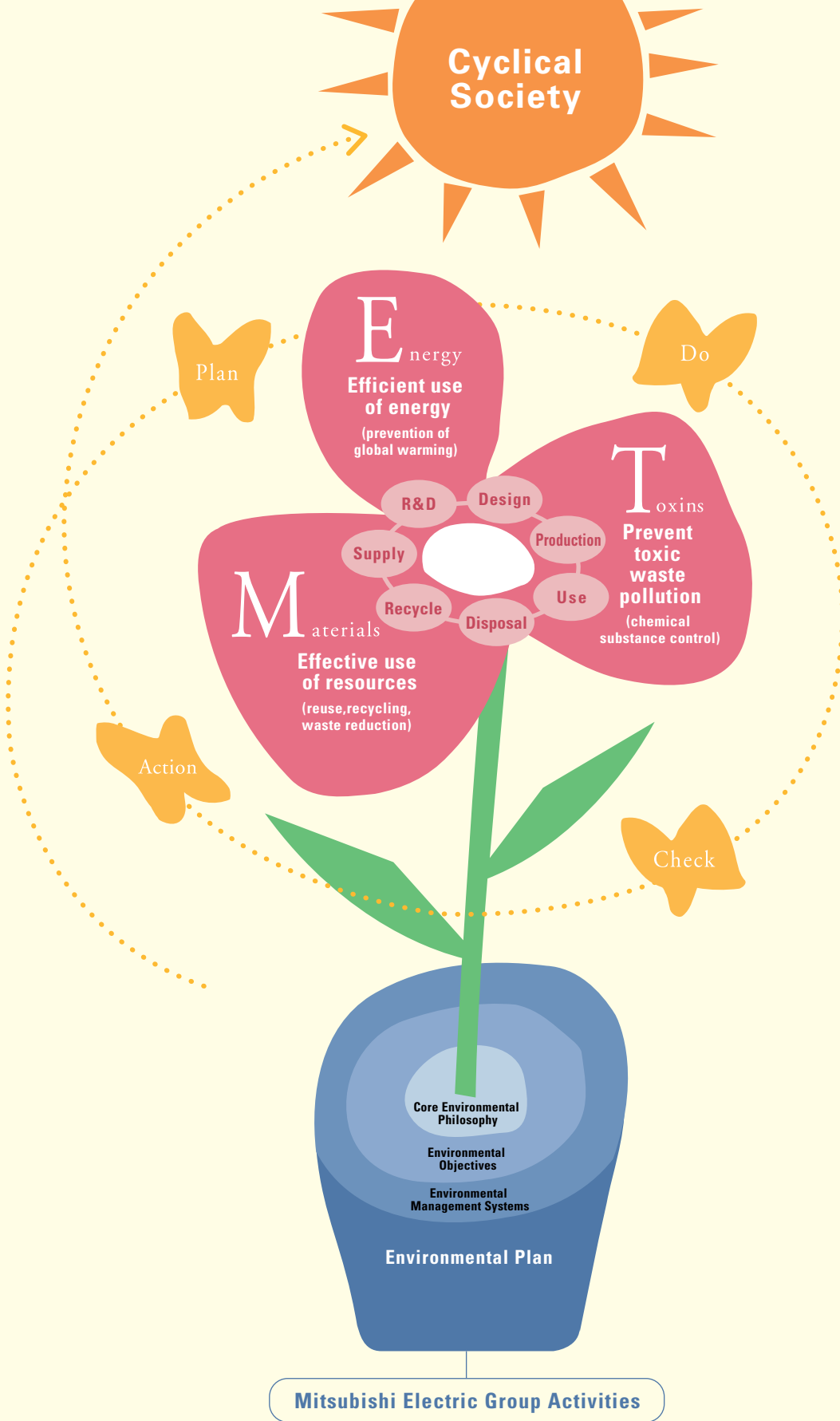
Mitsubishi Electric made public its Environmental Plan in 1993. In addition to previous environmental protection measures introduced by the company to save resources, this new plan confirmed a company-wide commitment to promote energy savings and recycling, reduce wastes, and improve chemical substance control (including reductions in use). All of the company's manufacturing sites are ISO 14001 certified. A recent affirmation to the company's environmental efforts is the completion and opening of a recycling plant for home electronics and office automation products in May 1999. In addition to operating as a recycling station, product and materials data are being compiled and utilized to develop more environmentally friendly product designs.

Mitsubishi Electric has a long history of developing and manufacturing products that both serve the public and help preserve the environment. Examples include water treatment equipment and manufacturing systems that utilize original high-concentration ozone technology to substitute for hazardous chemicals, power generation systems that use clean energy sources (photovoltaic, fuel-cell, etc.), and numerous other products that incorporate the latest in energy-saving technologies.

The 1999 Environmental Report explains Mitsubishi Electric's Environmental Plan, its environmental objectives and related actions and progress towards achieving those objectives, and provides an overall summary of other environment-related activities.

The Mitsubishi Electric Group is now ready to lead the way to the 21st century. "Creating together" with you, we will foster a cyclical society that preserves the ecosystem and allows sustainable development for future generations.

# Cyclical Society



## CONTENTS

- ③ Environmental Plan
- ⑤ Environmental Management Systems
- ⑦ Progress in Attaining Environmental Objectives
- ⑦ Materials Flow
- ⑨ Actions to Reduce Negative Environmental Impact in Production Activities
- ⑨ Prevention of Global Warming
- ⑬ Promotion of Resource Conservation, Recycling and Reduction of Industrial Waste
- ⑮ Control of Chemical Substances
- ⑰ Actions to Reduce Negative Environmental Impact of Products
- ⑳ Water and Greenery Protection
- ㉒ Education and Awareness
- ㉒ Social Contributions
- ㉓ Actions of Affiliated Companies
- ㉔ Environmental Accounting
- ㉕ Environmental Related Business and Development

### Corporate Profile

Name : Mitsubishi Electric Corporation  
 Head Office : Mitsubishi Denki Bldg., 2-2-3 Marunouchi, Chiyoda-ku, Tokyo 100-8310, Japan Tel: +81-3-3218-2111  
 Date Established : January 15, 1921  
 Paid-in Capital : 175.8 billion yen (as of March 31, 1999)  
 Employees : 45,329 (as of March 31, 1999)  
 Operations : Head office - Design & manufacturing facilities 30 R&D laboratories 13 Sales offices 62  
 Consolidated subsidiaries - Domestic 89 Overseas 42 (Overseas operations : 118 facilities in 35 countries)  
 Sales : Fiscal 1998 (Apr. 1, 1998 - Mar. 31, 1999)  
 Non-consolidated : 2.7707 trillion yen Consolidated : 3.7940 trillion yen

# Environmental Plan

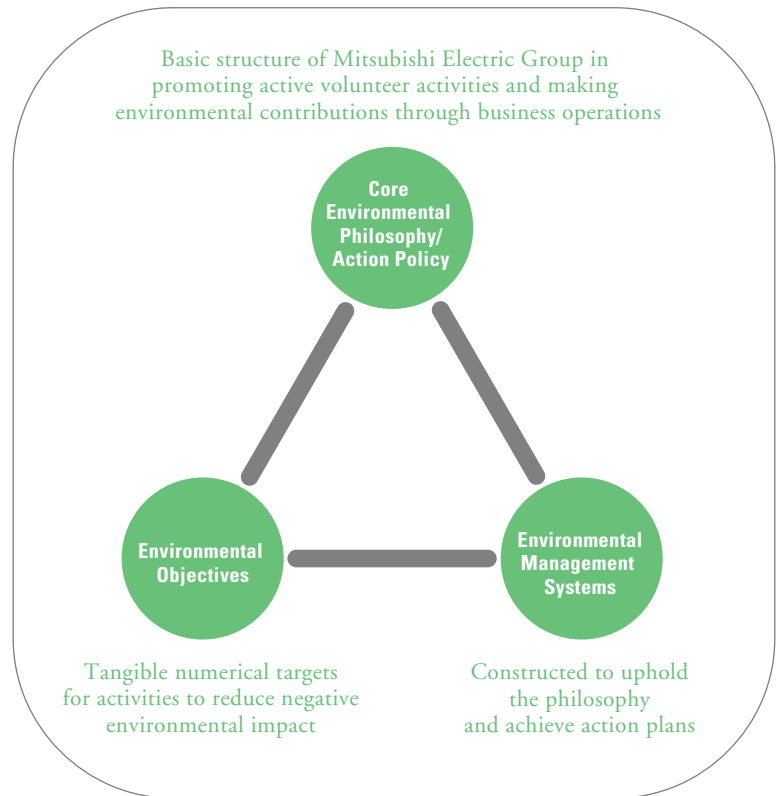
In executing the Environmental Plan, Mitsubishi Electric is challenging to introduce improved products and innovative processing technologies that will lead to the establishment of a "cyclical society" that promotes more efficient resource use and allocation and manufacturing processes. The Environmental Plan consists of a trilateral structure, as illustrated in the figure.

## Core Environmental Philosophy

Under the international principle of "sustainable development," the Mitsubishi Electric Group is committed to protecting and improving the global environment through all business activities using its accumulated knowledge and the technologies it will develop in the future.

## Environmental Action Policy

1. We will strive to reduce any negative environmental impact resulting from our products and activities. We will develop technologies and processes that are compatible with the environment. Products will be fully assessed over their entire lifecycle, and our facilities will promote resource efficiency, conservation and recycling.
2. We will commit ourselves to improving our understanding of environmental problems and contributing to a universal awareness of the need for businesses to integrate their activities with the natural cycles of nature.
3. We will establish environmental management systems at all of our business sites and operate them according to accepted standards. At the same time, we will continually improve environmental controls through environmental audits and similar methods.
4. We will educate, train and motivate employees to be good environmental stewards in their own right, as well as support employees and their families when they engage in activities that promote environmental protection.
5. We will foster active communication and cooperation regarding environmental protection worldwide.



## Environmental Objectives

To ensure the effective use of energy and other resources as well as the prevention of pollution by toxic substances, environmental assessments take into consideration all business activities and the full lifecycle of products and utilize quantitative evaluation to attain the maximum possible reduction in negative environmental impact.

### Prevention of Global Warming

#### Activities

Reduce energy consumption of business activities to control carbon dioxide (CO<sub>2</sub>) emissions.  
Reduce emission of greenhouse gases by 25% by fiscal 2010 (compared to fiscal 1990 level of carbon-equivalent energy consumption to net sales).

#### Products

Increase energy efficiency by reducing product electricity consumption including reduction in standby-state energy use.  
As a plan to reduce negative environmental impact, reduce product electricity consumption and standby-state electricity consumption by the end of fiscal 2000 (established for normal fiscal year, reduction amount and product category).

### Promotion of Resource Conservation, Recycling and Reduction of Industrial Waste

Promote resource conservation and recycling, and control of waste matter production.  
Reduce the amount of waste disposed of by waste removal services by 30% by the end of fiscal 2000 (using fiscal 1995 as the base year).  
Reduce the total amount of waste generated to less than 100,000t/yr by the end of fiscal 2000.  
Increase the rate of product recycling to more than 75% by the end of fiscal 2000.

Resource conservation and recycling of products and packaging materials.  
Increase the use of recycled materials by 30% by the end of fiscal 2000 (using fiscal 1995 as the base year).  
Reduce the use of packaging materials by 20% by the end of fiscal 2000 (using fiscal 1995 as the base year).  
Increase the identification of plastic component materials to the maximum possible extent by the end of fiscal 2000.

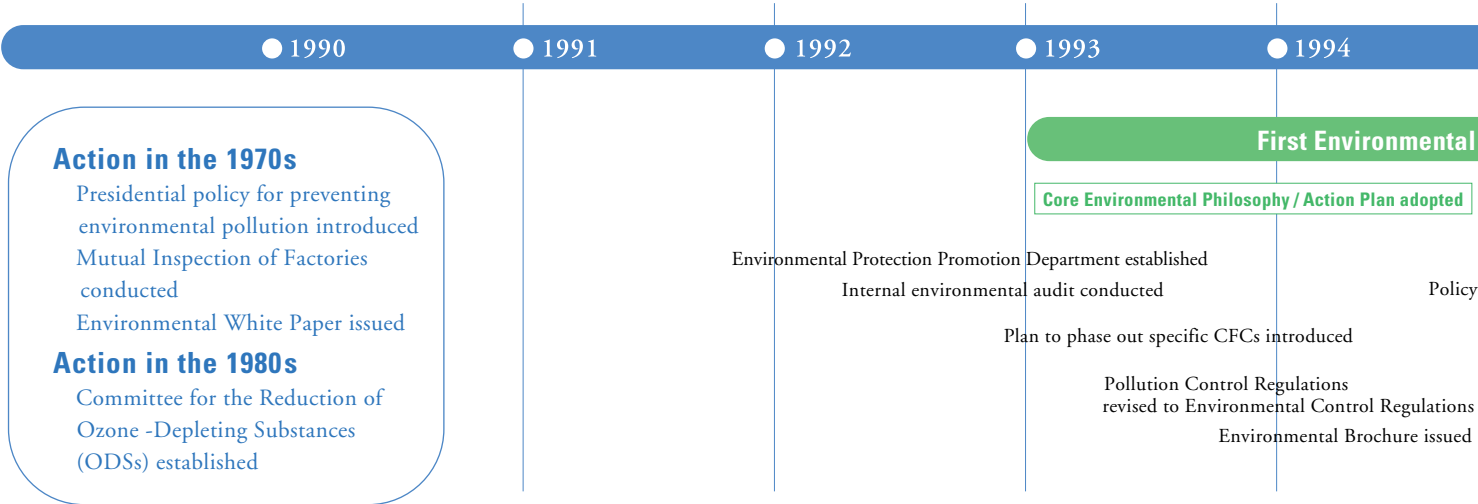
### Control of Chemical Substances

Reduce emissions of chemical substances by controlling their use in production processes.  
Identify the amounts of chemical substances used in production processes and set targets to reduce those substances having a strong negative environmental impact.  
Eliminate the use of organic chlorine solvents by the end of fiscal 1999.  
Reduce the use of volatile organic substances in open systems and promote recovery and recycling.

Thorough control of chemical substances used for products including reductions in chemicals used and substitution.  
Set targets to reduce or eliminate by substitution the use of chemical substances having a strong negative environmental impact by the end of fiscal 2000.  
Eliminate the use of hydrochlorofluorocarbons (HCFCs) as refrigerator refrigerant by the end of fiscal year 2010. Eliminate the use of HCFCs as foaming agents in refrigerators by the end of fiscal 2004.

# Environmental Management Systems

## Actions to Present



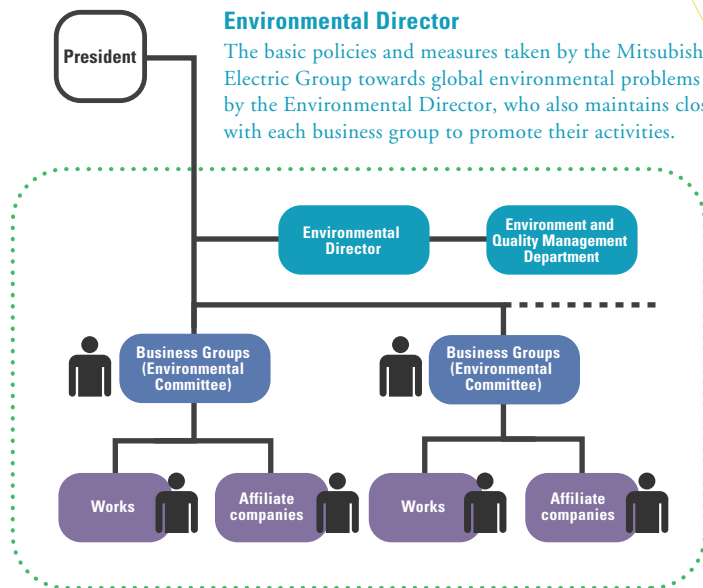
## Corporate Environmental Management Organization

Mitsubishi Electric has 12 business groups, each of which handles specific product segments from power and industrial systems to semiconductors and is assigned full responsibility for all operations. Global environmental problems are considered a business management task in each group, and special committees and activities are developed and set up to promote environmental awareness and solutions based on the characteristics of each group's business and products.



### Environmental Committee

The Environmental Committee was established for the purpose of providing a means of reviewing the progress of activities implemented under the Environmental Plan. Environmental managers from all of the business groups and works gather regularly to review the plan, exchange information, coordinate matters between business groups and confirm group policy.



### Environmental Director

The basic policies and measures taken by the Mitsubishi Electric Group towards global environmental problems are decided by the Environmental Director, who also maintains close contact with each business group to promote their activities.

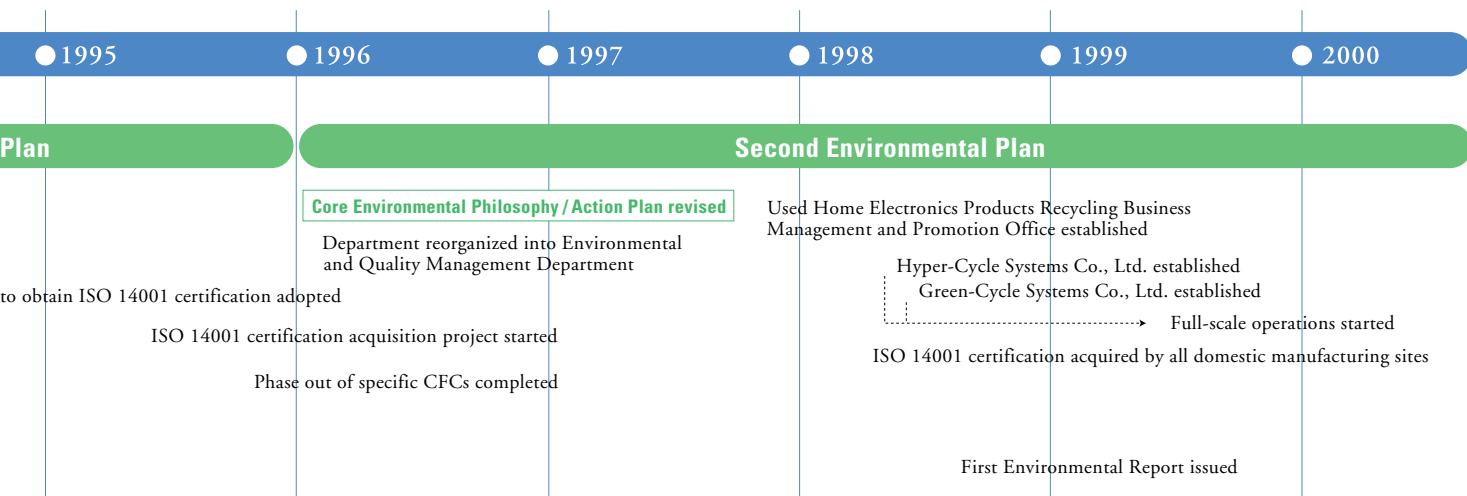


### Environmental Representatives

An Environmental Representative is assigned in each business group, works and affiliated company.

### Environmental Management System (EMS)

An EMS that conforms to ISO 14001 has been established in works and affiliate companies for the purpose of promoting continual improvement in environment related activities.

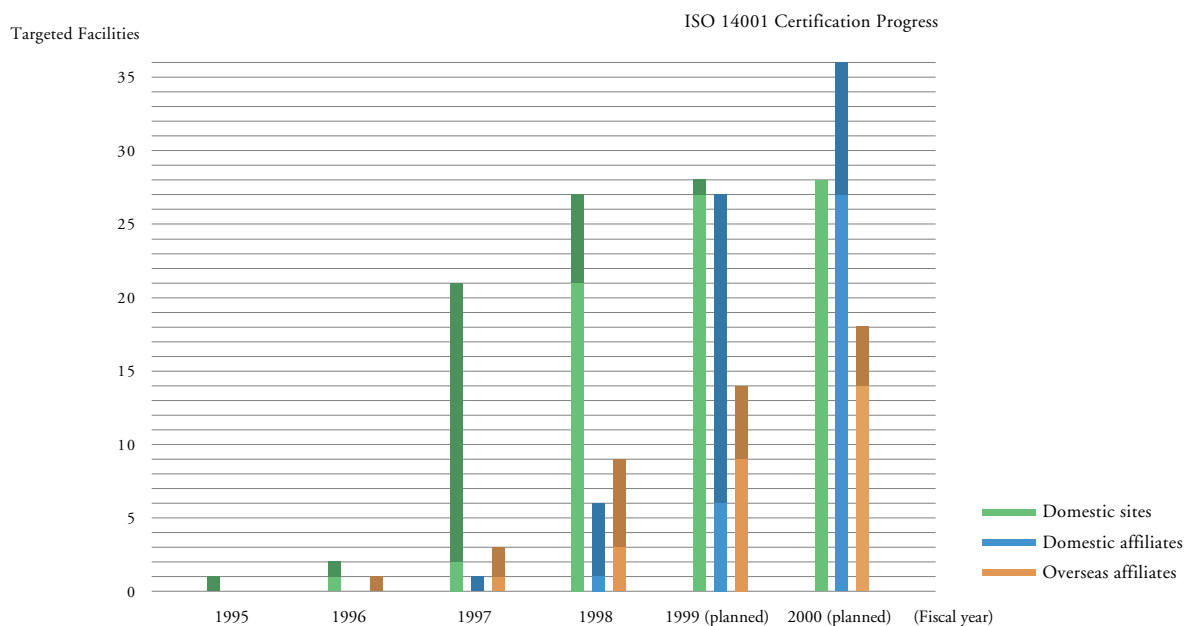


## Environmental Management System Construction ( plans and circumstances for acquisition of third-party certification )

Mitsubishi Electric decided to bring its operations into compliance with ISO 14001 in December 1994. Accordingly, a policy to acquire ISO 14001 certification was set and an environmental management system introduced at manufacturing sites and affiliate companies. As a result, all of the company's domestic manufacturing sites received certification by the end of fiscal


1998 and the main manufacturing sites of its affiliates are scheduled to receive certification by the end of fiscal 2000. The progress of acquiring certification in Japan as of the end of March 1999 is shown in the graph below. All domestic manufacturing sites (25 areas), the Plant Construction Division and research laboratories (1 area) have

acquired certification. For affiliate companies, six of the 36 domestic companies targeted and nine of the 19 overseas companies targeted have acquired certification. Plans are for all targeted affiliate companies, domestic and overseas, to be certified by the end of fiscal 2000. (The actions of affiliate companies are introduced from page 27.)



# Progress in Attaining Environmental Objectives

The progress made towards attaining our environmental objectives in fiscal 1998 is shown in the following chart. (A more detailed description of individual activities is provided in the following pages.) Future targets will be set in accordance with societal trends and the accumulation of new knowledge.

 New target set in fiscal 1999

## Tangible Targets

## Progress in Fiscal 1998

### Business Activities

#### Prevention of Global Warming

Reduce emissions of greenhouse gases by 25% by fiscal 2010 (compared to fiscal 1990 level of carbon-equivalent energy consumption to net sales).

- Efforts to save energy have resulted in a 3% reduction in total CO<sub>2</sub> emissions, 8,000t-C, as compared to the fiscal 1990 level.
- Total CO<sub>2</sub> emissions were reduced by 8% for carbon-equivalent energy consumption to net sales (compared to fiscal 1990 level).

#### Promotion of Resource Conservation, Recycling and Reduction of Industrial Waste

Reduce the amount of waste disposed of by waste removal services by 30% by the end of fiscal 2000 (using fiscal 1995 as the base year).



Reduce the total amount of waste generated to less than 100,000t/yr by the end of fiscal 2000.



Increase the rate of product recycling to more than 75% by the end of fiscal 2000.

- The amount of commissioned waste disposal was 15,000t, a reduction of 46% as compared to fiscal 1995, thus achieving our objective.

#### Control of Chemical Substances

Identify the amounts of chemical substances used in production processes and set targets to reduce those substances having a strong negative environmental impact.



Eliminate the use of organic chlorine solvents by the end of fiscal 1999.

Reduce the use of volatile organic substances in open systems and promote recovery and recycling.

- There are 64 types (8,300t) of chemical substances utilized in manufacturing processes.
- Reductions in the amount of organic chlorine solvents (e.g., trichloroethylene) utilized in production and their emissions are proceeding as planned.
- Transfer to the use of non-solvent paints and varnishes is advancing gradually.

#### Prevention of Global Warming

As a plan to reduce negative environmental impact, reduce product electricity consumption and standby-state electricity consumption by the end of fiscal 2000 (established for normal fiscal year, reduction amount and product category).

- Power consumption during operation: A 65% reduction was achieved for a new elevator that does not require a machine room as compared to its predecessor.
- Power consumption in standby state: A 96% reduction was achieved for a new color TV as compared to its predecessor model.

#### Promotion of Resource Conservation, Recycling and Reduction of Industrial Waste

Increase the use of recycled materials by 30% by the end of fiscal 2000 (using fiscal 1995 as the base year).

Reduce the use of packaging materials by 20% by the end of fiscal 2000 (using fiscal 1995 as the base year).



Increase the marking of materials of plastic components to the maximum possible extent by the end of fiscal 2000.

- Utilization of recycled materials such as recycled papers and plastics (from product bodies) increased 2.3-fold (using fiscal 1995 as the base year).
- Utilization of packaging materials such as wood, corrugated cardboard boxes, etc. was reduced 10,000t (17%) (using fiscal 1995 as the base year).
- Plastic components of newly developed products in many product categories were clearly marked for materials identification.

### Products

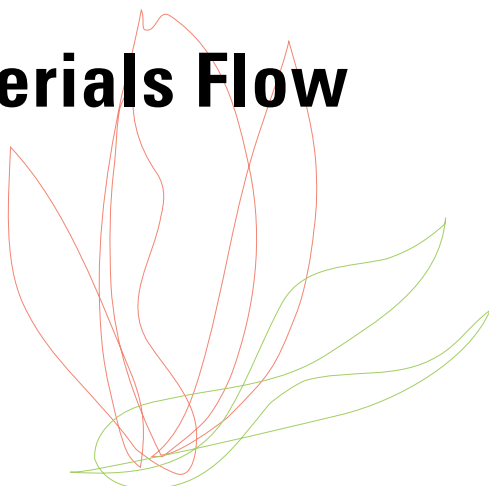
#### Control of Chemical Substances

Set targets to reduce or eliminate by substitution the use of chemical substances having a strong negative environmental impact by the end of fiscal 2000.

Eliminate the use of hydrochlorofluorocarbons (HCFCs) as refrigerator refrigerant by the end of fiscal year 2010. Eliminate the use of HCFCs as foaming agents in refrigerators by the end of fiscal 2004.

- Action taken to phase out the use, and prevent emission to the environment of substances such as mercury, cobalt, sulfur hexafluoride (SF<sub>6</sub>), etc.
- The phasing out of HCFC utilization is proceeding as planned.

## Materials Flow

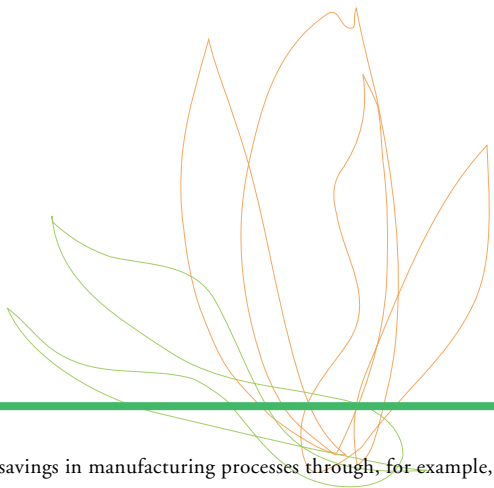


Water: 15.8 million m<sup>3</sup>  
 Electricity: 1.7 billion kWh  
 Gas: 29.0 million m<sup>3</sup>  
 Natural gas: 2,800t  
 Oil (crude oil conversion): 22,000kℓ  
 Chemical substances: 8,300t  
 Paper: 7,000t (inclusive of recycled paper materials, approx. 3,000t)

\*Calculated from used paper supply ratio

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## Evaluation

(5-point basis, self-scored by Mitsubishi Electric)

## Future Action

Evaluation 3



- A reduction of 25% by fiscal 2010 is targeted.
- As future objectives, a greater focus will be placed on energy savings in manufacturing processes through, for example, improvements in facilities and quality.
- Action in the three areas of energy savings, new energy sources and fuel conversion will be included in medium and long-term plans.

Evaluation 4



- Make efforts to control total emissions by improving manufacturing processes.
- Take action to expand resource recycling efforts utilizing thorough separation recovery.
- Establish an information system for waste management.

Evaluation 4



- The company will eliminate the utilization of organic chlorine solvents by the end of fiscal 1999, and affiliate companies will eliminate their utilization by the end of fiscal 2000.
- Efforts will be made to reduce the emissions of high-emission chemical substances such as the solvents of paints and varnishes (e.g., xylene acid, toluene), and the use of non-solvent materials will be promoted.
- We will promote the reduction of emissions by strengthening control procedures for the management, recovery and reuse of greenhouse gases.

Evaluation 4



model.

- Higher reduction targets will be set for individual products to promote further reductions in power consumption during operation and standby state.
- Attempt to expand applications to other models.

Evaluation 4

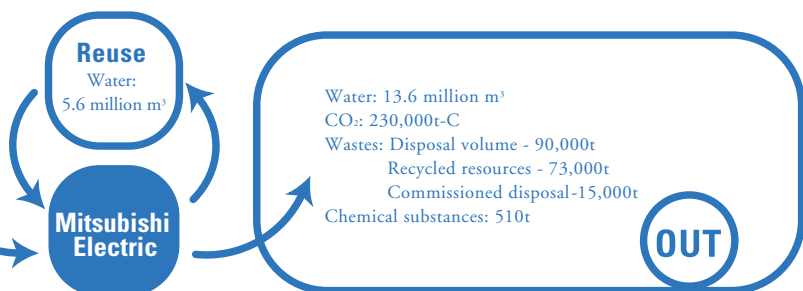


- Promote Design for Environment (DFE) and improve product recycling capabilities.
- Expand the DFE educational program for product design engineers.
- Continue with the development of DFE support tools.
- Review packaging design and promote simpler packaging as well as returnable packaging.
- Continue to mark the materials of plastic components.

Evaluation 4



- Set higher reduction targets for individual products, and promote the control of chemical substances utilized in products.
- Promote the plan to eliminate the utilization of HCFCs.



# Actions to Reduce Negative Environmental Impact in Production Activities

## Prevention of Global Warming

After the Conference of the Parties Third Session of the United Nations Framework Convention on Climate Change (COP3) held in Kyoto, Japan in December 1997, the Japanese regulations promoting countermeasures against global warming (Global Warming Countermeasures Law) and regarding the streamlining of energy use (Energy Conservation Law) were revised and strengthened. By fiscal 2010, Mitsubishi Electric aims to reduce its output of greenhouse gases by 25% as compared to the level in fiscal 1990 (carbon-equivalent energy consumption to net sales).

### 🌿 Conditions of Fiscal 1998 Activities

The total emission of CO<sub>2</sub> by Mitsubishi Electric operations was 230,000t-C for the year, which accounted for 0.02% of the total CO<sub>2</sub> output of Japan. This figure, having increased since 1993 due to energy conservation efforts, decreased this year by 15,000t-C. Compared to 1990, emissions dropped by 8,000t-C, corresponding to a 3% reduction. In terms of carbon-equivalent energy consumption to net sales, the emission of CO<sub>2</sub> was reduced by 8% compared to the 1990 level. Future subjects from this point on include the promotion of greater energy conservation in manufacturing processes by improving facilities. The following policies will be implemented in the medium- to long-term.

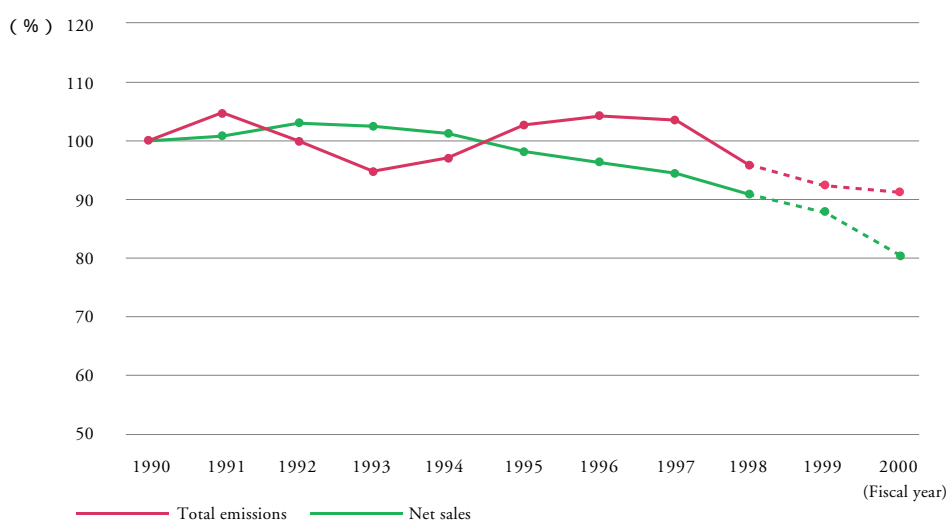
#### Main Points for Reducing Energy Usage

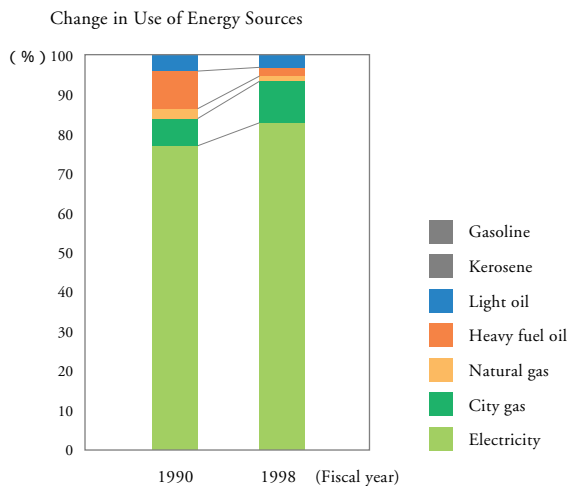
- Improve Power Sources (boilers, compressors)
- Introduce Co-Generation Systems
- Improve Air-Conditioning and Lighting Products/Systems
- Improve Manufacturing Processes

### Three Main Medium-to Long-Term Challenges

- Promote Energy Conservation through Intelligence and Innovation (reduce energy loss, use waste heat)
- Actively Use Renewable New Energy Sources (introduction of photovoltaic and fuel cell power-generation systems)
- Shift to Energy Sources with Minimal Negative Environmental Impact (change from use of oil to natural gas and electricity)

Transition in CO<sub>2</sub> Emissions (fiscal 1990 as base year)

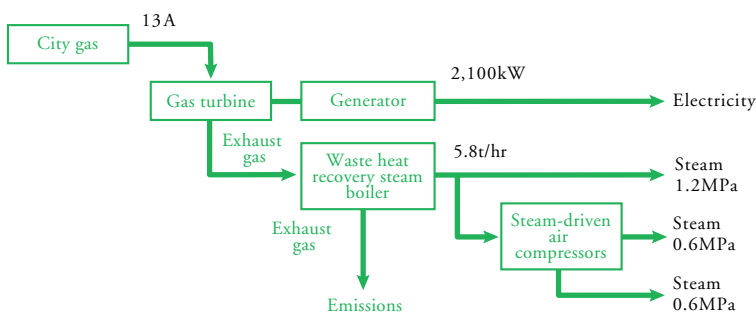




Designated Works



Gas Turbine Co-Generation System



## Details of Energy Usage

Of all the energy utilized by Mitsubishi Electric each year, electricity accounts for 85%, or 1.7 billion kilowatts. Compared to fiscal 1990, a shift away from the use of oil to city-supplied natural gas and electricity has progressed. The use of clean energy is expanding, and the negative impact on the environment has lessened.

## Factories Designated for Energy Management

As the result of revisions to the Energy Conservation Law, ten works utilizing electricity and thermal power fall under the heading of "Type 2" facilities designated for energy management.

At Mitsubishi Electric, not only the designated works but also its research facilities, main offices, branch offices and training facilities are included in broad reforms, and energy conservation has been taken up collectively, with the participation of all employees.

## Meeting the Challenge in Works / Factories

### Effective Use of Energy-Shizuoka Works

The Shizuoka Works, which manufactures products such as refrigerators and air-conditioning equipment, has set up an advanced energy streamlining facility utilizing a highly efficient, environmentally sound gas turbine co-generation system incorporating digital control and materials capable of withstanding high temperatures. The waste heat from the turbines is recovered and electricity consumption greatly reduced by using a power cascade. Additionally, effective energy use is realized by utilizing steam (i.e., waste heat recovered from boilers) to power air compressors. Some 300 million yen was invested in the works, including a subsidy from the New Energy and Industrial Technology Development Organization (NEDO). Annual emission of CO<sub>2</sub> has been reduced by 970t-C (13%).

## Reduction of Energy Loss Transmission & Distribution, Transportation Systems Center, Itami Region, Japan

The Transmission & Distribution, Transportation Systems Center, which manufactures devices such as gas-insulated switchgear and electrical equipment and systems for trains, reduced the electricity consumption of its cranes from 39 to 6Mwh per machine, an 85% decrease over previous usage, by means of introducing inverter control for the motors. Additionally, by switching boilers, compressors and transformers to highly efficient, low power consumption models, the center's overall energy consumption has been reduced 25% compared to the fiscal 1990 level; the center received recognition from the Kinki regional office of Japan's Ministry of International Trade and Industry (MITI) for excellence in factory energy management.

## Managing Energy Measurement Six Factories

Promotion of awareness of the actual energy used is one means of stimulating energy conservation activities. The Energy Conservation Center sponsors and conducts energy conservation surveys of buildings. In its role as a monitor, the organization installed energy measuring equipment and displays at six Mitsubishi Electric locations and is measuring electricity usage in real time.

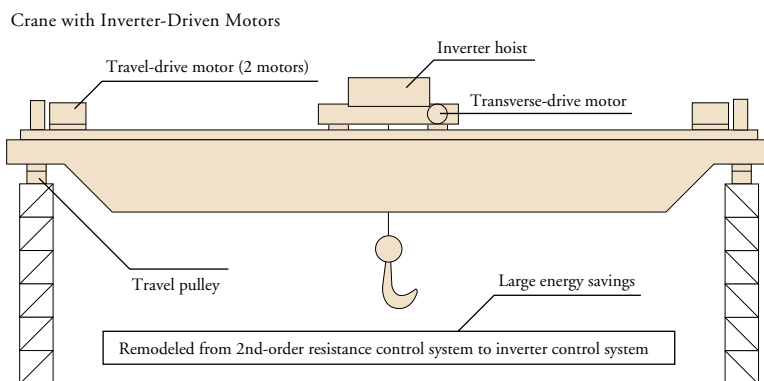
### 6 Locations

Head Office, Kamakura Works,  
Information System Engineering  
Center, Shizuoka Works,  
Communication Systems Center,  
Kita-itami Administration Center

## Handling Greenhouse Gases Other than CO<sub>2</sub>

Hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>) are thermally and chemically stable substances, and are used widely in the field of manufacturing. However, these gases are greenhouse gases, with global warming effects that are from hundreds to many thousand times greater than that of CO<sub>2</sub>; emission levels of these gases were set at COP3. In Japan in February 1998, the minister of MITI announced guidelines (based on industry) for measures to control the emission of HFCs and other greenhouse gases. Under these guidelines, members of the manufacturing industry independently decide plans for controlling the release of these gases, and seek to attain goals in emission reduction.

At Mitsubishi Electric, we set limits on the utilization of these greenhouse gases in 1996, and have begun reducing their emission through the implementation of closed systems, the recovery, recycling and destruction of the gases, and the development of alternative materials and technologies.



Crane



Energy measurement  
(Communication Systems Center)

## Hydrofluorocarbons

Contribution to ozone layer protection and global warming prevention is now being promoted by careful selection of the types of refrigerants being utilized in refrigeration and air-conditioning equipment.

Mitsubishi Electric's basic policy is to eliminate the use of all ozone-depleting materials in its manufacturing processes and products. We have already stopped the use of specific chlorofluorocarbon (CFC) refrigerants. Furthermore, in fiscal 1998, the changeover from hydrochlorofluorocarbon (HCFC) refrigerants to HFC refrigerants was begun. This conversion will be completed for all major products by 2005, with all remaining products being converted by 2010. Moreover, we are aiming to minimize the emission of greenhouse gases throughout the entire lifecycle of our products.

Presently, in terms of performance, safety and economics, the energy efficiency of HFCs can be maximized. However, because these gases have an enormous impact on global warming, we are reducing their use, preventing release through leakage, and collecting and recycling them when products are serviced or discarded. In the long term, substitute refrigerants that have a lesser effect on global warming are being developed.

## Perfluorocarbons

PFCs (such as  $CF_4$  and  $C_4F_8$ ), HFCs,  $SF_6$ ,  $NF_3$  and other fluorine gases are widely used in their gaseous state for dry etching in the manufacture of semiconductors, as well as for cleaning semiconductor apparatus. At Mitsubishi Electric, we are independently challenging the utilization of PFCs in the following ways.

Reduction of Amount of PFC Utilized (improved use efficiency, optimization of processing)

Introduction of PFC Abatement Equipment (increased reduction efficiency), actual equipment evaluation  
Examination of Substitute Gases, PFC Recovery and Recycling (investigation, examination, basic evaluation, actual equipment evaluation)

## Sulfur Hexafluoride

We established the  $SF_6$  Emissions Suppression Committee, and are targeting the following in the management and reduction of the emission of  $SF_6$  gas utilized for insulation in electrical devices.

Reduction of Emissions to 3.0% of Purchase Volume by 2005  
Control of the Volume of Gas Purchased, Enclosed in Products and Emitted  
Investigation of Emission Control Systems and Installation of the Necessary Equipment

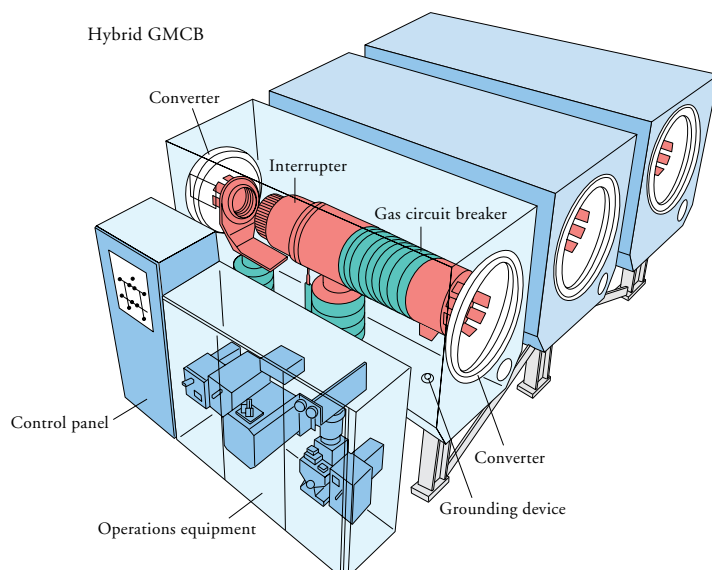
### Reduction of Enclosed $SF_6$ Gas Hybrid Generator Main Circuit Breakers (Hybrid GMCBs)

A 35% reduction in weight and 75% reduction in volume of hybrid GMCBs, which combine components such as gas circuit breakers, interrupters and earthing switches devices, have been attained over previous models by utilizing three-phase gang operation. By integrating components, the units occupy 70% less area and utilization of enclosed  $SF_6$  gas has been reduced by 55%.

## Gas Arresters for Gas-Insulated Switchgear

$SF_6$  gas is used as the insulator in the metal-enclosed type arresters of gas-insulated switchgear (GIS). A  $SF_6$  gas recovery device has been introduced to collect and recycle the gas exhausted during assembly, testing and installation. We have developed an advanced arrester by incorporating new zinc-oxide ( $ZnO$ ) elements with a varistor voltage nearly twice that of conventional elements, thus realizing a volume reduction of 40-60%. This led to a 40% reduction in the amount of  $SF_6$  gas enclosed in the device.

We have been working to reduce the amount of  $SF_6$  gas utilized in metal-enclosed type arresters for GIS by 40% by fiscal 2001 as compared with the amount of  $SF_6$  gas used in 1997.



# Promotion of Resource Conservation, Recycling and Reduction of Industrial Waste

Mitsubishi Electric is committed to reducing the amount of commissioned waste disposal 30% by fiscal 2000 as compared to the 1995 level. In accordance with the 1998 revision of the regulations regarding waste management and purification (Waste Management Law), the industrial waste management manifest has been expanded to apply to all industrial wastes. An electronic manifest has also been started. In 1999, we will work to complete an internal information system for waste management.

## Activities in Fiscal 1998

In addition to the existing recycling of oil and plastic wastes into fuel and the conversion of plastic wastes into blast furnace reducing agents, the introduction of alkali waste evaporation and condensation equipment has resulted in a reduction of liquid waste, and processing improvements have yielded shortened plating processing times. Efforts to recycle chemical substances utilized in manufacturing processes and the microbe treatment of wastewater from positive-film development processing with in-plant drainage treatment equipment have both proved successful, especially at semiconductor plants. These measures, along with the natural decline accompanying lower product output, have resulted in a 46% reduction in the volume of commissioned waste disposal as compared to the 1995 level. In the future, when production output increases, plans are to suppress any accompanying increase in waste volume as a means to contribute to the overall reduction of total emissions.

## Total Waste Volume and Recycling Rate

In order to increase the conservation of resources, goals for total emission volume and recycling must be established.

### New Objectives

Reduce total emission volume to less than 100,000t annually by fiscal 2000.

Increase the rate for recycling resources to more than 75% by fiscal 2000.

These goals are made with the aim of increasing recycling and suppressing the total production waste output to predetermined levels, without being affected by changes in production volume. The goals were met in 1998, but in order to maintain this achievement, we are placing efforts on thoroughly reforming manufacturing processes and introducing new separation technologies.

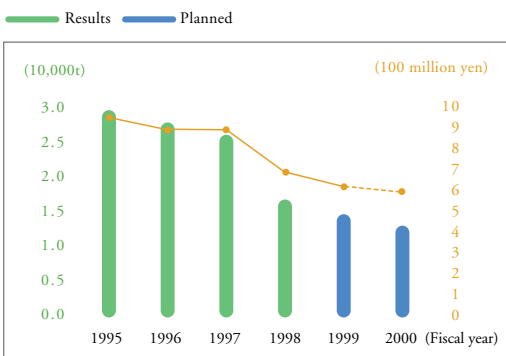
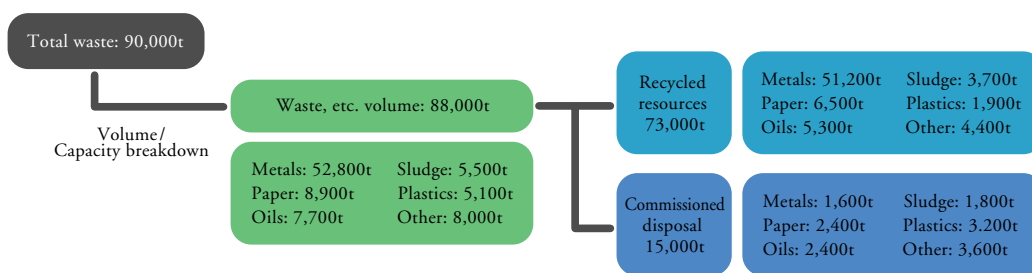
## Structure of Information Management System for Waste Management

In order to expand the application of the manifest for industrial waste management, manifest operations heretofore performed by people are being electronically automated. We have linked with the electronic manifest system provided by the Information Management Center for Japan Industrial Waste Management Promotion, and are implementing waste management operations at our sites that support the structure of the waste management information system.

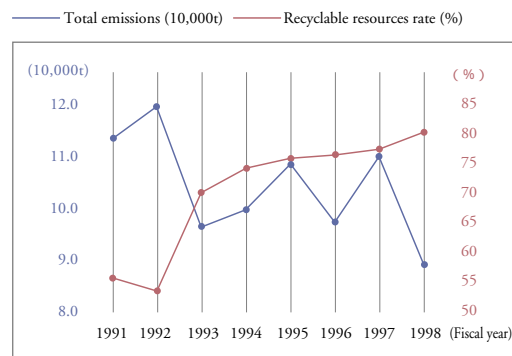


Information Management Center, "Electronic Manifest" operation screen (<http://www.jwnet.or.jp/>)

### Processing Flow



Transition of Commissioned Waste Disposal and Cost



Transition of Total Waste Volume and Recyclable Resources Rate

## Meeting the Challenge in Works / Factories Actions to Reduce Waste and Implement Recycling (Communication Systems Center)

Idle facilities have been remodeled at the Communication Systems Center, which manufactures items such as satellite communications equipment and cellular phones. A system for the evaporation and condensation of waste alkalis, an industrial waste requiring specialized handling, was introduced. The wastewater containing the alkali substance is low-pressure evaporated, the effluent is condensed to one-sixth of its original volume and then the separated, condensed water is treated at an onsite wastewater management facility. Utilizing this process, the volume of treated waste was reduced by approximately 140t in the seven months since commencing operations, helping to reduce waste management costs as well. Improvements in the recycling of paper and plastics are also planned.



Waste Alkali Evaporation and Condensation System



Fukuyama Works

## Zero Waste through Recycling (Fukuyama Works)

Until recently, the Fukuyama Works, which manufactures devices such as circuit breakers and watt-hour meters, previously sent the scrap generated in thermoplastic forming processes for treatment at an industrial waste management dealer. In order to reduce waste and improve recycling procedures, in September 1998 we installed a plastic waste recycling facility that pulverizes the scrap and mixes it with pure materials, thus constructing a thermoplastics recycling system. Two varieties of resin scrap (11.5t) are reusable in entirety, while 13 types of resins that produce relatively little scrap (5.6t) are disposed of by resale to the supplier, where they are converted into pellets again. These measures have reduced the waste from plastic forming processes to zero, and at the same time, have reduced the total production-related output of plastic waste by 17.1t. Furthermore, the annual purchase of raw materials has been reduced from 74.4 to 62.9t, a savings of 15%.

## Developing Waste Reduction through Exhibition

(Transmission & Distribution, Transportation Systems Center, Itami, Japan)

The Transmission & Distribution, Transportation Systems Center, which manufactures devices such as gas-insulated switchgear and electrical equipment and systems for trains, took "Thinking of Wastes" as a theme and sponsored a two-day exhibition, called "Reuse & Recycle," in October 1998.



Reuse & Recycle Exhibition

Discarded waste materials were collected from each building of the facilities and brought to the recycling center. Materials that could still be used were separated out and recycled and the remaining materials were treated as waste.

Valuable materials that can be recycled are called "reusables." However, in one year, 2,000t of reusables are disposed of at a cost of 800 million yen. If reusables are utilized in the manufacture of new products, the cost of raw materials, excluding processing, would be 200 yen per kilogram, giving a product price of some thousands of yen. However, if reusables are not utilized, the price of the product becomes some tens of thousands of yen, thus creating a disparity of some hundreds of millions of yen annually.

Reusables include unused parts, cables and products packed in wood, all originating as the result of order modifications or order surpluses. By displaying them at the exhibition, people from various departments could verify, with their own eyes, what kinds of things are being discarded. The exhibition was evaluated to have left a good impression regarding the use of resources and played an important part in promoting the reform of business practices.

## Measures to Handle Dioxins

Mitsubishi Electric has 11 incineration facilities that are all compliant with the fundamental regulations of the Waste Management Law enacted December 1998.

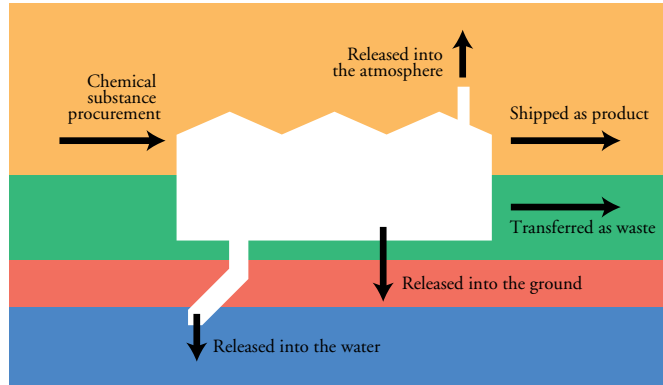
To prevent the release of dioxins during the incineration of waste, when the materials are to be incinerated at an onsite facility, they are first sorted, the volume is reduced to ensure proper combustion, and then incineration is performed only in a furnace compliant with the law. We are also promoting the development of technologies that will separate dioxins and ensure optimum incineration.

# Control of Chemical Substances

In February 1996, the council of the Organization for Economic Cooperation and Development (OECD) recommended member countries to introduce the Pollutant Release and Transfer Register (PRTR) system, which enables the registration of released and waste transfer amounts of chemical substances. This system was implemented as a law in Japan in July 1999. The control of chemical substances at Mitsubishi Electric is based on the concept of the PRTR.

## System of Voluntary Management

Mitsubishi Electric prohibits the use of 27 chemical substances (S class), and categorizes some 488 other chemical substances into four classes (A, B, C1 and C2) targeted for the company's voluntary management system. If a targeted substance is found to be utilized in a manufacturing process or in a product itself, the materials balance is identified and efforts are made to substitute substances that are more relevant to the environment with those that cause little or no harm.



Materials Balance Management

## Chemical Substance Classification

Class	Group Qty.	Example	Management
S	27	PCBs, specified ozone-depleting substances, some asbestos, etc.	Utilization prohibited in manufacturing and products
A	13	Organic chloride compounds, trichloroethylene, dichloromethane, etc.	Release into the air to be reduced utilizing quantitative targets
B	144	Chemical substances targeted for control in the electrical and electronics industry by PRTR system	Materials balance to be recorded, Reduction in discharge/utilization is being promoted where possible, Detailed management conditions set according to environmental relevance
C1	255		
C2	76		

## Chemical Substance Control System

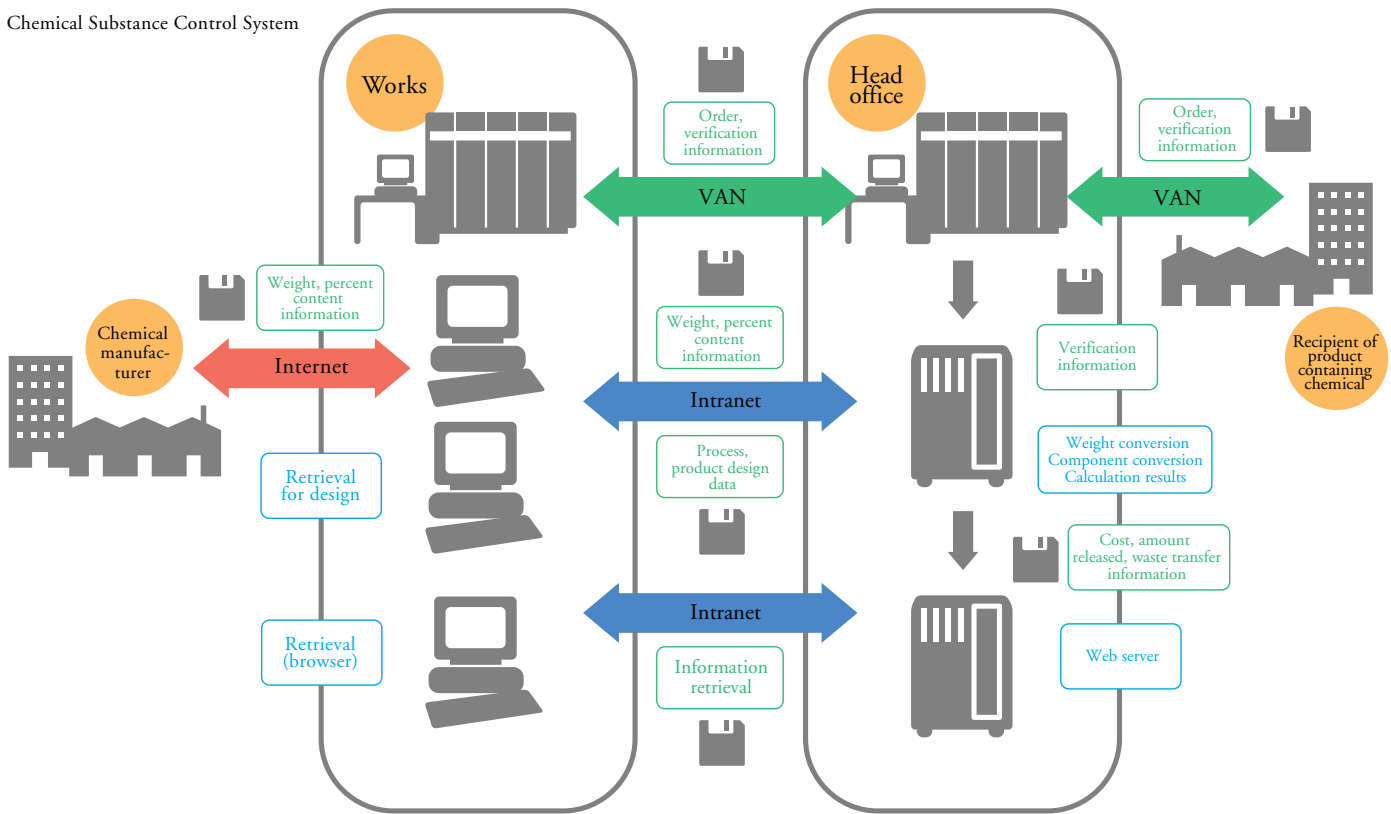
In Mitsubishi Electric, the release and transfer data of each factory are collectively calculated at the company head office based on the electronic data interchange (EDI) transactions for materials purchase. Once the purchase quantity reported by the EDI transaction data is converted to product weight, the weight of each chemical component in the product is computed. Additionally, conversion to released and waste transfer amounts can also be simulated based on past results. Applying this system for the control of chemical substances presents the following three advantages:

- 1) Energy and labor savings for computation and management services (efficiency of automation over manual operation),
  - 2) Information disseminated company-wide (component data obtained from each works is available throughout the company), and
  - 3) Consolidation of the infrastructure for "green procurement" (mechanism in which products with environmentally relevant substances cannot be purchased).
- Mitsubishi Electric plans to link its DFE system for design and to develop activities with affiliated companies in the future.

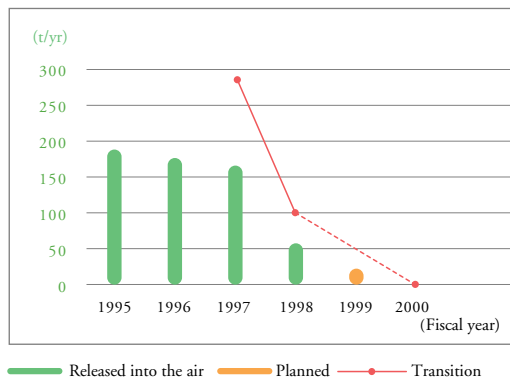




Chemical Substance Control System



Transition in Trichloroethylene Release into the Air

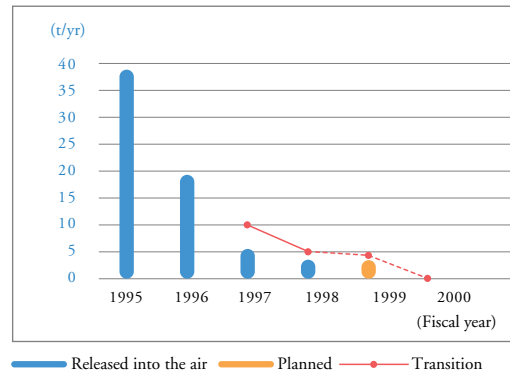


PRTR at Mitsubishi Electric

The results of summing up utilization by the chemical substance control system are shown on page 17. A total 8,300t of chemical substances were used at 31 works in Japan, with a breakdown showing 64 chemical substances categorized into 39 groups according to classification and substance type. The overall rate of release was 6.2%, of which 97.7% was released into the air. Chemical substances noted for large release volumes included the xylenes, toluene, etc., which are used as solvents in paints and varnishes. Giving due consideration to the influence of such results on product quality, Mitsubishi Electric is now promoting the utilization of non-solvent paints and varnishes.

The company has targeted the phasing out of class A substances, particularly trichloroethylene and dichloromethane in view of the large volumes released into the atmosphere, as well as other organic chloride compounds by the end of fiscal 1999 (i.e., zero use fiscal 2000). The results of reduction efforts and future plans are shown in the graphs to the left.

Transition in Dichloromethane Release into the Air



Chemical Name	Electric/Electronics Machinery 5-organization PRTR Substance No.	Transition volume	Released into Atmosphere	Released into Water	Released into Ground	Consumed	Disposal	Waste Transfer	Recycle	Control Reclamation	
Substance A	Trichloroethylene	72	87.22	41.31	0.00	0.00	0.00	9.00	36.91	0.00	
Substance A	Dichloromethane	50	4.87	3.39	0.18	0.00	0.38	0.80	0.12	0.00	
Substance A	Chloroform	32	0.34	0.10	0.00	0.00	0.05	0.09	0.10	0.00	
Substance A	Tetrachloroethylene	66	0.15	0.05	0.00	0.00	0.00	0.10	0.00	0.00	
Substance A	Formaldehyde	105	2.56	0.05	0.01	0.00	1.97	0.48	0.06	0.00	
Substance A	Benzene	100	0.05	0.01	0.00	0.00	0.00	0.04	0.00	0.00	
Substance A	Nickel compound	81	0.55	0.00	0.00	0.40	0.08	0.03	0.00	0.03	
Substance A	1,2-dichloroethane	43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Substance A	Acetaldehyde	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Substance B	Lead solder	905	669.23	0.18	0.01	0.00	552.15	0.79	1.68	110.88	3.53
Substance B	Chromium compound (VI)	24	0.46	0.01	0.00	0.07	0.23	0.15	0.00	0.00	
Substance B	Beryllium and compounds	99	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	
Substance B	Mercury and compounds	62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Substance B	Arsenic and compounds	87	0.58	0.00	0.00	0.04	0.23	0.31	0.00	0.00	
Substance B	Manganese and compounds	107	0.15	0.00	0.00	0.00	0.15	0.00	0.00	0.00	
Substance C1	Xylenes	21	323.08	234.79	0.00	0.79	3.89	74.65	8.96	0.00	
Substance C1	Toluene	79	259.28	202.21	0.00	1.05	25.58	18.63	11.80	0.00	
Substance C1	Trichlorophenols	74	11.00	10.45	0.00	0.00	0.55	0.00	0.00	0.00	
Substance C1	Styrene monomer	63	95.69	4.63	0.00	80.78	3.22	5.21	0.00	1.85	
Substance C1	Hydrogen chloride (excl. hydrochloric acid)	15	961.59	1.43	0.36	2.98	956.82	0.00	0.00	0.00	
Substance C1	Fluorine hydrogen	94	143.90	1.42	10.85	0.00	90.43	37.70	0.00	3.50	
Substance C1	Boron and compounds	104	3.35	0.12	0.00	2.05	0.03	0.84	0.31	0.00	
Substance C1	Tungsten compounds	148	0.10	0.10	0.00	0.01	0.00	0.00	0.00	0.00	
Substance C1	Chlorine	18	3.15	0.09	0.00	0.11	2.96	0.00	0.00	0.00	
Substance C1	Ethylbenzene	123	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	
Substance C1	Fluorine compounds (inorganic)	96	3.99	0.04	0.03	0.00	3.93	0.00	0.00	0.00	
Substance C1	Cyanogen compounds	37	1.26	0.04	0.00	0.00	1.22	0.00	0.00	0.00	
Substance C1	Diphenylmethane diisocyanate	55	1842.62	0.01	0.00	0.00	1779.90	0.05	62.66	0.00	0.00
Substance C1	Hydrazine	88	0.36	0.00	0.01	0.00	0.00	0.35	0.00	0.00	
Substance C1	Diethyle hexyle phthalic acid	93	2.77	0.00	0.00	0.00	0.00	2.77	0.00	0.00	
Substance C1	N,N-dimethyl formamide	58	7.39	0.00	0.00	0.00	0.00	7.39	0.00	0.00	
Substance C1	Mono-ethanolamine	121	132.50	0.00	0.00	0.00	0.00	132.50	0.00	0.00	
Substance C1	Silicon carbide	147	0.30	0.00	0.00	0.27	0.00	0.03	0.00	0.00	
Substance C1	Zinc compounds	1	28.99	0.00	0.03	9.15	0.00	18.77	0.97	0.06	
Substance C1	Antimony and compounds	8	194.13	0.00	0.00	181.36	0.02	3.49	9.27	0.00	
Substance C1	Lead compounds	80	1653.43	0.00	0.03	1565.69	0.00	0.80	86.90	0.01	
Substance C1	Cobalt and compounds	34	0.69	0.00	0.00	0.08	0.00	0.60	0.00	0.00	
Substance C1	Barium and compounds	86	688.39	0.00	0.03	653.27	0.55	0.28	34.25	0.01	
Substance C2	Aluminum compounds (insoluble salt)	118	1169.28	0.00	0.08	0.00	1054.28	43.91	15.52	55.49	0.00
<b>Total</b>		<b>8293.45</b>	<b>500.48</b>	<b>11.62</b>	<b>0.00</b>	<b>5886.41</b>	<b>1135.55</b>	<b>394.45</b>	<b>355.95</b>	<b>8.99</b>	

Chemical substance transition, release into the environment and waste transfer for the operations of Mitsubishi Electric (fiscal year 1998 results, units in t/yr).  
Due to rounding of the third decimal point, transition volumes less than 0.005 t/yr are indicated as 0.00.

## Action Taken for Water Resources

The pollution of water resources by organic chlorine compounds has become an important problem for society. Mitsubishi Electric closely monitors activities related to such matters, such as revisions in the Water Pollution Control Law and ISO 14001 certification, and places the highest priority on observing all laws and establishing corporate morals in the industry. Beginning in June 1998, we conducted a re-inspection of all facilities company-wide, applying standards stricter than ever before to ensure that our operations are compliant and environmentally safe.

### Basic Policy

- Eliminate the utilization of organic chlorine compounds
  - Company factories : by the end of fiscal 1999
  - Domestic affiliate companies : by the end of fiscal 2000
- Report the results of investigations on underground water pollution to local authorities immediately.
- If the level of pollution in underground water exceeds environmental standards, appropriate countermeasures are to be implemented swiftly under the guidance of local governmental authorities.

## Action Taken for Works - Elimination of Trichloroethylene - (Kani Factory of Nagoya Works)

The Kani Factory previously used trichloroethylene in the manufacture of magnetic contactors (rust-proof treatment of the magnetic core); however, the development of substitute rust-proofing technology enabled the elimination of trichloroethylene by March 1999, within the first year of the phase-out plan. Applied is an aqueous chemical process that provides sufficient degreasing, washability, rust resistance and productivity. Combined with a wastewater treatment plant, water pollution control within environmental standards is achieved. As the process is automated, productivity has been improved as well.

## Non-Chromium Etching Liquid for Evaluation (ULSI Development Center)

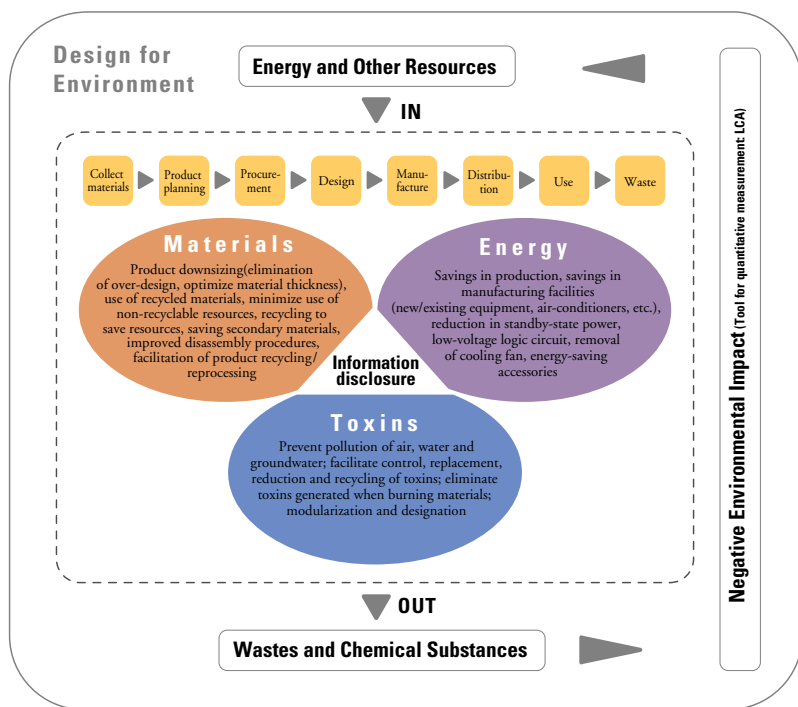
The ULSI Development Center is involved in the development of silicon semiconductor devices, in which a chromium compound ( $Cr^{6+}$ ) etching solution is utilized to test for defective crystals. A substitute has long been sought in view of the highly toxicity of the chromium compound. It was recently found that a new solution, SATO, is applicable for evaluating crystal defects. SATO is a mixture of hydrofluoric and nitric acids and water, and thus enables the elimination of chromium compounds from semiconductor manufacture. An additional benefit is that SATO can be treated using the same wastewater treatment facilities used for the wastewater from other semiconductor processes.



Automated Aqueous Formation Coating System

# Actions to Reduce Negative Environmental Impact of Products

Since the enactment of the "Recycled Resources Utilization Law (Recycling Law)" in 1991, Mitsubishi Electric has taken a positive approach in the use of product assessment to increase more effective use of materials, facilitate recycling and minimize the wastes of a variety of products.



## 🌿 M.E.T. Considerations

In addition to approaching environmental problems as previously conducted, the company is actively working to expand activities throughout its operations. The introduction of "Design for Environment" is one such activity. This system considers the impact a product has on the environment throughout its entire lifecycle focusing on the factors of materials, energy and toxins (M.E.T.); effective use of materials and energy and prevention of toxic pollution.

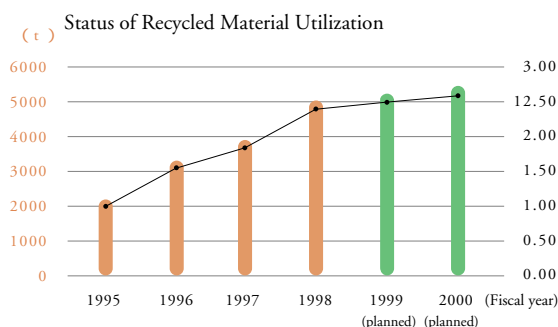
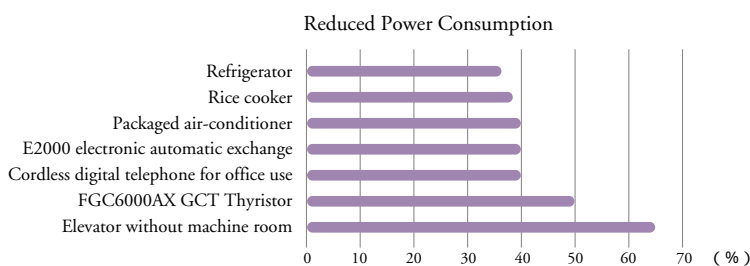
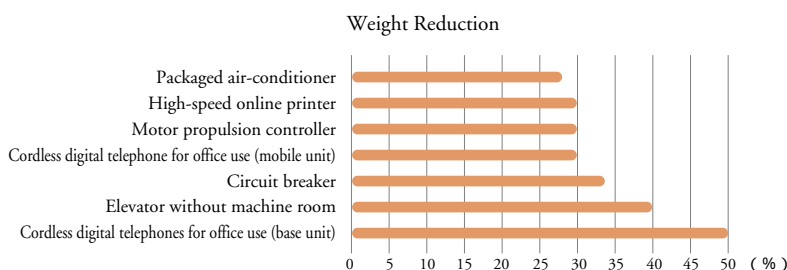
### Effective Use of Resources

In fiscal 1998, by reducing the weights and volumes of fingerprint identification equipment, display monitors, gas-insulated transformers and a number of other products, disassembly times were shortened.

The effective use of resources requires not only that resources be recycled but that the recycled materials are also used. Excluding recycled metals, we have set a goal to increase the quantity of recycled materials utilized in Mitsubishi Electric products by 30% by fiscal year 2000 (fiscal 1995 as the base year). The approach taken varies depending on the individual product or manufacturing facility, but the application of recycled plastics to the main bodies of products (including in-process recycling) and the recycling of manuals and product catalogs are major items to be taken into consideration.

### Reductions in Product Power Consumption

The revised "Energy Conservation Law" has led to greater energy savings in many devices, creating "first-rate systems." In addition to saving energy during the normal operation of a device, Mitsubishi Electric is developing ways to save power consumption during the standby-state for products such as high-definition TVs, power devices, microwave ovens, cordless digital telephones for office use, etc.



## Control of Chemical Substances

We are now reviewing chemical substances to determine those that can be used in products without causing toxic pollution. Additionally, studies are being conducted for the application of non-halogen resin wiring material and using vinyl chloride resin cable as a substitute material.

## Reduction of Packaging Materials

Packaging materials consumption in fiscal 1998 was 47,000t, a reduction of 17% compared to the materials used in fiscal 1995. Polystyrene consumption was reduced 180t as the result of utilizing substitute packaging materials like cardboard, air-cap plastic and recycled pulp-mold. The consumption of corrugated cardboard was reduced 2,200t compared to that utilized in fiscal 1995 as the result of reducing package size, making the cardboard itself thinner and introducing simpler packaging. Further, wood consumption fell 4,000t owing to the substitution of steel packaging and packaging products according to revised specifications.

From this time on, we will approach activities regarding product packaging from the standpoint of maintaining compliance with the "Container and Package Recycling Law," which is to be fully enforced from April 2000.

## Promotion of DFE

Mitsubishi Electric developed a recycle information system based on the information obtained during its participation in the "Inverse Manufacturing Forum" presided by the Manufacturing Technology Center. Based on the technology obtained in the forum, we created a support system, "Design for Environment (DFE)" for departments engaged in product design. DFE enables the automatic collection of data from current design systems (three-dimensional CAD, PDM systems, etc.) for quantitative assessment of product recycling ratio and negative environmental impact. Focusing on mass-produced products, engineering departments can evaluate the simulation of system designs to create the optimum plan.



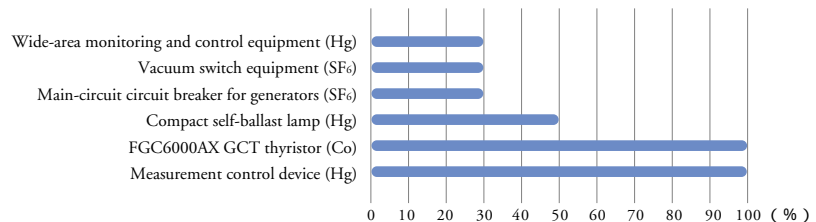
Recycle Information System

## Home Electronics Products Issues

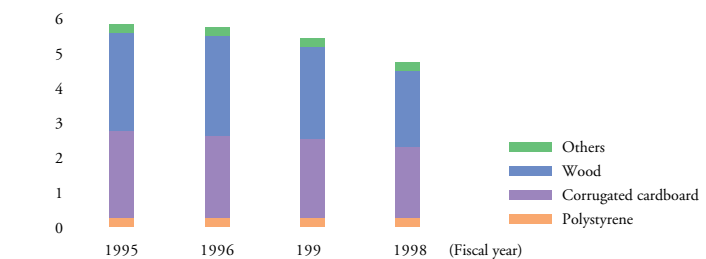
In accordance with the basic concept reflected in the Mitsubishi Scroll Recycle System (MISERS), the goals set forth for our DFE activities will be achieved by taking into account materials, energy and toxins (M.E.T.). Products are categorized into three groups, (1) "Products (air-conditioners, refrigerators, washing machines and televisions) covered by the Home Appliances Recycling Law," (2) "Products other than the four items listed in (1) above," and (3) "Products such as lighting fixtures and ventilators." Tangible numeric values are set for 33 items such as "Possibility to design-in recyclable materials," "Promotion of product energy savings," "Prevention of toxic

pollution," "Ease of disassembly and sorting," "Promotion of recycled materials use," "Reuse of long-life parts," etc. and determined for two periods, short-term (2001-2004) and medium to long-term (after 2005). As an example, reductions of lead soldering and vinyl chloride are applicable to three groups, the short-term goal is a 30% reduction and the medium to long-term goal is zero use. Based on the reference values obtained for home electronics products sold in fiscal 1998, this concept is being applied to all newly developed products, and the progress of accomplishment will be verified each year.

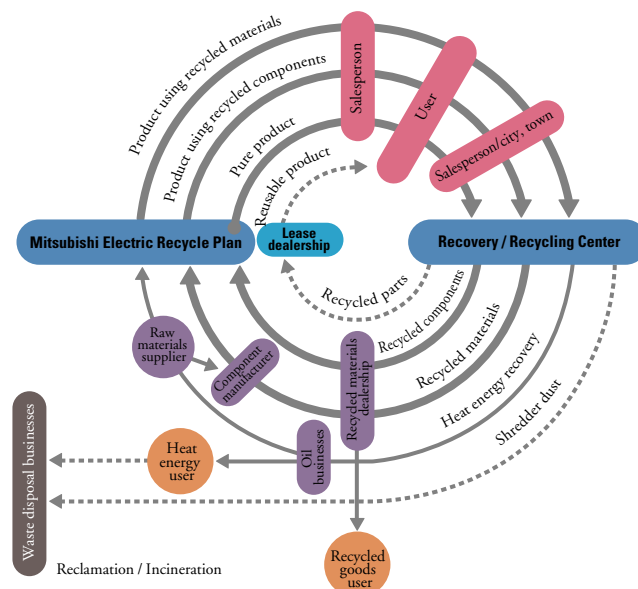
Reduction of Toxins



Transition of Total Packaging Material Use



## Mitsubishi Scroll Recycle System



## Compliance with the "Home Appliances Recycling Law"

The Home Appliances Recycling Law\* requires the proper disposal and recycling of products after their abandonment. Designated products include color televisions, refrigerators, air-conditioners and washing machines.

\* New recycling law introduced by the Japanese government.

### Establishment of Higashi-hama Recycle Center (Japan)

To uphold compliance for the Home Appliances Recycling Law, which is to become effective in April 2000, a recycling plant for the intermediate disposal of used home appliances and office automation equipment was constructed in Ichikawa City, Chiba Prefecture, Japan, and began full-scale operation in May 1999.

In addition to recycling standard materials such as iron, copper, aluminum and glass, Mitsubishi Electric is collaborating with intermediate processing businesses and materials manufacturers to improve separation technologies for materials like plastic components and expand the application of recycled materials. The company will compile the various knowledge obtained from this plant and feed it back to product planning departments for utilization in designing products that are more recycle friendly.

### Plant Features

- Annual disposal capacity is approximately 60,000 home appliance products and 400,000 office automation products.
- "Zero emissions" is targeted through the utilization of disassembly and separation technologies.

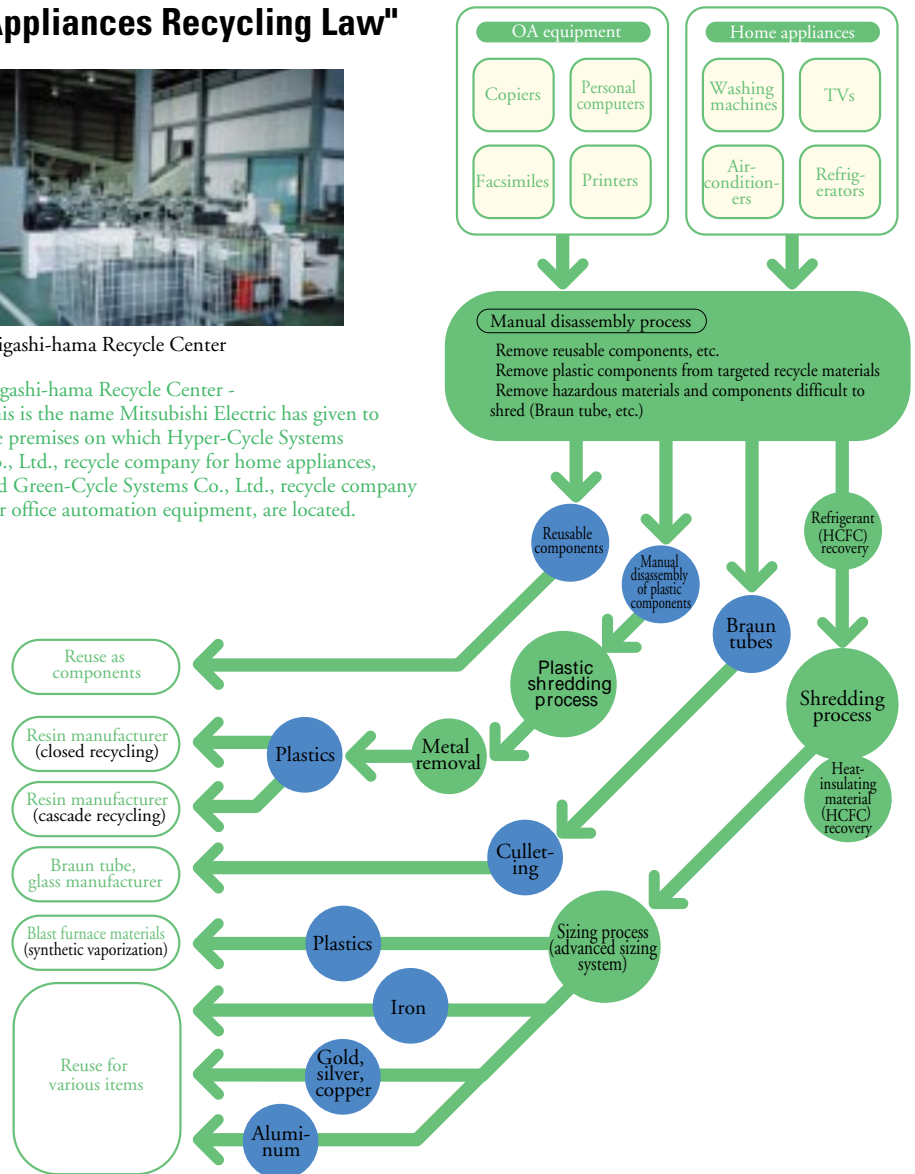
For inquiries, please contact

Living Environment Systems Group  
Used Home Electronics Products Recycling Business  
Management and Promotion Office  
Tel: +81-3-3218-9186



Higashi-hama Recycle Center

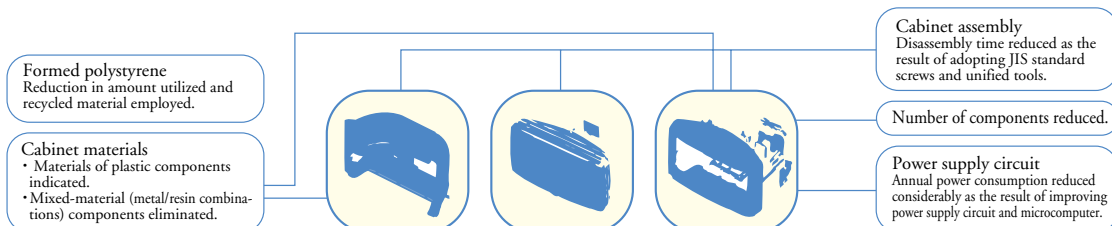
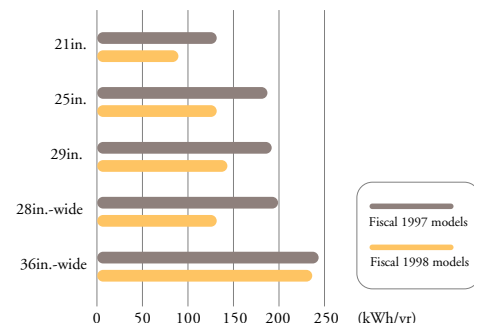
Higashi-hama Recycle Center - This is the name Mitsubishi Electric has given to the premises on which Hyper-Cycle Systems Co., Ltd., recycle company for home appliances, and Green-Cycle Systems Co., Ltd., recycle company for office automation equipment, are located.



### Actions for Designated Products Color TV

Energy conservation	<ul style="list-style-type: none"> <li>• Annual power consumption reduced considerably as the result of improving power supply circuit and microcomputer.</li> <li>• Former models required electric power even when the main power switch was turned off; however, new models use 0W.</li> <li>• Standby-state power use reduced dramatically from 6 to 0.25W (96%).</li> <li>• Pressing the "Economy" button switches the TV to electricity saving mode.</li> </ul>
Product recycling	<ul style="list-style-type: none"> <li>• Disassembly time reduced as the result of adopting JIS standard screws and unified tools.</li> <li>• Number of components reduced by 20% (28in.-wide models).</li> <li>• Materials of plastic components indicated (more than 95% as component weight ratio).</li> <li>• Utilization of mixed-material (metal/resin combinations) components eliminated.</li> </ul>
Packaging	<ul style="list-style-type: none"> <li>• Utilization of formed polystyrene reduced by 25% (21in.-wide models).</li> <li>• Recycled formed polystyrene utilized.</li> </ul>

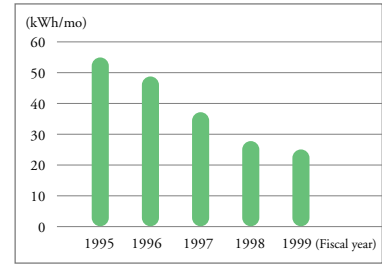
Annual Power Consumption of Color TV



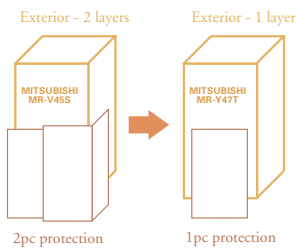
### Actions for Designated Products **Refrigerators**

Energy conservation	<ul style="list-style-type: none"> <li>Improved inverter control, increased compressor efficiency, and a larger blower fan enabled consumption of electricity to be reduced by approximately 10% (50% reduction compared to power use 4 years prior).</li> </ul>
Product recycling	<ul style="list-style-type: none"> <li>Materials of plastic components indicated.</li> <li>Packing insertion groove integrated into the door to eliminate hard vinyl chloride component for groove (all models over 370 liters).</li> </ul>
Packaging	<ul style="list-style-type: none"> <li>In simplifying exterior packaging, corrugated cardboard was reduced 20% (R-Y47T).</li> </ul>

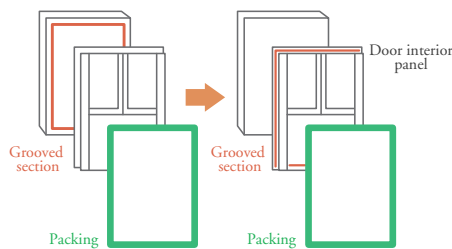
Transition of Electricity Consumption Rate (method B)



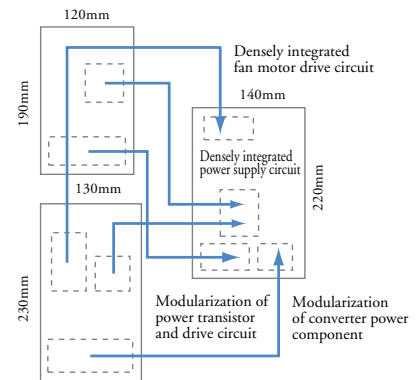
Reduction in Corrugated Cardboard Use



Elimination of Hard Vinyl Chloride Used in Door



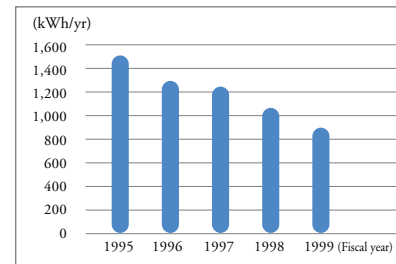
Reduction of Outdoor Unit Circuit Board Components and Solder



### Actions for Designated Products **Room Air-Conditioners**

Energy conservation	<ul style="list-style-type: none"> <li>Consumption of electricity reduced 16%, from 1,063 to 897kWh.</li> <li>Standby-state electricity consumption reduced 75%, from 3 to 0.8W.</li> <li>Average energy efficiency improved 18%, from 3.95 to 4.65.</li> </ul>
Product recycling	<ul style="list-style-type: none"> <li>Disassembly time shortened as the result of introducing a simplified disassembly process.</li> <li>Introduction of a hollow heat-insulated air vent construction enabled the elimination of pasted heat-insulating material (polystyrene).</li> <li>Dense integration of circuit board electrical components in outside unit enabled a 45% reduction in number of components.</li> <li>Materials of plastic components indicated (amounts less than 100g also indicated).</li> <li>Dense integration of circuit board electrical components in outside unit enabled a 45% reduction in the amount of solder.</li> </ul>
Packaging	<ul style="list-style-type: none"> <li>An automatic refrigerant leakage inspection utilizing helium confirmed that the release of refrigerant (substitute HFC) into the atmosphere was eliminated entirely.</li> </ul>

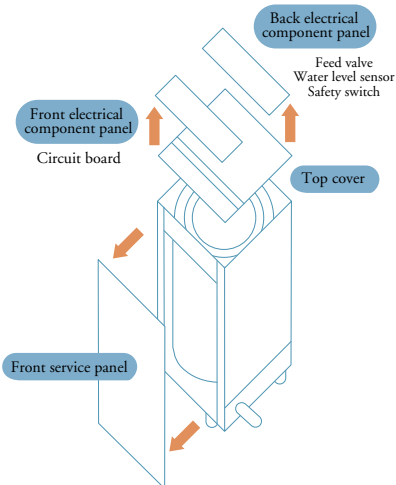
Transition of Annual Electricity Consumption Rate



### Actions for Designated Products **Washing Machines**

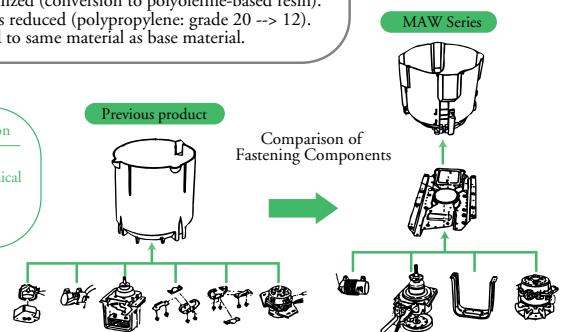
Energy conservation	<ul style="list-style-type: none"> <li>Incorporation of inverter water flow for the drum enabled the consumption of electricity to be reduced by 45%.</li> </ul>
Water conservation	<ul style="list-style-type: none"> <li>Correct measurement of clothing volume reduces wasted water from 35 to 12 liters (MAW-V8MP).</li> <li>Adoption of a stepless automatic water setting function reduces actual amount of water utilized.</li> </ul>
Product recycling	<ul style="list-style-type: none"> <li>Disassembly directions unified.</li> <li>Elimination of special tools (configuration of rinsing bin attachment changed).</li> <li>Structural components unitized in blocks.</li> <li>Materials of plastic components indicated (amounts less than 100g also indicated).</li> <li>Unification of plastic utilized (conversion to polyolefine-based resin).</li> <li>Number of plastic grades reduced (polypropylene: grade 20 --&gt; 12).</li> <li>Pasted faceplate changed to same material as base material.</li> </ul>

Simplified disassembly process



Simplified Water Tank/Structural Component Separation

- Structural components unitized in blocks.
- Number of fasteners attaching the water tank and mechanical components reduced (27-->8pc).
- Number of fasteners for other component attachments reduced (49-->29pc).



\* Information compared to previous Mitsubishi Electric products unless specified otherwise.

## Other Environment Adaptive Products

### Ventilation Fan (metal-bodied, propeller type for kitchen)

Mitsubishi Electric is the first company in the industry to change from the use of aluminum plate to a magnesium alloy as the material of the molded blade in ventilation fans. Magnesium is an abundant resource and is also easily recycled. The energy required for melting the magnesium is only about 4% of that used for processing the raw material. Likewise, magnesium requires one-third less the calories required for melting down an equal amount of aluminum.

- Magnesium is the lightest metal alloy and has high strength and excellent processability, thus making it suitable for forming an ideal propeller fan.

A significant reduction in blade thickness and weight (from 280 to 170g) has been realized.

- Lower airflow resistance over the blade section (about 3dB noise reduction during actual use; with a static pressure of 10Pa) and reduction of motor load have enabled energy savings of 30% to be achieved.

- Number of components in the blade construction was reduced from 10 to 2, greatly facilitating ventilation fan disassembly.

### Composite Integrated Camera for Indoor Use

The durability of this camera is such that it can be installed either inside a store or under the eaves of a roof outside. It has a surveillance view pattern with rotation in all directions (vertical angle of 180 ° and horizontal angle of 360 °).

Compared to its predecessor model, the CIT-751, rotation speed has been increased fourfold and maximum 60x zoom-up magnification incorporated.

A more compact, lighter camera design achieved a weight reduction of 33% and overall volume reduction of 52%. This led to reductions in the consumption of packaging and anti-shock materials required.

The adoption of a power-saving design for the motor-drive circuit enabled power consumption to be reduced approximately 10%, from 15 to 13.5W.

### MF355F-3 Flexible Disk Drive (REV.F)

Careful consideration is given to the environment when making each product, as can be witnessed in a new flexible drive disk developed in 1998.

Application of an IC (M61839FP) comprised of an electrical circuit that includes a small signal amplifying circuit and the control circuit necessary for driving the magnetic head enabled reductions of power consumption during operation by 51% (0.85W) and power consumption in standby mode by 40%

(0.015W), achieving considerable energy savings.

Audible noise generated during the travel of the magnetic head has been reduced 15% (28dB).

### MR-J2-03A5 24VDC Servo-Amplifier

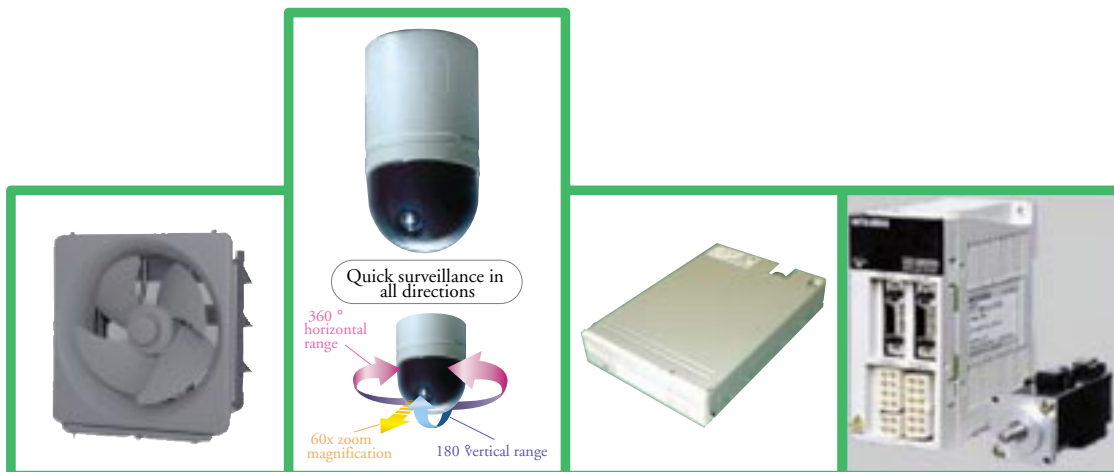
We developed a series of compact 24VDC servo-amplifiers, the MR-J2-JR Series. These servo-amplifiers can be utilized with motors of three different drive ranges (10, 20 and 30W) that our previous servo-amplifiers were not capable of complying with.

The outer dimensions of the newly developed servo-amplifier have been made amazingly compact, thus reducing the overall volume of the product to one-third of the volume of our conventional servo-amplifier.

Combining the motor-drive cable and detector cable has made saving cable wiring possible and considerably reduced the materials required.

The use of plastic materials and a design that enables the unit to be assembled/disassembled without tools has made the separation process easier.

Even if a customer uses a variety of the newly developed servo-amplifiers, the product features have been unified so that only a single user's manual is required. The manual context has been simplified greatly, from 250 pages to a single sheet of A3 paper, thus providing a tremendous savings in paper consumption.



Ventilation Fan  
(metal-bodied, propeller-type)

CIT-755 Composite  
Integrated Camera for Indoor Use

MF355F-3  
Flexible Disk Drive (REV.F)

MR-J2-03A5 24VDC Servo-Amplifier



### CU-250 Car Navigation Unit

The production of the circuit board for this car navigation unit utilizes extreme precision, high-density gate arrays and large-capacity, small-size memory to achieve a compact and lightweight design. Weight has been reduced by 66% and overall volume by 68%.

The number of components was reduced by approximately 53% by increasing the circuit board from 4 layers to 6, thus allowing the number of circuit boards to be reduced from 4 to 1.

Energy saving technologies enable the newly developed unit to operate on only 68% of the current required by the previous model.

### Simple Packaging for Indoor Condensing Units

Our indoor condensing units were conventionally packaged in wood framing. However, design changes introduced, including a pallet-like structure in the lower section of the freezer unit for handling, making the entire top of the unit flat and an even height to strengthen resistance to other loads, and replacing the upper wood section with corrugated cardboard, have made it possible to eliminate the use of wood packaging entirely.

Additionally, the number of steps required for shipping units has been halved compared to conventional means, realizing a cost reduction of 80%.

### Development of a High-Power Amplifier for Mobile Telephones

Yet another example of Mitsubishi Electric's concern for the environment can be found in the resource-friendly technologies incorporated into its 800MHz Personal Digital Cellula (PDC) telephone. Both power consumption and unit size have been reduced considerably.

Operation efficiency has been improved 53 to 57% by reducing the electrical current required during operation from 500 to 470mA without lowering the output of the high-power amplifier. This increases communication time to 120min and standby-state time to 320hr.

Studies of how to make the PDC more compact and lighter resulted in reductions in overall volume from 0.2 to 0.1cc and weight from 0.56 to 0.28g.

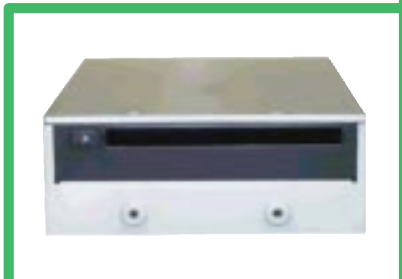
### Ultra-Compact, Lightweight Dual-Inline-Intelligent Power Module (DIP-IPM)

To increase the energy savings of electrical appliances, we have studied the possibility of utilizing DIP-IPMs designed for use with inverters. As a result of our studies, we have developed a compact transfer-mold DIP-IPM focusing on small-capacity inverters for refrigerators and washing machines. The incorporation of DIP-IPMs promotes savings in space (i.e., smaller product size), energy consumption and resources (i.e., use of fewer resources in product manufacture).

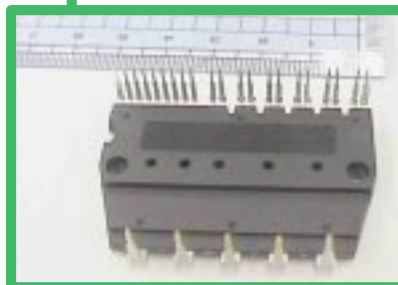
Adoption of a thin transfer-mold package without fins reduced the packaging area by approximately 40% and weight by approximately 60%(54 to 24g). Further, the overall volume has been reduced by approximately 60% compared to the previous model.

The utilization of high-voltage integrated circuits (HVICs) in DIP-IPMs has enabled elimination of the use of insulating elements such as photo-couplers, etc. The simple addition of a couple of circuits enables the operation of devices with a single external battery rather than four batteries as required previously.

CU-250 Car Navigation Unit



Developing a high-power amplifier for mobile telephones



Ultra-Compact, Lightweight DIP-IPM



(Conventional wood frame packaging)



(Simplified packaging)

Packaging material examples

# Water and Greenery Protection / Education and Awareness / Social Contributions

## Preservation of Water and Greenery

### 🌿 Preservation of Water Resources

Mitsubishi Electric newly utilized 15.8 million cubic meters of water in fiscal 1998, and recycled 5.6 million cubic meters in keeping with its policy for effective utilization of water resources. Based on a total annual consumption of 21.4 million cubic meters, the ratio of recycled water used was 26%.

### Actions to Reduce Water Consumption

(Semiconductor Business Group)  
Voluminous amounts of water are required for manufacturing semiconductors. Of all the water Mitsubishi Electric utilizes annually, 9.6 million cubic meters (61%) of newly consumed water goes toward the manufacture of semiconductors. A massive volume of purified water is needed to process semiconductors, and large amounts of liquid chemicals and energy are required to refine it. Since the reuse of purified water results in energy and water resource savings, we do our utmost to recycle and utilize water from these operations. Of the total volume of purified water used last year, 5.1 million cubic meters was recycled purified water. In addition to building a large purified water recycling system for the semiconductor facilities, other daily water-saving efforts include the fixation of water reduction devices to faucets and sensors to control toilet water throughout the offices. Further, water that is returned from the facilities to the environment is so pure that it is possible to raise carp, goldfish, etc. in the draining tank.

### Killifish of Mitsubishi Electric (Fukuoka Works)

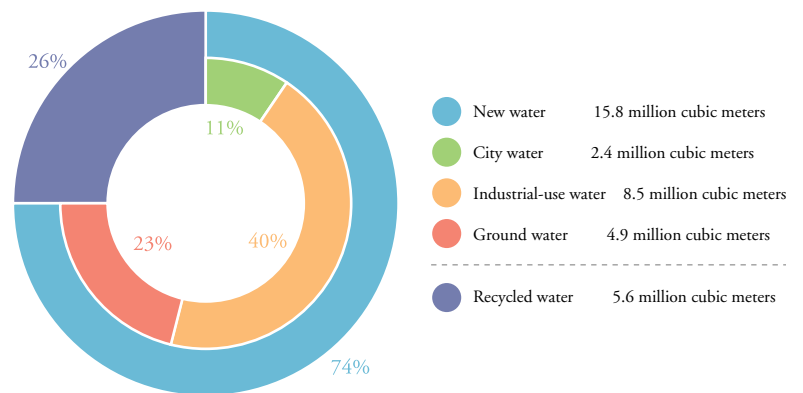
Killifish live in the waterway (formerly Matsumoto River) across from the Fukuoka Works. Water flowing into this waterway is now only that derived from rainwater runoff and the water expelled from the factory, and there is no trilateral drainage. However, the used water has been processed so thoroughly that the waterway maintains a purity high enough for killifish to live in it. These killifish (known as "medaka" in Japanese) are called "the Mitsubishi Medaka" and are bred for zoological and botanical gardens, and schools in Fukuoka City. We are now preparing to breed fireflies using a marsh snail that also lives in the waterway.

### 🌿 Preservation of Greenery

In efforts to reduce paper consumption, the company promotes the utilization of electronic mail, and intranet/Internet services. Paper utilized for photocopies, catalogs, brochures, toilet paper, etc. contains a high percentage of recycled paper. In fiscal 1998 alone, 6,500t of used paper was collected for recycling; this corresponds to preserving 130,000 logs\*.

\*One ton of used paper is equivalent to 20 logs (14cm in diameter, 8m long), from Guidelines for the Green Procurement Network.

Fiscal 1998 Water Consumption: 21.4 million cubic meters



Home of Mitsubishi Medaka

## Education and Awareness

Global environmental preservation is a task common to all Mitsubishi Electric employees as global citizens, thus increased education and awareness thereof form the basis for handling environmental problems.

### Actions of the Overall Company

- Technical sectional meetings
- Technological seminars
  - Satellite broadcasts (after/during working hours), Meeting training, Mitsubishi Business Seminar (MBS) lectures
- Sales lectures

Environmental Education

### Actions of Each Works

- Training of public disaster control and energy coordinators
- Training of internal auditors
- Separate training classes for new employees
- Training for new managers, new supervisors, newly appointed department heads, new section managers, and new group leaders

### Technical Sectional Meetings

A meeting, entitled the "Special Environmental and Technical Sectional Meeting," was organized in fiscal 1997 as a technical sectional meeting to promote positive action towards the accumulation and development of technologies through communication among employees. Signs of our efforts can be witnessed in the advancement of DFE technologies.

### Mitsubishi Electric Technological Seminars

The company holds a variety of technical seminars ranging from lectures to trainees by guest speakers at training facilities to the in-house satellite broadcasting of lectures company-wide. In addition to themes like ISO-14001 among others, seminars focusing on DFE began in fiscal 1997.

### DFE Meeting Lectures

This is a three-day program where participants consider possible measures to reduce negative impact on the environment through actual hands-on experience in disassembling products. The disassembly training themes include practice in disassembling an actual product, tree graph computation of the disassembly time, comparison of the computed time with the actually measured time, and analysis of recycling capabilities. The number of participants has surpassed 250.

### Lectures via Satellite

Utilizing a satellite communications system has increased the effectiveness of giving lectures by enabling us to reach an increasingly larger number of employees. Communications links connecting many locations allows interactive, informative discussions between the lecturer and trainees.

### Mitsubishi Business Seminar (MBS) Lectures

On Environment Day (June 5th) every year, "Mitsubishi Electric's Concept for the Environment - A Challenge for the Future (Commemorating Environment Day)," is broadcast throughout the company sites in Japan via an internal satellite communications network.



Participation in Business Forum for the Prevention of Global Warming



Lectures via satellite



Meeting lectures

## Social Contributions

As a member of a society, Mitsubishi Electric is continually exploring activities that contribute widely to improving and preserving the global environment.

### Support of the "Business Forum for the Prevention of Global Warming"

The World-Wide Fund For Nature (WWF) is the world's largest international non-governmental natural environment protection organization; the headquarters of which is located in Switzerland. The Japan Chapter for the World-Wide Fund For Nature (WWF-Japan) has established a business forum that seeks the cooperation of industries toward the common goal of preventing global warming. Mitsubishi Electric has participated actively in the Japan Chapter through information exchange and discussions, including the presentation of

### Beach Cleaning Project, "Love the Earth Clean-Up 1998" (Fukuoka Works)

"Love the Earth Clean-Up 1998" is an annual activity that targets community understanding of the importance of environmental protection by collecting garbage and trash from the beaches, rivers and mountains in Kyushu and Yamaguchi prefectures in Japan as well as in South Korea. The Fukuoka Works participates in the activities to clean the Imajiku and Nagataru beaches of Fukuoka City, part of the Genkai National Park. In fiscal 1998, led by the general manager of the works, 92 employees participated in the clean-up operations carried out on June 8th. Volunteers from the works also returned to the same beaches on Marine Day (July 20th) and participated in clean-up activities.

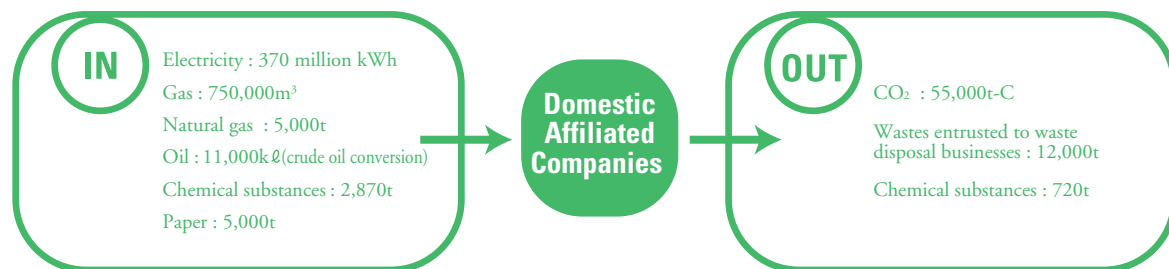


Love the Earth Clean-Up 1998

# Actions of Affiliated Companies

Recognizing the importance of the intimate link between the company and its affiliated companies when carrying out environmental management, Mitsubishi Electric actively promotes deeper awareness and understanding of environmental planning and related activities. Presently, all of the company's subsidiaries have either established or are in the process of setting up environment management systems focusing on manufacturing facilities and aim to achieve ISO 14001 certification by the end of fiscal 2000.

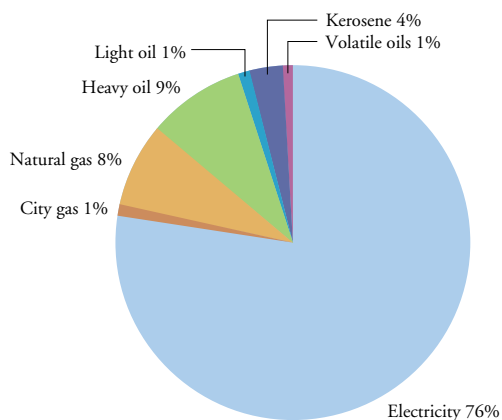
## Materials Flow



### Actions for the Prevention of Global Warming

(Manufacturing Facilities Energy-Saving Activities)

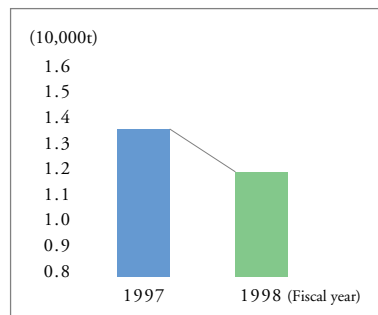
**Domestic :** The total CO<sub>2</sub> emissions discharged in fiscal 1998 was 55,000t-C. A breakdown of the energy sources from which the CO<sub>2</sub> originated is electricity 76%, various oils such as heavy oil 15%, and finally gases such as LPG 9%. We are now proceeding with activities to convert from energy sources that have a large negative environmental impact to those with little or no negative impact.



Breakdown of Energy Use

### Actions for Promotion of Conservation, Recycling and Reduction of Industrial Waste

**Domestic :** Commissioned waste disposal was approximately 12,000t in fiscal 1998, a reduction of approximately 10% over the previous year. Affiliated companies have devised environment management systems and are implementing them with the goal of acquiring ISO 14001 certification. Many of the companies have set a waste reduction value of 5% as the target value to be achieved in fiscal 1999.



Transition of Waste Entrusted to Disposal Businesses

### Actions for Control of Chemical Substances

**Domestic :** Mitsubishi Electric's domestic affiliated companies utilized 52 different types of chemicals, which were categorized into 41 groups. Total volume of chemical substance use for fiscal 1998 was approximately 2,900t. Following the activities of Mitsubishi Electric closely, the amount of organic chlorine compounds released into the environment has declined markedly, and the goal of eliminating their utilization entirely by the end of fiscal 2000 has been set.

**Overseas :** Of the organic chlorine compounds released by overseas affiliated companies, the largest amount was trichloroethylene with emissions of some 7.73t into the atmosphere.

Emissions	(t/yr)
Toulene	470
Hydrogen chloride	89
Dichloromethane	53
Xylenes	51
Chloroform	41

Chemical Substances Released into the Environment (Domestic Affiliated Companies)

## Setup and Structure of Environment Management System(EMS)

As shown below, five and six domestic and overseas affiliated companies, respectively, acquired ISO 14001 certification in fiscal 1998. This brings the total number of affiliated companies with ISO-14001 certification to 15, six domestically and nine overseas.

Country	Company	Business	Acquisition Date	Certifying Organization
Japan	Mitsubishi Electric Kumamoto Semiconductor Co., Ltd.	Manufacture of semiconductors and development, design and manufacture of semiconductor manufacturing equipment	Jul. 28, 1998	Japan Audit and Certification Organization for Environment and Quality
	Toyo Takasago Battery Co., Ltd., Chemical Products Business Division	Manufacture and marketing of various types of batteries and rubber products for industrial use, marketing of products such as electric appliances	Nov. 13, 1998	Japan Quality Assurance Organization
	Ohi Electric Corporation, Mizusawa Works	Manufacture and marketing of various types of communications equipment, electronic applications devices, information transmission equipment, measuring instruments and paging systems	Nov. 28, 1998	Japan Quality Assurance Organization
	Mitsubishi Electric Home Appliances Co., Ltd.	Manufacture and marketing of electric home appliances such as vacuum cleaners, electric rice cookers, electric ranges and microwave ovens	Mar. 12, 1999	Japan Quality Assurance Organization
	Kodensha (Kita) Co., Ltd.	Sales of basic electrical goods, electrical industrial systems and equipment, marketing of general machinery, household appliances, and motors, etc.	Mar. 26, 1999	Japan Management Association for Quality Assurance
China	Shanghai Mitsubishi Elevator Co., Ltd.	Manufacture, marketing, installation and maintenance of elevators	Oct. 23, 1998	Lloyd's Register Quality Assurance
Taiwan	Powerchip Semiconductor Corporation	Manufacture and marketing of semiconductor integrated circuits	Oct. 22, 1998	Lloyd's Register Quality Assurance
	China Ryoden Co., Ltd.	Manufacture, marketing, installation and maintenance of elevators	Nov. 21, 1998	The Bureau of Commodity Inspection and Quarantine Ministry of Economic Affairs Taiwan, R.O.C.
Thailand	Melco Manufacturing (Thailand) Co., Ltd.	Manufacture and marketing of magnetic disks and systems	Mar. 19, 1999	Bureau Veritas Quality International
	Mitsubishi Elevator Asia Co., Ltd.	Manufacture and marketing of elevators	Oct. 30, 1998	Bureau Veritas Quality International
Malaysia	Mitsubishi Electric (Malaysia) Sdn. Bhd.	Manufacture and marketing of VCRs and car audio systems, and manufacture of monitors	Mar. 19, 1999	SIRIM QAS

### Powerchip Semiconductor Corporation

(Taiwan Semiconductor Factory)

Power Semiconductor Corporation was inspected by Lloyd's Register Quality Assurance and acquired ISO 14001 certification in October 1998. It was the first semiconductor operations in all of Taiwan to be awarded certification within two years of beginning production. It is also a model company in the introduction of technologies for environmental safety such as the recycling of purified water utilized in semiconductor production and the promotion of waste separation processes.



Liquid Waste Recycling System

### Mitsubishi Electric (Malaysia) Sdn. Bhd.

(Malaysia VCR Factory)

Mitsubishi Electric (Malaysia) Sdn. Bhd. acquired ISO 14001 certification following inspections by SIRIM QAS. It is said environmental regulations set by the Malaysian government are even stricter than those of Japan, thus the important role of the activities by the company and its staff were highly commended. The company was first notified of acquisition during a facility tour visitation by Mitsubishi Electric's president, Mr. Ichiro Taniguchi. President Taniguchi addressed the importance of the EMS directly to the staff.



President Taniguchi and Mitsubishi Electric (Malaysia) Sdn. Bhd. staff

### Mitsubishi Semiconductor Europe, GmbH

(German Semiconductor Factory)

Mitsubishi Semiconductor Europe was rated the best semiconductor factory in all of Europe by the European Environment Management Scheme (EMAS) in November 1995, and became the first European semiconductor factory to acquire ISO14001 certification in May 1996. Since that time, the company has been continuously improving its EMS by conducting an internal audit each year. In October 1998, it passed re-examination by the EMAS for ISO 14001 status renewal.

**Osram-MELCO Co., Ltd.**  
Kakegawa Factory

The Kakegawa Factory of OSRAM-MELCO Co., Ltd., which manufactures lighting fixtures and electric ballast for fluorescent lamps, acquired ISO 14001 certification in fiscal 1997, and has subsequently worked under a proactive stance to contribute further through activities for environmental preservation backed by the annual issuance of a corporate environment report. Among its various successes, as a result of efforts to preserve energy, the energy required to manufacture a fluorescent lamp has been reduced by 23% since fiscal 1993. The company's efforts have not gone unrecognized as can be seen by the many awards it was presented in fiscal 1998.

- Superior Factory Energy Management Director-General's Prize, Agency of Natural Resources and Energy
- All-Japan Excellence Award (presentation of energy conservation case study) sponsored by the Energy Conservation Center
- Excellence Prize (energy conservation presentation) sponsored by the Kakegawa Sales Office of Chubu Electric Power Company

**Mitsubishi Electric Kumamoto Semiconductor Co., Ltd.**

Mitsubishi Electric Kumamoto Semiconductor Co., Ltd.(MKS) manufactures semiconductor ICs. In July 1998, six companies comprising the MKS group all acquired ISO 14001 certification, an event that gained much attention from related industries. Under the guidance of MKS, members of the group are exploring environment improvement activities focusing on energy and resources savings. Examples of improvements include assuring more efficient manufacturing operations; an inspection revealed that by monitoring the dry-air dew point and shutting down a vacuum generator of a dry compressed-air generator, one of the three compressors always in continuous use was no longer needed (i.e., elimination of a 110kW compressor). An energy savings of 5% was achieved for the entire facility owing to the joint efforts of the engineering and manufacturing divisions. The group's efforts have been well-recognized, and in fiscal 1998 two of the companies were presented awards for superior factory energy management from the Kyushu Bureau of Trade and Industry and the Energy Rationalization Council of Kyushu Electric Power Co., Inc.

**Mitsubishi Electric METECS Co., Ltd.**  
Joetsu Factory

The Joetsu Factory of Mitsubishi Electric METECS Co., Ltd. manufactures copper alloy materials for electronic parts. The manufacture of alloy requires numerous thermal processes such as melting, casting, annealing, rolling, etc. Therefore, reducing energy consumption is a big issue for us. In fiscal 1997, by implementing process rationalization, common-use compressors, optimization of air-conditioning temperature control, and introducing demand monitoring equipment, energy consumption was reduced 10% as compared to the level in fiscal 1995 (primary unit of electricity). As a result of these actions, in 1998 the Joetsu Factory was presented an award for superior factory energy management from the committee to promote electric power utilization in the seven Tohoku prefectures.

**Advanced Display Inc.**

Advanced Display Inc., a manufacturer of liquid crystal displays, has introduced an ice thermal-storage tank system that restricts peak power usage to about 90% of that when the system is not in operation by producing ice during the nighttime (when power demand is small) and then utilizing it for daytime air-conditioning of the clean room. The thermal-storage unit is a cylindrical tower that stands 27m high, has a diameter of 3.7m and contains 470,000 individual ball-shaped collectors capable of a heat fusion capacity of 10,560Mcal.

**Mitsubishi Electric Automotive America, Inc.**

(Automotive Electronics Factory, U.S.A.) Mitsubishi Electric Automotive America, Inc. has introduced highly energy efficient equipment into the production facilities and is now focusing on efforts to reduce paper consumption. Last year, 22,000m<sup>3</sup> of paper and 74,000m<sup>3</sup> of corrugated cardboard were recycled and 76 sets of printer cartridges reused.

**Power Circuit Board Integrated Manufacturing System S.A.de C.V.**  
(Projection TV and Monitor Factory, Mexico)

Power Circuit Board Integrated Manufacturing System recycled 500t of corrugated cardboard, and was presented the Environmental Award by the Environment Protection Agency of Mexico for the second consecutive year.



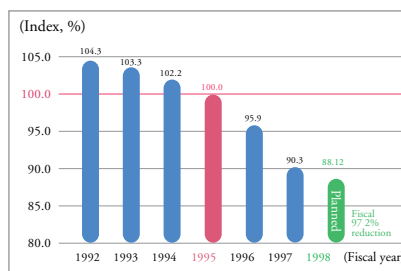
Mitsubishi Electric Automotive America, Inc.



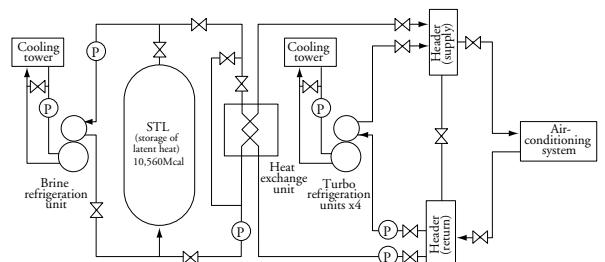
Power Circuit Board Integrated Manufacturing System S.A.de C.V.



Kakegawa Factory, Osram-MELCO Co., Ltd.



Transition of Electric Power Use (fiscal 1996 as base year)



Ice Thermal-Storage Tank System

# Environmental Accounting

It is important for a company to fully understand costs related to environmental activities as one of the indexes in evaluating its business operations. Mitsubishi Electric is trying to clarify the effectiveness of its environmental investments and expenses, which have been difficult to reflect in financial analyses of the company thus far. The introduction of "Environmental Accounting" is one approach for interrelating our economic and environmental activities. However, the definitions of accountable items and calculation methods for effectiveness are not standardized, and therefore Japan's Environment Agency and other international organizations are currently in the process of forming guidelines for this purpose. We also believe that it is important to operate on the basis of an environmental plan in order to make an overall judgement regarding more effective development of environmental issues, and as our first step, we have calculated the total cost of environmental related activities undertaken by the company. We shall proceed forward in the formation of a sound environmental plan while making reference to "Guidelines to Understanding and Reporting Environmental Accounting," published by Japan's Environment Agency in March 1999. Mitsubishi Electric's environmental related expenses in fiscal 1999 were as follows.

Period: Apr. 1, 1998 - Mar. 31, 1999  
Corporate figures only.

Environmental Related Expenses      1.23 billion yen

Total expenses for industrial and general waste treatment, recycling, pollution prevention, EMS establishment and enforcement, maintenance control (excluding personnel expenses) and environmental education.

Amount invested in reducing negative environmental impact

- R&D investment      6.22 billion yen
- Facility investment      4.07 billion yen

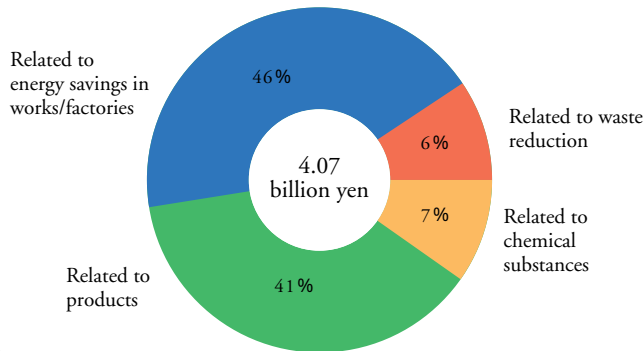
Total expenses for R&D and equipment investments related to energy savings in works/factories, waste reduction, control of chemical substances, and products that cause minimal negative impact on the environment. The environment-related costs of R&D and equipment investments were 6.22 and 4.07 billion yen, respectively, equivalent to 4.8 and 3.4%, respectively, of the total for Mitsubishi Electric in fiscal 1999.

Regarding investments in R&D, there exist no definitions for distinguishing activities that cause less damage to the environment from the other investments, and therefore the full amount is included in the calculations where there was difficulty in separating the investments by a fixed rate.

## Main equipment investments in fiscal 1999 were as follows.

- 430 million yen... Substitution line for organic solvents, incinerator renewal, control of specific HFC gases, freezer renewal (Nagoya Works)
- 300 million yen... Co-generation systems--waste heat utilization (Shizuoka Works)
- 210 million yen... Co-generation system--waste heat utilization (Air-Conditioning & Refrigeration Systems Works)
- 250 million yen... Increase in gas-engine compressors, etc. (Himeji Works)

Environmental Related Facility Investments  
(unit :100 million yen)



Use of Energy, Water, Etc.

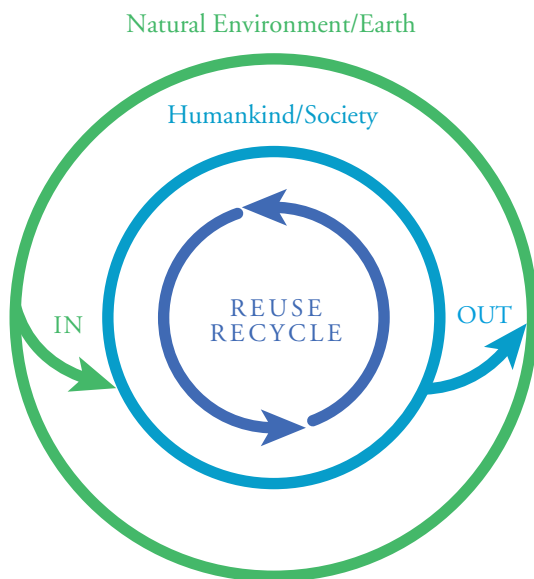
- Energy      23.07 billion yen
- Water (inclusive of sewerage)      2.01 billion yen
- Paper      1.90 billion yen

Profits from sales, etc. of valuable industrial and general wastes      580 million yen

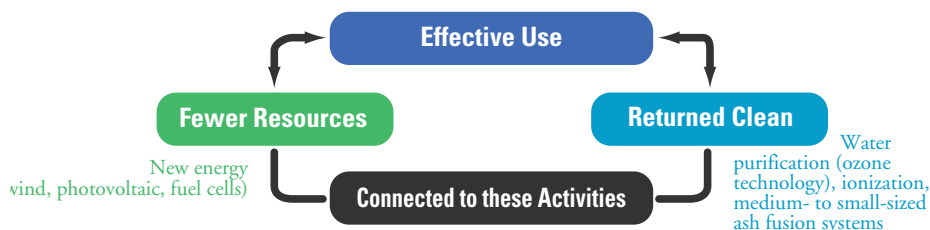
● Total profits from selling materials for separation and intermediate management.

# Environmental Related Business and Development

Mitsubishi Electric is actively involved in the research and development of environmentally related projects. Successful results of project development in fiscal 1998 are reported in the following.

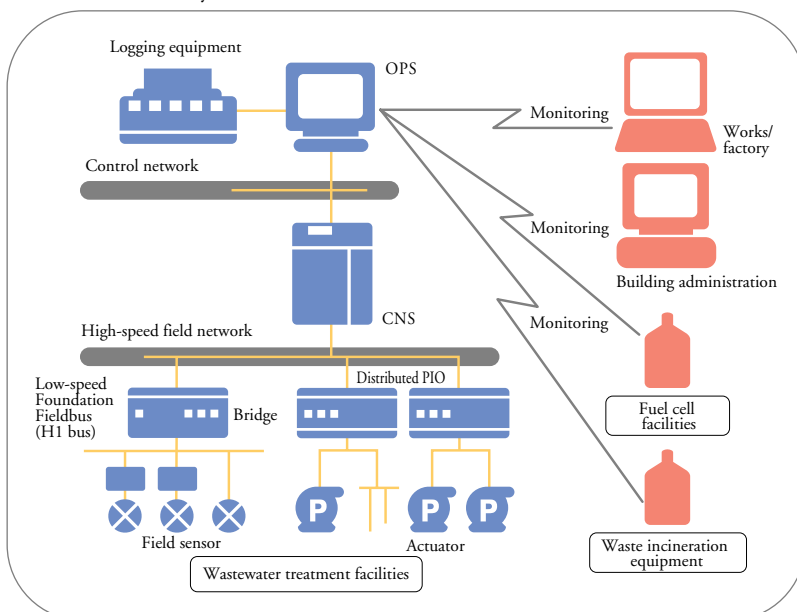


Energy-saving devices, co-generation systems, ice-thermal storage air-conditioning systems, advanced water treatment/purification/recycling, ozone generation/storage, key components for gasoline direct-injection (GDI) systems, ECO-Process, highly efficient power generation, power transmission/distribution systems, home electronics recycling plant technologies (recycling systems), Jet Towel, Hot-water system utilizing nighttime electricity



Observation satellites (remote sensing technologies), traffic control systems (ITS), Fieldbus system for wastewater treatment facilities, circuit breakers with measuring and display units, energy monitoring systems, support systems for environmentally conscious product design

Foundation Fieldbus System for Wastewater Treatment Facilities



## Development

### ECO-Process

Large quantities of chemical solutions consisting of strong acids, strong alkalis and organic solvents are utilized in the manufacturing processes of electronic devices for semiconductors and the cleaning processes for precision machine components. Although ozone has strong oxidizing power, it is gentle on the environment, because its reaction with organic compounds produces only oxygen, carbon dioxide and water.

We have developed a clean, high-concentration ozone generator and coined the word "ECO-Process" for its high speed and environmentally friendly processing ability. Moreover, processing with ozone is also economical as it enables us to reduce the quantities of chemical solutions used and conduct treatments at room temperature. Future development of ECO-Process technology will focus on reducing the quantity of chemical fluids used in manufacturing processes, with the aim of zero emissions.

### Fieldbus System for Wastewater Treatment Facilities

Utilization of the world-standard Fieldbus signal transmission system enables connection to the field equipment of any monitoring and control system manufacturer. Merits include reductions in cost for wiring cables and the ability to construct systems utilizing the equipment of multiple suppliers; therefore, inexpensive plant systems that meet customer needs can be constructed easily.

A monitoring and control system incorporating the Fieldbus system has been developed for a wastewater treatment plant that is now servicing the Energy & Industrial Systems Center of Mitsubishi Electric in the Kobe region of Japan. As a result, the chemical fluids and wastewater treatment conditions are observed and data compiled automatically. Plans are to improve high- and low-speed Foundation Fieldbus equipment for application in distributed control systems (DCS) in fiscal 1999.



## Business

### Using Fewer Resources...

#### Fuel Cell Power Generation Systems

Fuel cells are a form of co-generation system that react the hydrocarbons of city gas with oxygen to produce electricity and heat. This is a very clean form of electricity generation, producing less than 10ppm of NO<sub>x</sub> and negligible amounts of SO<sub>x</sub>. Fuel cells also produce very little noise (below 60dB) and vibration. The efficiency of electricity generation is 40%, however adding heat utility (steam and hot water) total efficiency rises to 80%.

There is one brewing company that utilizes the gas assimilated from its wastewater treatment facilities (i.e., methane gas) as the fuel of a specific boiler. However, studies are currently underway to make more efficient use of this energy such as developing a means for fuel cells to utilize the gas. Recently, a 200kW fuel cell power generation system capable of utilizing methane gas was supplied to the Tochigi Factory of Kirin Brewing Company.

Other activities include a joint development project with Nisshin Oil Mills, Ltd. in which a fuel cell power generation system that operates on city gas is combined with a gas-turbine inlet-air cooling system that utilizes direct steam emissions (a characteristic of Mitsubishi Electric fuel cell systems). The first system is to be delivered to the Yokohama Isogo Factory.

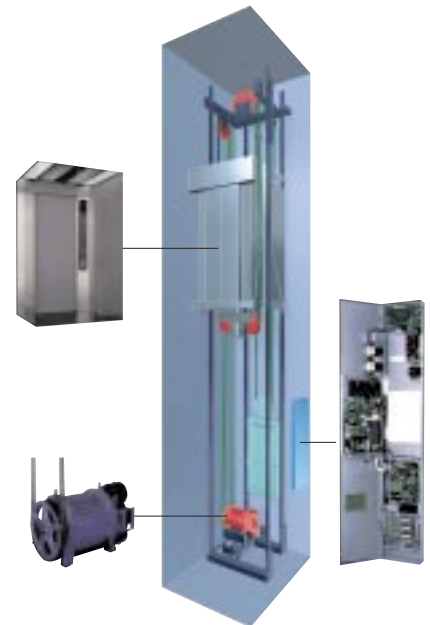
#### Photovoltaic Power Generation Systems

Photovoltaic systems convert solar energy into electricity. The electric power is first generated as direct current and stored in solar batteries, after which it is converted to alternating current via a power conditioner. Following conversion to alternating current, the electricity is ready for use in daily life. This new energy source is un failing and friendly to the environment, and is an excellent backup system for emergency power in the event of an unsuspecting power outage. Recently, many systems are being manufactured and installed at schools and community centers, public and welfare facilities, and factory and office buildings. The delivery and installation of 500kW photovoltaic systems for public use have been underway since fiscal 1998.

### More Effective Use

#### Diesel Generator Co-Generation System

A 280kW, class 2 co-generation system was delivered to the Hidatakayama Hotel in Gifu Prefecture, Japan. The system has improved utility efficiency markedly and will be utilized as an emergency generator during emergency power outages. Diesel fuel is utilized to power the generator, which has a maximum output of 560kW. In addition to providing as a source of electricity, the water of the generator cooling system, which is heated when fuel is burnt, is circulated into the hotel to heat the floor and supply the hot water system. Approximately 70% of the fuel energy is effectively utilized as electricity or warm water, and about 30-40% of the energy is saved. Reductions in fuel consumption also mean reduced emission of waste gases; harmful NO<sub>x</sub>, SO<sub>x</sub>, CO<sub>2</sub> and dust have been decreased by 30-40%.



#### Elevator with No Machine Room ELEPAQ Series

An elevator that takes up less space, uses fewer resources, requires less energy to operate, and most of all, requires no rooftop machine room is currently being marketed. Elimination of the machine room structure gives the added benefits of lower cost and installation utilizing relatively few construction materials. The actual space required for the elevator is approximately 65% of the area required for conventional traction elevators and 70% of the area for hydraulic elevators. The incorporation of a permanent-magnet gearless traction machine and a thin, transformer-less control panel enabled power consumption to be reduced 10% compared to conventional traction elevators and 65% compared to hydraulic systems. Moreover, a reduction in standby-state power of almost 35% has been achieved (compared to conventional traction elevators). As compared to hydraulic elevators, ELEPAQ does not require the management of waste oil.

Above values refer to Mitsubishi Electric elevators for residential use (9-passenger maximum capacity, speed of 60m/min, 5 stops).



Fuel Cell



Photovoltaic Power Generation System



Co-Generation System

## Ultra-Efficient Super Transformer

Mitsubishi Electric introduced an ultra-efficient "super transformer" to meet the growing energy conservation requirements of works, factories and offices. This product joined an already broad transformer lineup, including a standard low-loss transformer and an ultra-efficient super transformer for energy conservation. The size and mass of the ultra-efficient transformer are larger than the conventional (oil-immersed) transformer and previous ultra-efficient transformer but less energy is required. Marketed together with the company's previous ultra-efficient transformer, works, factories and offices now have a wider variety of energy-saving, environmentally safe transformers to choose from.

### Characteristics of the Ultra-Efficient Super Transformer (compared to current standard product)

Total loss reduced by approximately one-half through the incorporation of domain-refining, grain-oriented silicon steel and low-loss design.

- Transformer noise during operation reduced to approximately 10dB.
- Annual CO<sub>2</sub> generated by a 3-phase, 1,000kVA transformer (60% load) has been reduced approximately 11t.

## ROSAHL Panel Dehumidifier

The ROSAHL panel dehumidifier utilizes porous electrodes on each side of the hydrogen-ion conductive electrolyte film, thus transferring moisture from the anode to the cathode and dehumidifying it. In terms of energy, approximately 1/50 of the heater system and one-fifth of the Peltier system are required, thus signifying efficiency; for example, the ROSAHL is capable of dehumidifying 2m<sup>3</sup> of a control panel at 5W, whereas the heating and Peltier systems require 250W and 25W, respectively.

Moreover, the ROSAHL has no moving mechanical components and reacts only with oxygen and water; therefore, there is no noise, vibration or harmful objects for consideration. In addition to preventing unsafe conditions (corrosion, etc.) and extending the service life of the control panel and its components, the utilization of ROSAHL dehumidifiers reduces the energy consumption and negative environmental impact of the unit. Furthermore, the dehumidifier can also be utilized for preventing moisture in storage areas for clothing, foodstuffs and pharmaceuticals.

## ECO-Ice Mini - Compact Ice Thermal-Storage Packaged Air-Conditioner

Concerned about the electricity burden, nine Japanese power companies requested four domestic refrigeration/air-conditioning manufacturers to jointly develop the "ECO-Ice Mini," a compact ice thermal-storage packaged air-conditioner. Daytime power consumption is reduced by more than 20% as the result of utilizing nighttime power to make and store ice in the holding tank, which is then used in the cooling system as it melts during the day. (Power use during nighttime hours produces approximately 20% less CO<sub>2</sub> than that during the daytime because of differences in power generation sources.)

## Jet Towel

Mitsubishi Electric's "Jet Towel" hand dryer utilizes uniquely designed high-speed jets of air to blow water off ones hands after washing. While a warm-air hand dryer (1,000W) requires 30sec for drying, the Jet Towel (900W) requires only 5sec; a savings of 85% in energy required. Additionally, utilization of the Jet Towel results in the reduction of paper towels consumed, thus contributing to forestry conservation and helping to reduce paper waste. If 400 people use a Jet Towel daily for 5 years, approximately 36 trees could be saved.\*

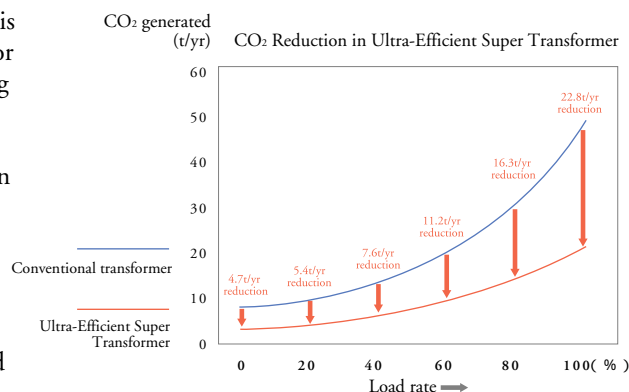
\* Approximately 20,000 paper towels to a log (14cm in diameter, 8m in length).

## MELARS - Adhesive Rivet Jointing Method

The enclosures for electronic control panels (controllers) of power generation plants and industrial machinery are often assembled manually utilizing such methods as arc welding because of their variety and limited production volume. This welding operation, however, produces noise, dust and sparking, and is therefore a major environmental problem for factory operations. In order to eliminate the need for such welding procedures in packaging assembly, Mitsubishi Electric developed an adhesive rivet jointing method. The new method requires no corrections, as required with welding, and produces a quality-assured enclosure that enables assembly operations to be carried out in a clean environment. Additionally, the switch from welding to adhesive jointing enables a reduction in the number of processes as there is no need to correct welds, thus shortening the production time and reducing cost by 30-50%. Other merits include lower energy requirements, improved joint rigidity, and reduced weight owing to the utilization of thinner panels. This technology may be adopted when assembling sheet-metal products that currently require arc welding.



ROSAHL Panel Dehumidifier



JT-16C3 Jet Towel

## Return in Good Condition...

### MAMS Series - Medium and Small-Sized Ash Fusion Furnaces

The MAMS series of medium and small-sized ash fusion furnaces are high-temperature incinerators that utilize a rotating burner process to turn ash into a slag-like matter. The process reduces the volume of ash to approximately one-third, trapping all heavy-metal ash inside the slag-like material. This enables disposal, reclamation or recycling for such uses as concrete filler or roadbed materials. The dioxin included in the ash is almost entirely broken down at the extremely high temperature (1,450 °C), with the actual quantity of dioxin gas emitted from the furnace measuring less than 0.1ng-TEQ/Nm<sup>3</sup>; equivalent to that released by large incinerators. Adopting the company's original heat- and corrosion-resistant ceramics system, the time required for loading and shutting down the furnace has been shortened, the interior walls of the furnace last longer and the required wall maintenance time has been reduced. (Ash volume: MAMS-T, 1.5t/day; MAMS-3.0T, 3.0t/day)

### Ozone Technology/High-Concentration Ozone Generator

The technology utilized in the development of our high-concentration ozone generator, introduced in the 1998 Environmental Report, has been appraised highly and awarded Japan Industrial Newspaper's 41st New Product Award, the Japan Machinery Federation's Superior Energy Conservation Equipment Award, and the Japan Ozone Association's Presentation Award.

### Ozone Technology/Dry-Ozone Deodorization Device

The agricultural wastewater treatment facilities in agricultural districts beyond the reach of the city sewage treatment plants commonly handle treatment for populations of 1,000 people, and are also responsible for water purification processes and improving the environment in their regions. It is therefore indispensable to construct such facilities incorporating an effective deodorization device to remove the peculiar smells common in treatment processes. Mitsubishi Electric has developed a dry-ozone deodorization device for agricultural wastewater treatment facilities. The system is comprised of compact and easy-to-handle equipment, and operation can be performed unattended. Gases emitted following treatment meet the standards of the Offensive Odor Prevention Law (odor intensity of less than 2), and the system itself provides an excellent deodorizing effect. It is therefore believed that the system will be useful in the construction of agricultural wastewater treatment facilities in the future.

### Ozone Technology/Advanced Sewerage Treatment Equipment

The Kichijoin Sewage Treatment Plant of Kyoto, Japan, was the first sewage facility built for the city, and it receives all of the wastewater and dye drainage from the dyeing factories (Kyoto's traditional industry) in the area. The former treatment system used to color the water as a form of treatment, thus causing the problem of the water color not blending properly with the natural scenery, although water quality standards were satisfied. One of Mitsubishi Electric's advanced high-concentration ozone wastewater treatment systems was installed at the plant in order to remove the color and purify water released back into the environment. The volume of water treated is 120,000m<sup>3</sup>/hr and the capacity of the ozone equipment is 67.5kg/hr (22.5kg/hr × 3 units). The equipment installed is said to be the best in all of Japan. Following installation, the treated water became clean, void of color and is bringing great satisfaction to residents in the surrounding area.

## Integrating Actions...

### Energy-Saving Support Equipment (Electric Measuring Units, Etc.)

Electric measuring units (EMUs) are manufactured with separate current sensors and a display unit, thus enabling more detailed measurement. Current sensors can be easily attached to the circuit of a main device without the cutting or splicing of any wiring. The main unit transmits measurements of the power and current, etc., while the display unit enables the monitoring of measurement data onsite. The addition of a measuring display unit (MDU) circuit breaker and an electric measuring control unit (MRU),

for measuring high-voltage circuits, make it possible to measure electrical current from low to high voltages, thus supporting energy conservation.

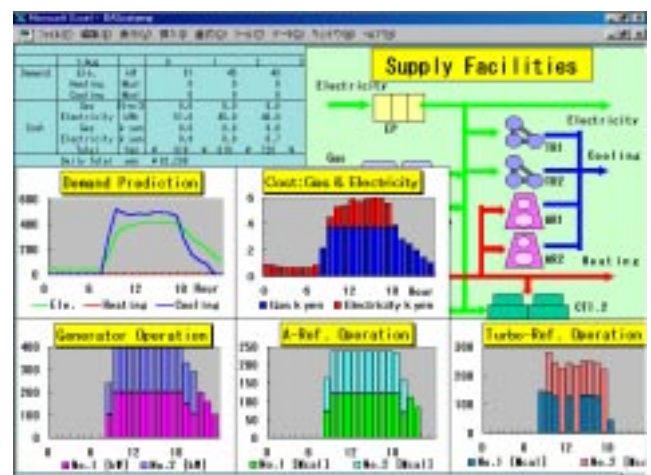
An interface (ISA) card for transmitting and software for collecting data (B-DAS) are also provided for energy-saving maintenance of the system in order to collect data utilizing a personal computer. It is possible to display and analyze data or even create a data file for graphic calculations.

### MELBAS Building Automation System

We have improved the energy-saving functions of the Mitsubishi Electric Building Automation System (MELBAS). A highly accurate demand prediction method using a time-variant regression algorithm and an optimal operation planning technique that precisely determines the nonlinear and dynamic characteristics of the supply facilities have been newly developed for the system. It is now possible to save 2-5% in primary energy costs such as electricity, gas, oil, etc. The system is especially effective if utilized with thermal-storage air-conditioning or co-generation facilities, as well as conventional facilities. A stand-alone system is planned for introduction to the market during fiscal 1999.



MAMS Series Medium to Small-Sized Ash Fusion Furnace



MELBAS Building Automation System (monitor screen)



Mitsubishi Electric Group environmental action logo

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