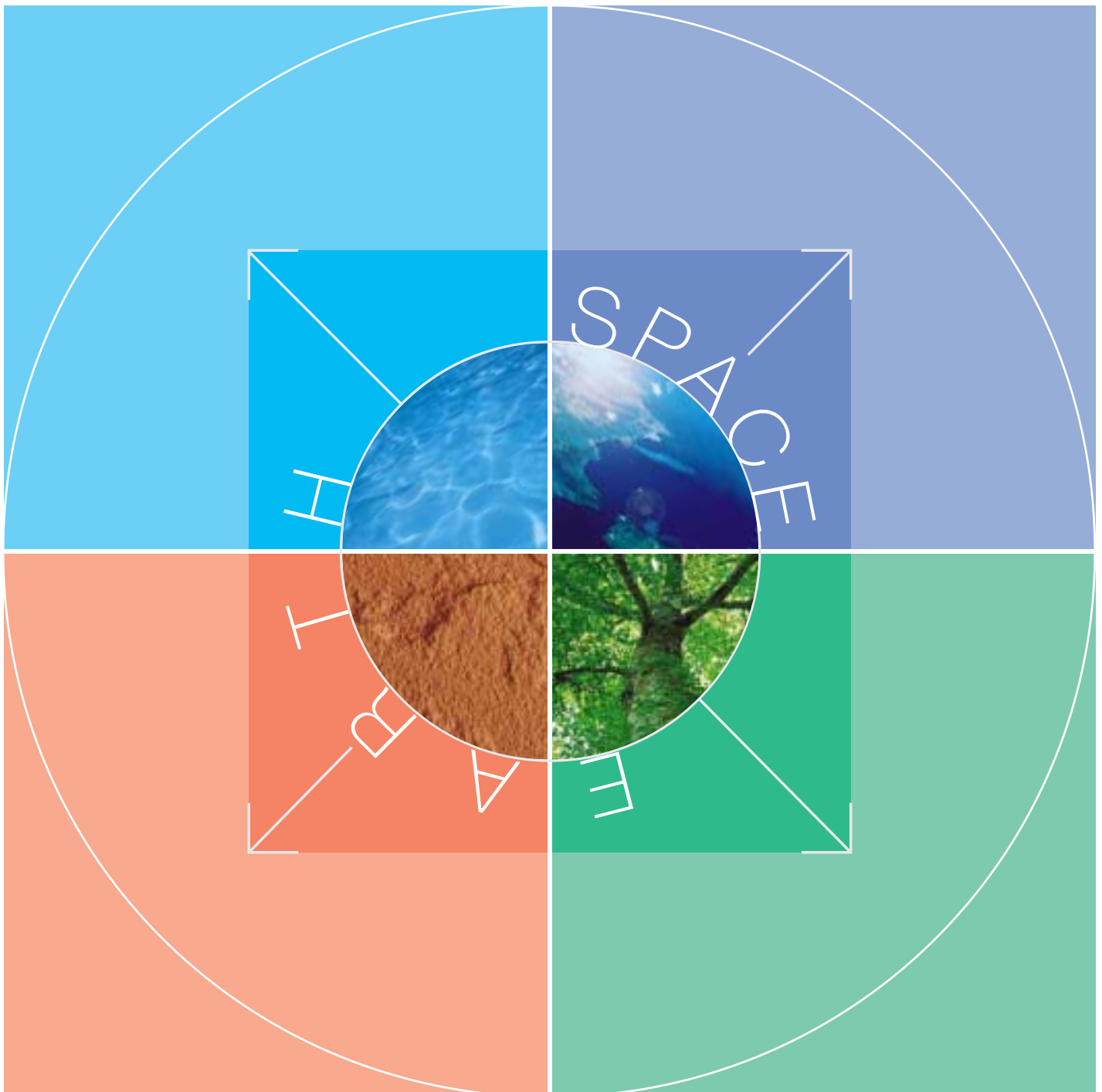


2003

Environmental Report



Environmental protection as a contribution to society

I N D E X

Company Policy and Management Principle	1
Greetings	2

Environmental Management

Basic Policy on Environmental Matters	3
Mid- and Long-term Objectives	4
Relationship between our Business Operations and the Environment	5
Environmental Management System	7
Environmental Accounting	8
Education/Training and Environmental Risk Management	9

Environmental Performance

Energy Conservation	11
Efficient Use of Resources	12
Waste Management	13
Control of Chemical Substances	14
Countermeasures against Fluorocarbons	15
Examples of Improvement in Production Activities	16

Products and Technology Related to the Environment

Environmentally Conscious Research/Development and Designing	19
Environmentally Conscious Products	21
New Technology that Creates the Future World	26

Corporate Activities Other Than Production Business

Harmonization with Local Communities	30
Communication with Society	31
Mitsubishi Minato-Mirai Industrial Museum / New Head-Office Building	32
History of Environmental Activities	33

Company Profile and Location	34
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Note upon Publishing MHI's Environmental Report

Mitsubishi Heavy Industries, Ltd. issued their first environmental report in 2001, and a succeeding report has been issued every year since. The next issue is scheduled for the end of June 2004. Our efforts of tackling environmental matters also have been and will be published through our website in plain language, both in Japanese and English.

Home page address: <http://www.mhi.co.jp>

1. Coverage

The activities and efforts of the production plants and works in Japan and in part of the Head Office are reported. Sales offices/branches and subsidiaries in and out of Japan are not included.

2. Applicable term

The activities and efforts made from April 1, 2002 to March 31, 2003 are covered.

3. Editing Policy

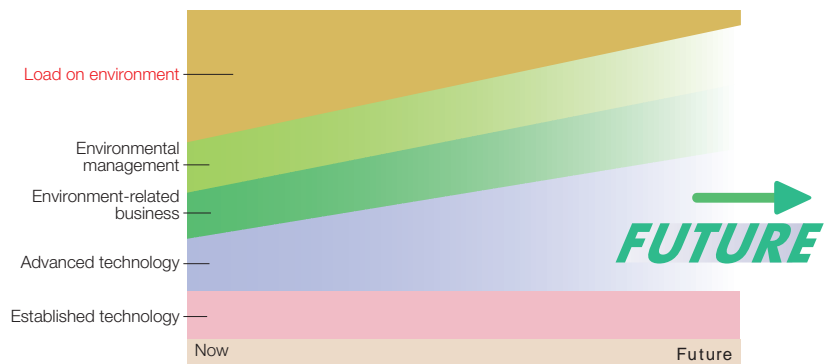
The 2003 Environmental Report was edited based upon the "Guideline for Environmental Reports (2000 issue)" by the Ministry of the Environment.

Mitsubishi Heavy Industries, Ltd. (MHI) established a basic policy and conduct guideline for managing environmental matters (see Page 3), based on the corporate philosophy observed since its foundation and on its spirit emphasizing contribution to the society. The company is committed to tackling this assignment and contributing to the building of a society that allows sustainable development.

Corporate Philosophy

Starting from shipbuilding business, the company has conducted various activities, following its corporate policy which obligates the company to contribute to the progress of society through its business operations. This philosophy is succeeded from the "Three Principles"(established in an early ages of Mitsubishi group) to the Company's Creed instituted in 1970, and sustained through the company's expansion and transformation to a leading manufacturer of general heavy-machinery.

Now, the company values this philosophy more than ever, and will continue its efforts not to leave the load upon the future environment by protecting the environment not only in areas related to its manufacturing, but also in a global view through development of new technology, thus contributing to society.



Creed

1. We strongly believe that the customer comes first and that we are obligated to be an innovative partner to society.
2. We base our activities on honesty, harmony, and a clear distinction between public and private life.
3. We shall strive for innovative management and technological development from an international perspective.

Reason for Instituting the Creed

In Japan there are many enterprises with their own "creeds" which simply represent their management concept. Mitsubishi Heavy Industries, Ltd. has a creed of this type, also. This creed was instituted in 1970 on the basis of the policy advocated by Koyata Iwasaki, president of Mitsubishi Goshi Kaisha in the 1920s, to indicate the essential attitude of the company, the mental attitude of the employees, and the future directions of the company. The reason for instituting the present creed is so that all of us can call to mind our one hundred years of tradition, and strive for further development in the future.

Issued June 1, 1970

Bequeathing a verdant Earth to the next generation

What We Should Do for the Earth

With the stars of the night sky, there are a number of artificial satellites that are always watching the Earth. These satellites fly around the Earth day and night and support our daily lives. The environmental observation technical satellite, "Midori II," which was launched in December last year with the H-IIA Rocket developed by a group of which Mitsubishi Heavy Industries, Ltd. comprises the main body, is one of these satellites. It is expected that "Midori II," which has started full-scale activities, will help clarify the various problems of the Earth's environment whose causes are not yet known, such as unusual weather conditions in various parts of the world and the expanding hole in the ozone layer.

We are also aware of phenomena such as global warming, the reasons for which have been elucidated to a certain extent, but whose deterioration continues in spite of warnings by many scientists.

We have entered an important era where, to solve the various problems of the Earth's environment, individuals, enterprises, autonomous bodies and countries each must clarify the reasons and find measures of coping with these problems.

Mitsubishi Heavy Industries, Ltd. and the Protection of the Environment

Mitsubishi Heavy Industries, Ltd. has devoted itself to promoting versatile activities for environmental protection of the Earth by fully exploiting its overall technological power developed for more than a century.

Last year, we established mid- and long-term objectives concerning the environmental protection and clarified the targets of environmental protection activities. As a result, activities for zero waste land-reclamation and landfill started at each works following the Yokohama Dockyard & Machinery Works model that has already achieved this objective. We are also rapidly promoting, on a whole company basis, specific activities such as "green purchasing" office supplies and introducing work uniforms using material made from reclaimed pet bottles. At the same time, these activities are being developed in subsidiaries in and outside Japan, and thus the whole Mitsubishi group is engaged in activities for environmental protection.

Global Measures

We have to cope with environmental protection of the Earth on a global scale. MHI has put its full power into global environmental protection activities by fully exploiting the worldwide network and the rich experience gained through manufacturing products in various areas. Recent examples include the development of technology to prevent global warming by storing carbon dioxide under the ground or in the deep sea and technology to realize desert greening by combining energy conservation and resource recycling in the coastal area of the Red Sea of Saudi Arabia.

In future, considering the experiences of environmental pollution during the period of high economic growth in Japan, we wish to make a bigger contribution to environmental protection in areas where the economy is rapidly developing.

Through the Spirit of Craftsmanship

MHI is a comprehensive machinery manufacturer with diverse products unparalleled in any other part of the world, such as ships, bridges, power plants and aircraft. In spite of this product diversity, we are always aware of environmental protection. Our efforts to offer high quality products that can be used for a long time are an expression of this attitude.

Last year, after receiving an award from the Director-General of the Agency for Natural Resources and Energy for our gas engine MACH-30 series, the GSR series of the same type engine received the 2002 Technical Grand Prize from the Japan Gas Association. In addition, our low-noise, high-capacity gearless windmill using a permanent magnet-type multi-polar synchronous generator received the Minister of Economy, Trade and Industry Prize from the New Energy Foundation and our battery sorter received the New Technology Award of the WESTEC Award 2002. That our products using energy-saving and environmental-protection technology have received a number of awards is proof of the value of our efforts in environmental preservation.

A Verdant Earth for the Next Generation

The Mitsubishi Minato-Mirai Industrial Museum in Yokohama City has invited 140,000 elementary school and junior high school students for free of charge up to last year. Taking such an opportunity, a large number of young people are studying environmental problems through the exhibitions displayed in the museum.

The global environment cannot be protected unless each of us living on the Earth considers the problem as our own. It is important that this individual responsibility is shared by all and extends gradually to global-scale activities. MHI will contribute to realizing the idea of all people living on the Earth for the protection of the environment through its technology and experience. MHI hopes that the Earth, viewed from other stars, will be an eternally blue and beautiful planet.

Please continue to support the environmental protection activities of MHI.



Kazuo Tsukuda
President,
Mitsubishi Heavy Industries, Ltd.

A handwritten signature in black ink that reads "K. Tsukuda".

Basic Policy on Environmental Matters and Conduct Guidelines

While rapid technological progress in various scenes make our daily life more and more convenient, protecting our environment has loomed up as an issue we should take seriously. In 1996, MHI established its Basic Policy on Environmental Matters and Conduct Guidelines to promote further activity for environmental protection, which has been a major concern ever since MHI's founding, while taking into consideration the compatibility between technological progress and reduction of load upon environment.

Basic Policy on Environmental Matters

In order to make the sustainable development of society possible, a basic policy on environmental matters has been established.

Pursuant to the express provisions of Section 1 of its Creed that "We strongly believe that the customer comes first and that we are obligated to be an innovative partner to society," MHI shall, as a matter of primary importance, strive, through its R&D, manufacturing and other business activities, to play a useful role in the development of society.

To this end, while remaining aware that a business enterprise is a member of society, MHI shall endeavor, in all aspects of its business activities, to reduce the burden on the environment and shall concentrate and fully utilize its technological capabilities for the development of technologies and products that will protect the environment, thus contributing to the establishment of a society in which sustainable development is possible.



Conduct Guidelines

In order to realize the basic policy, the following seven conduct guidelines have been decided.

- 1 Recognize that environmental protection is a matter of first priority in the Company's operations, and to encourage the entire Company in its endeavors to protect and improve the environment.
- 2 Define roles and responsibilities regarding environmental protection by developing and maintaining a corporate organization designated for environmental protection, and creating and implementing corporate policies and procedures on environmental matters.
- 3 Endeavor to reduce the burden on the environment by preventing pollution, saving resources, saving energy, reducing waste, reusing materials, and recycling, in all aspects of the Company's business activities entailing R&D, designing procurement of materials, manufacturing, transportation, use, service and disposal.
- 4 Endeavor to develop and provide advanced, highly reliable and unique technologies and products that contribute to the solution of environmental and energy problems.
- 5 Comply with national and local environmental laws and regulations, going beyond mere compliance by enacting, implementing, and evaluating voluntary standards where necessary, and to endeavor to improve and promote, on a continuing basis, environmental protection activities by establishing environmental goals and targets.
- 6 Endeavor to protect the environment of foreign countries by carefully examining the consequences of the Company's business operations in foreign countries and the exportation of its products to foreign countries upon the natural and social environment of such foreign countries, and to get actively involved in technological cooperation overseas in the area of environmental protection.
- 7 Provide environmental training and other programs to enhance environmental awareness of all employees of the Company, and take steps to expand public relations activities, such as providing environment-related information to the public and social contribution activities.

Mid- and Long-Term Objectives of MHI

We have decided on five items for reducing the environmental burden, i.e., reduction of waste, restraint of chemical substances, energy saving, countermeasures against fluorocarbons and environmental management, and have set up “Mid- and Long-term Objectives” to be achieved between Year 2005 and Year 2010 (see the attached table).

Fourteen domestic production sites and one engineering division have already obtained ISO14001 certification, and they are renewing their certificates.

As for waste materials, we are promoting recycling of metal chips and waste plastics.

Approximately half of the Works are involved in activities for zero waste land-reclamation and landfill, which Yokohama Dockyard & Machinery Works has already accomplished. Many works are eagerly trying to follow this achievement by Yokohama Works.

In the field of chemical substance reduction, we plan to finish replacing PCB-containing lighting ballasts with those that are PCB-free, by 2010. In comparison to 1996 levels, we will reduce the amount of organic

chloride chemical substances by 95% by 2005, and 100% by 2010.

Our energy conservation program for the prevention of global warming aims to cut CO₂ emission by 6% in comparison to 1990 levels by 2010 (the numerical target stipulated in the Kyoto Protocol for Japan).

Our plans also include the development and introduction of an integrated management system for environmental management data by 2005.

Mid- and Long-term Objectives

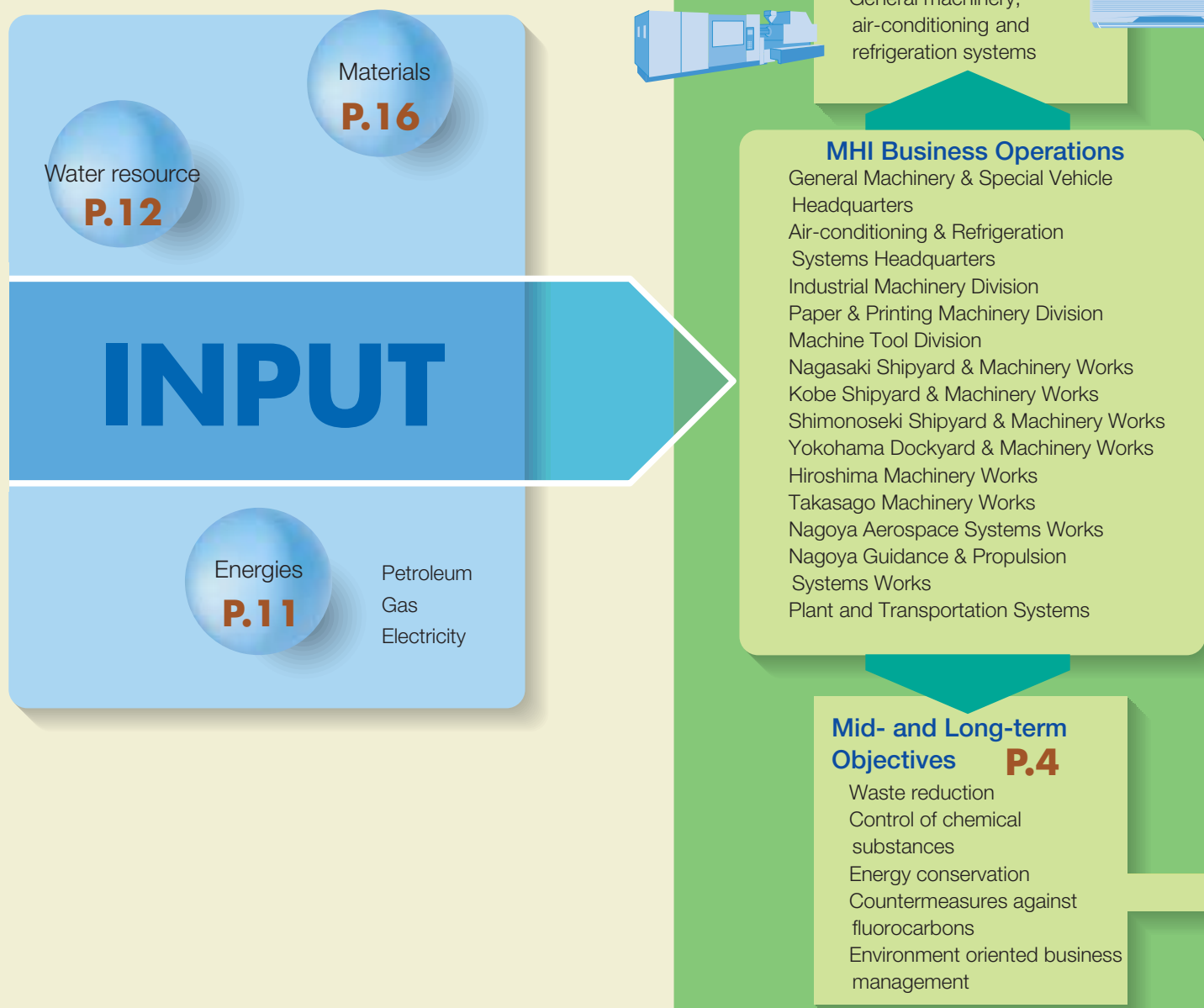
Category	Item	Objective	Reference page
1 Waste reduction	Controlling generation and emission of waste materials	Limiting the total amount of waste materials in 2010 to 170,000 tons, a minimum 20% cut compared with the amount in 1992 by promoting resource savings and controlling material purchases	➡ P.13
	Reducing waste landreclamation and landfill	Zero waste land-reclamation and landfill to be achieved by more than half of the Works by 2005, and by all the Works by 2010, through promotion of reuse and recycle	➡ P.13
2 Control of chemical substances	Total disuse of equipment using PCB	Disuse of ballasts for lighting fixture and high voltage equipment using PCB by 2010	➡ P.13
	Reducing emission of organic chloride chemical substances	By thoroughly controlling organic chloride chemical substances and their emissions, atmosphere releases of dichloromethane, trichloroethylene, and tetrachloro-ethylene to be reduced by 95% by 2005, and by 100% by 2010, compared with 1996 levels	➡ P.14
3 Energy conservation	Reducing CO ₂ emission	Reduction of CO ₂ emission by 6% by 2010, compared with 1990 level, through strict control of CO ₂ emission at production plants. Introduction of solar power generating systems by 2005.	➡ P.11
4 Countermeasures against fluorocarbons*	Reducing use of fluorocarbons	Switching from HCFC that can destroy the ozone layer to HFC whose ozone destruction factor is zero, by 2010	➡ P.15
5 Environment oriented business management	Environmental management system	Continuation of renewal of ISO14001 certification for the Works in Japan	➡ P. 7
	Database system for environment-based corporate management	Developing a database system for the data of environmental burden by 2005	—
	Promoting environmental accounting	Continuous work on environmental accounting, and completing the on-line summary system by 2005	➡ P. 8
	Issuing Environmental Reports	Further upgrading of the contents for the following issues	—
	Purchase of environmentally friendly products	Encouraging the purchase of environmentally friendly goods based on the in-house guideline for purchasing “Green goods”	➡ P.16
	Advancing environmentconforming designs	Setting up and promoting working groups for designs conforming to environmental requirements	➡ P.19

* Fluorocarbons : Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs) and Hydrofluorocarbons (HFCs)

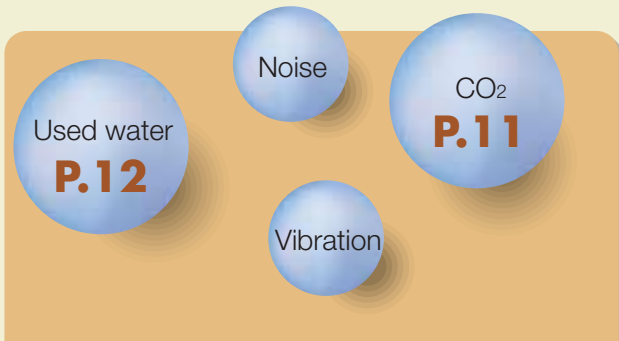
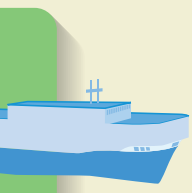
Relationship between our Business Operations and the Environment

Towards Operations that Allow Sustainable Development

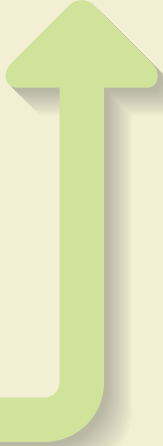
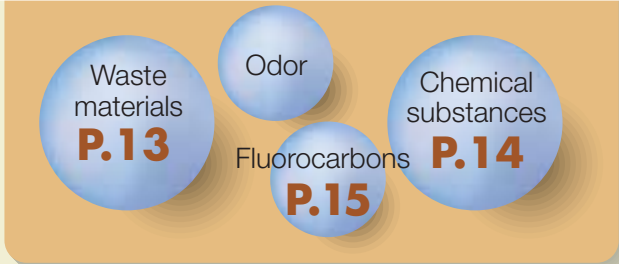
In the process of production, we use various resources of the Earth such as materials, water and energy. Realizing that it is important to recognize the environmental burden in all our operations, we assess and verify the amount of energy and resources used as well as the resulting waste at headquarters, divisions and works. With five mid- and long-term objectives, we aim to continuously decrease the burden on the environment.



Environmental Load Flow Chart



OUTPUT



Set-up and Promotion of the “Environmental Management System”

Under the leadership of our “Environment Committee” set up in 1996, the works determine their own environmental policies and targets to promote environmental protection activities. In addition, all production bases in Japan have acquired ISO14001 certification, the international standard for an “environmental management system,” and their operations are conducted in accordance with the “PDCA Cycle.”

We have set up the “management organization” of the whole company dealing with environmental protection matters to prepare and implement detailed activity plans.

MHI has been contributing to society through its manufacturing since the date of its founding. The spirit of “manufacturing” is reflected in the Creed, and is thoroughly understood in all of MHI’s production sites. Some of the products we manufacture are small enough to hold in the palm of your hand. But most of our products are large structures such as airplanes, ships, and bridges. In order to keep on manufacturing these diversified products and offering them to the world, and to serve in the development of the society through such products, we should always bear in mind that the key is full-fledged environmental management and safety management.

To clarify our stand on environmental protection to those both inside and outside the company, we have set up the “Environment Committee” in 1996.

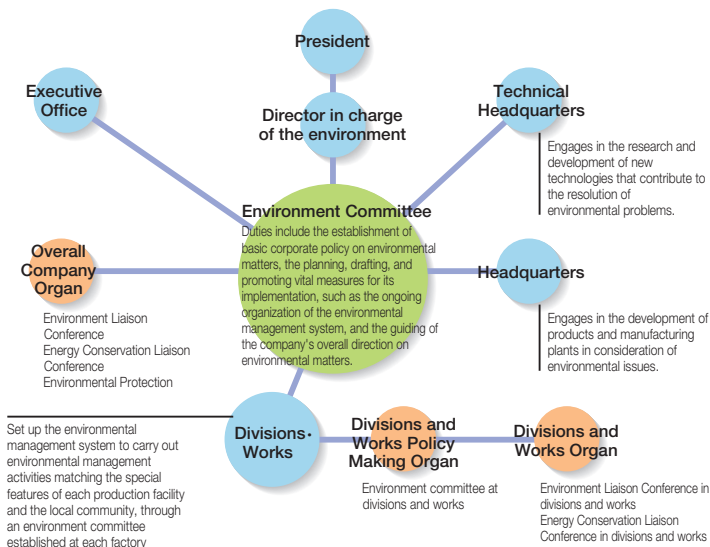
The Environment Committee leads the company-wide environmental policy by generating annual environmental countermeasure plans each year, and regularly checking up on the execution of the annual plans made by all divisions and works.

In addition, the Committee has established the “Environment Liaison Conference”, the “Energy Conservation Liaison Conference”, and the “Environmental Protection Technology Liaison Conference”. These conferences were established to employ effective energy supplies, promote energy-saving activities and to advance information and related know-how sharing regarding environmental protection.

Based on the company-wide policy, each division and works plans and promotes its own environmental activities according to the site-specific production and the characteristics of the local region.

Divisions and works also have their own Environment Committee, Environment Liaison Conference, and Energy Conservation Liaison Conference as the executive organizations for these activities.

Environmental Protection Organization



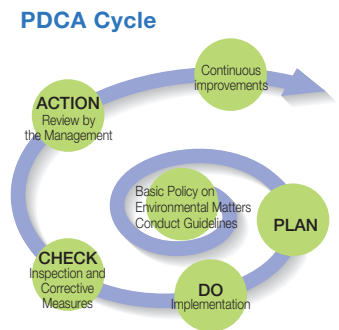
We are doing our best to prepare a sustainable “environmental management system” and improve our daily activities.

Beginning with the Yokohama Dockyard & Machinery Works, the first recipient of ISO certification in Japan among heavy industry facilities, MHI obtained ISO14001 certification for all 13 domestic production sites. Adding to this, MCEC recently obtained the certification in the field of engineering for its onsite engineering work.

Many of these Works are already renewing their certifications, and we have been intensifying our efforts to continuously improve our environmental management system, applying the spiral cycle of “PLAN-DO-CHECK-ACTION (PDCA).” Such daily efforts bring about many positive results. As the environments of the production sites are being improved greatly year-by-year, examiners from external organizations are rarely left unsatisfied.



Examination by external organizations



Status of ISO14001 Certificate

Issue date (Registration date)			Production site
1997	Oct.	31	Yokohama Dockyard & Machinery Works
1998	May	22	Nagasaki Shipyard & Machinery Works
1998	Jun.	26	Takasago Machinery Works
1998	Nov.	20	Air-Conditioning & Refrigeration Systems Headquarters
1999	May	21	General Machinery & Special Vehicle Headquarters
1999	Sep.	3	Paper & Printing Machinery Division
1999	Sep.	3	Plant and Transportation Systems Engineering & Construction Center (Mihara)
1999	Sep.	30	Hiroshima Machinery Works
1999	Nov.	24	Shimonoseki Shipyard & Machinery Works
1999	Dec.	18	Nagoya Guidance & Propulsion Systems Works
2000	Feb.	18	Kobe Shipyard & Machinery Works
2000	Mar.	27	Nagoya Aerospace System Works (Tobishima)
2000	Apr.	1	Industrial Machinery Division
2000	Aug.	8	Nagoya Aerospace Systems Works (Oe, Komakiminami)
2000	Dec.	28	Machine Tool Division
2001	Jun.	29	Plant and Transportation Systems Engineering & Construction Center (Yokohama)

In order to comprehend investment and expense for environmental protection and its results, we have established our own "Guidelines for Environmental Accounting," incorporating concrete examples with reference to the "Guide Book for Environmental Accounting (2002 edition)" of the Ministry of the Environment, and have continued to quantitatively measure these matters since 2001.

The amount of investment for environmental protection is 3.4 billion yen and the expense is 11.6 billion yen.

The total amount of investment for environmental protection is 3.4 billion yen. A total of 2.3 billion yen was invested in facilities inside the works (to prevent air and water contamination, save energy and re-circulate resources), and 1.1 billion yen was invested in facilities related to research and development. The total expense is 11.6 billion yen. A total of 6.6 billion yen was used for research and development, and 3.6 billion yen was spent on operation within the works. The increase in investment is mainly due to introducing solar power-generation panels to five works and the head office, and the acoustic insulation work for the heavy machinery plant of the Hiroshima Machinery Works.

Our operations have resulted in a great "effect on environmental protection," which is difficult to express in financial terms, and an "economic effect" of 1.8 billion yen from recycling, etc.

The economic effect of 1.8 billion yen is from recycling and reduction of expenses through saving energy. In addition, there has a further qualitative effect, which is difficult to express financially, of preventing the outflow of oils/fats and chemical substances, reducing the emission of chemical substances and other harmful materials, and developing fuel cells and various other environment-conscious products. Based on our technology, we have succeeded in making 430 kg of PCB waste harmless, and in reducing the amount of carbon dioxide by installing solar power-generation panels and purchasing green electric power.

Environmental Accounting Balance

100 million yen

Category	Environmental Protection Cost Description	2001		2002	
		Investments	Costs	Investments	Costs
Production Areas	Costs for pollution prevention, global environmental protection, resource recycling, etc.	17	38	23	36
Up/Down stream	Consignment fees for packaging and recycling of products		1		1
Management Activities	Operating costs of environmental management organs, Costs for configuration and maintenance of the environmental management system		11		9
R&D	Costs for research and development of environmentally friendly products	8	70	11	66
Public & Social Activities	Costs for disclosing environment-related information and placing such ads		3		3
Environmental damages	Dues and charges on pollution load, costs for underground water and soil purification		1		1
Total		25	124	34	116

Effect on Environmental Protection

Details of the Effect
Prevention of Outflow of Oils/Fats and Chemical Substances
Making our PCB Waste Harmless
Reduction in Emission of Water/Air Pollutants
Development of Various Types of Environment-Conscious Products

Total Investment in Facilities: 81.5 billion yen
Total Research and Development Expenses: 106.6 billion yen

Economic Effects of Environmental Protection Measures

100 million yen

Monetary Effect Item	Amount	
	2001	2002
Income from recycling	4	6
Cost reduction due to energy saving	4	6
Waste treatment cost reduction due to recycling	1	2
Reductions in supply water purchase and waste water treatment cost	4	4
Total	13	18

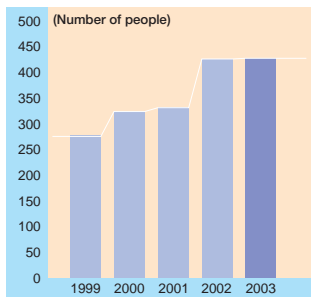
Note: Items indicated in the table are limited to those that can be quantitatively measured in monetary value. So-called "deemed effects" are not included in the calculation.

Environmental Education/Training and Environmental Risk Management

In order to enhance the environmental awareness of all employees of the company and to broaden their understanding of environmental protection and energy conservation, the company not only provides the following training programs, but also issues a special message from the President to all its employees, emphasizing the importance of a cleaner environment, in a specified “Environment Month.” In addition to these measures, the company encourages its employees to participate in clean-up programs for the local community and take part in tours of environmental protection facilities to contribute to preserving the environment. In addition, in the preparation and measures for risk management, we encourage our employees to obtain officially recognized certifications and qualifications in addition to complying with environment-related laws and regulations, while individual production sites regularly hold training sessions and drills for improved reaction to emergency situations.

“Internal auditors” are trained by an outside organization.

The role of internal auditors is essential for the effective operation of our environmental management system. We have adopted a program from an outer organization to train such internal auditors, where only those that have passed the test are registered as auditors for the company. The growth in the number of the qualified personnel is as shown in the chart below.



Internal Auditor Registration based on ISO 14001 As of April 1, each year

Qualification Type	Category/Class	Number of Holders
Environmental Measurement	Density, Noise and Vibration	14
Energy Control	Thermal, Electric	113
Management in Preventing Pollution	Atmosphere Water Quality Class 1 to Class 4, Noise, Vibration	514
Chief Manager for Preventing Pollution		16
Supervisor for Handling of Specified Chemical Substances		996
Supervisor for Operations Dealing with Organic Solvents		2,034
Engineering Management for Waste Disposal Facilities	(Waste Disposal Engineering Manager)	53
Management for Specially Designated Industrial Waste		147

List of Environment relating Qualification Holders As of January 1, 2003

In addition to our best efforts to comply with environment-related laws and regulations, we are active in obtaining official certifications and qualifications related to environment.

We give our uppermost effort to comply with environment-related laws and regulations, as we comply with other relevant legal requirements. For the achievement of an effective environmental management, and to deliver more reliable products to our customers, we are active in

obtaining official qualifications and certification. The qualification holders of our company, as shown in the list at the right, are working to protect our environment.

In October last year, when a passenger ship under construction at our Nagasaki Shipyard and Machinery Works caught fire, the initial fire-

extinguishing water was emitted as an emergency measure to prevent the ship from capsizing in Nagasaki Bay. Contamination of seawater by dioxin was feared. We independently surveyed the sediment and seawater to understand the effect on the environment, and we confirmed that there was no problem since all the values obtained through our survey were below the prescribed environmental standards. We published these results. In addition, an accident occurred in which hydrochlorofluorocarbons were emitted while repairing an air-conditioner at a related company. This accident was caused by an operation error in the recovery of hydrochlorofluorocarbons. We immediately gave notice to employees of our company and the subsidiary concerned, requesting that they grasp the importance of preventive action against hydrochlorofluorocarbons risk and to prepare thorough measures for work control and work procedures against recurrence of such an incident (see Page 15).

We conduct thorough “employee training” in environmental protection for all employees.

Understanding that continuous education on environmental protection is a prerequisite, we offer a diversified range of training programs for our employees. The regular programs include basic training for all the new employees, level-specific courses covering general to managerial-level staff, and programs highlighting the target of the ‘Environment Month.’

On the other hand, education and training for specific work such as paint spraying and handling of hazardous materials have much to do with our company’s business and operations. Therefore, training programs for personnel assigned to the above works are regularly provided so that they can learn about the influence of their work on the environment, daily management methods, proper methods of monitoring and measurement, and emergency procedures.

Head office, works and plants of the company extensively carry out educational activities such as publishing in serial form the article explaining environmental terminology or article on efforts for acquisition of ISO 14001 certificate in in-house brochures, or announcing the policies from the head of the works to realize the target of ‘Environment Month,’ or holding a seminar of ‘Environment Month,’ in order to promote a deeper appreciation of environmentally sound operations in the employees and those in subsidiaries.



Environmental training (Checking waste recycle)

We regularly conduct emergency drills to prepare for accidents such as oil leaks.

Half of our domestic Works are located facing the sea. The sea will be polluted in an instant if any trouble leading to oil leak occur during operations at these locations. In preparation for such emergencies, all the Works regularly repeat emergency drills, for example, to practice quick recovery with oil fences to minimize the spreading of oil, or to train for effective countermeasures in the event of leaking of chemical substances.



Oil Recovery Training at Sea

Environmental Performance



Measures for Energy Conservation [see Page 11](#)

- Positive introduction of highly effective facilities for energy conservation such as the co-generation system
- Development of equipment that uses natural energy such as a solar power-generation system and a wind power-generation system
- Careful consideration to details such as operating air-conditioners at the proper temperature in offices
- Preparation for emission trading

Efficient Use of Water and Paper [see Page 12](#)

- Reduction in the Use of Underground Water
- Recycling of waste water
- Recycling of used paper and the effective use of recycled paper

Control of Waste and Recycling [see Page 13](#)

- Leading action of Yokohama Machinery Works for "Zero Waste"
- Improvement in the recycling ratio of air-conditioners
- Encouraging the change from equipment using PCB to equipment not using PCB

Control of Chemical Substances [see Page 14](#)

- Selective reduction of solutions contained in paint
- Reduction of emission of organic chloride chemical substances

Measures for Reducing the Use of Fluorocarbons [see Page 15](#)

- Complete and early switching to fluorocarbons substitutes
- Preparation of fluorocarbons recovery system
- Development of a car air-conditioner that does not deplete the ozone layer

Examples of Improvements in our Production Activities [see Pages 16-17](#)

- Large-scale refurbishment work of an old ship
 - New methods of production in our production activities
 - Column of "green purchases" (purchase of environmentally friendly goods)
-

Energy Conservation

At our production site, we use various energy types and resources such as fossil fuel and electricity. We are doing our utmost in energy conservation and the effective use of resources to preserve limited resources and the global environment, to leave them for the next generation.

Through developing energy conservation equipment, we are participating in worldwide efforts to prevent global warming.

The protocol of the 3rd Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3), so-called Kyoto Protocol, was adopted in Kyoto in 1997 to control the emission of greenhouse gases such as CO₂, one of the main causes of global warming. Under this protocol Japan is to reduce its emission levels by 6%, compared to the 1990 level, by 2010.

Following this, the Japanese Government's Headquarters for Promotion of Measures to Cope with Global Warming decided, in March 2002, to review the Platform for Promotion of Measures to Cope with Global Warming. This resulted in the incorporation of fundamental policies into the platform, to devise step-by-step approaches for the sectors of household, transportation, and industries.

In accordance with these policies, MHI promotes activities that are effective towards preventing global warming as well as saving energy, such as aggressively introducing energy saving equipment in our production processes.

Each works of the company makes efforts to reduce consumption of electricity and introduce new energy systems.

Efforts to reduce electricity consumption vary depending on production methods at each of our works. In 2002, CO₂ emission increased by 1% compared to 1990 due to expansion of the Ohe Plant of the Nagoya Aerospace Systems Works.

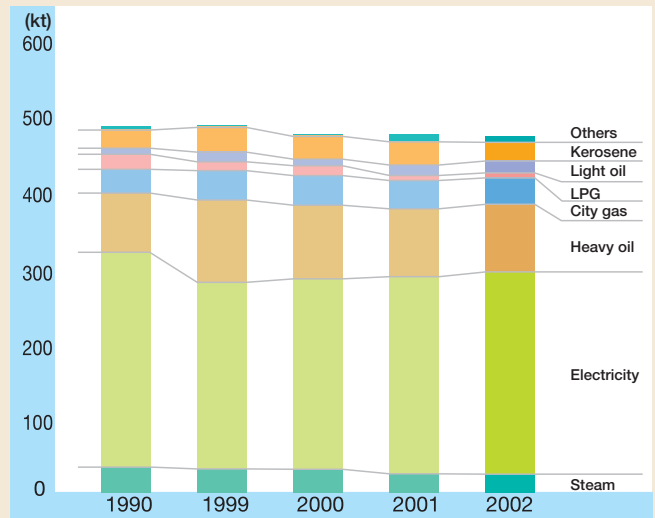
Examples of specific activities for energy conservation are the introduction of energy-saving facilities to drastically decrease the use of electricity for production, the introduction of a cogeneration-type generator for stringent checking and control of energy in each building, installation of solar power-generation panels (see picture) and installation of windows as a natural light sources in early-built windowless factories (see picture). In addition, in the offices, we encourage switching to lighting fixtures with inverters, using equipment with the international energy star program, operating air-conditioners at the proper level and turning off unnecessary lights in the early morning and at lunchtime.

To further save energy, we plan to introduce solar power-generation systems and maintain company-wide energy conservation efforts.

We are also preparing for the "emission trading" that has drawn attention from a number of business circles.

The right to trade emissions, stipulated in the Kyoto Protocol, has drawn wide attention from business circles both in and out of Japan. Viewing this trading system as a complementary scheme, we are determined to strive for further energy saving and CO₂ reduction, adhering to the original intent for the prevention of global warming.

Status of CO₂ Emission



Energy saving at our plants and works

Energy-saving promotion activities	Energy-saving operations	Production equipment
Energy-saving patrols	Improved methods for operating compressors	Placement of higher priority on introduction of energy-saving equipment for new facilities
Frequent energy-saving controls on lighting and air-conditioning	Installation of windows on factory roofs for natural light	Furnishing energy-saving inverters
Energy-saving controls during vacation periods	Frequent changes in the electric power supply	Introduction of use of fuel cells
Energy-saving controls during lunch time	PC controlled boiler operations	Introduction of solar power-generation systems
Patrol checks for leaks on air pipes		Introduction of compressor for individual use
Stricter controls regarding air usage		Introduction of energy-saving PC displays
More efficient use of heat		Promotion of use of compact boilers



Solar Power-Generation Systems



Natural light windows on factory roof

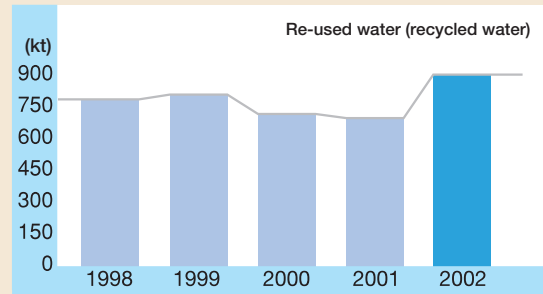
In order to reduce the use of underground water, which can cause ground subsidence, we promote the efficient use of water.

At our factories, water is needed in large amounts and a combination of supply water, industrial water and underground water is used. To reduce the use of underground water, which can cause ground subsidence, we collect and recycle our used water, doing our best to recycle so as to conserve this precious resource.

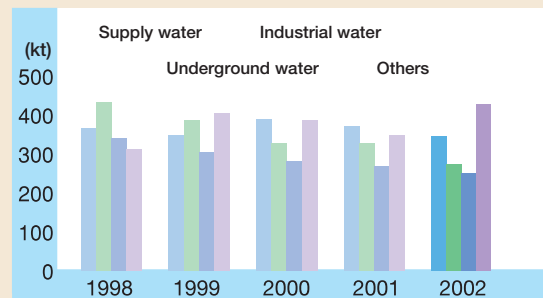
We are making efforts in the efficient use of paper such as recycling used paper and using recycled paper.

In 2002, our company used 3,900 tons of paper as office supplies for OA machines, documents, catalogs and business cards, most of which was recycled paper. Understanding that the primary waste from offices is waste paper, to reduce the amount of paper used, either made from virgin pulp or recycled paper, we promote using both sides of sheets of paper and recycling old paper through segregated collection.

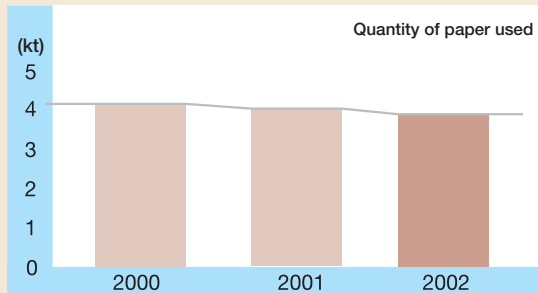
Water Recycling Status



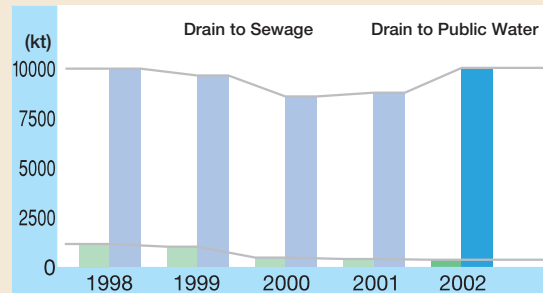
Source of Water Used



Amount of Paper Used



Draining Status



Topic Commended Activity

Activity for zero waste land-reclamation and landfill at the Yokohama Dockyard & Machinery Works

Activity for zero waste land-reclamation and landfill at the Yokohama Dockyard & Machinery Works was highly evaluated and received commendations from the Recycling Promotion Council and Yokohama City. This is the fruit of strict separation of waste materials by the whole factory members including production departments. We will continue to search for ways of recycling, and of reduction of waste materials. Other divisions and works are also trying hard to reduce the amount of wastes, following Yokohama's example.



Waste materials separation on carrier ship repairing site



Sludge carbonizing oven



Certificate of commendation from Yokohama City



A waste separating station



Certificate of commendation from the Recycling promotion Council

Waste Management

With increasingly fewer landfill sites left, reducing waste is a top priority issue for corporate citizens. MHI is stepping up its efforts to control chemical substances more strictly, while at the same time promoting waste recycling to achieve zero waste land-reclamation and landfill.

We have maintained strict control of waste materials and recycled 77% of the waste materials produced.

Our diverse production and repair activities produce various waste materials. However, 77% of the 187,000 tons produced by the company in 2002 was recycled. We aim for an even higher recycling rate in the future.

We have aimed for zero waste land-reclamation and landfill with successful results.

The Yokohama Dockyard & Machinery Works achieved zero waste land-reclamation and landfill in March 2001 and is still maintaining this achievement.

The Yokohama Works implemented separation of waste materials thoroughly and strictly, collaborating with recycling businesses for effective recycling. As a result, various methods of recycling waste material have been found, such as recycling paper, turning waste pieces of wood into fuel chips or plywood, making pet bottles into RDF and recycled bottles, turning glass objects such as bottles into roadbed material, waste oil into supplemental burning fuel, and so on. Our aim is to reduce the total volume of waste that has to be disposed of as landfill. These activities will be expanded to the whole company.

For disposal of waste, we use traders who specialize in the field.

For processing waste generated inside our company, we utilize the businesses specialized in this field and manage thoroughly the processing by way of 'industrial waste management slips'(manifest slips).

Our industrial waste incinerators conform to the stricter regulations.

Our incineration facilities conform to the stricter regulations to be effected in December 2002.

We aim for better recycling rates for air-conditioning units in the future.

The Electric Appliance Recycling Law requires that 60% of air-conditioning units be recycled. Our company recycled 4,134 tons of these units out of 5,098 tons to be processed in total, achieving a recycle rate of approximately 80%. We aim for better recycling rates in the future.

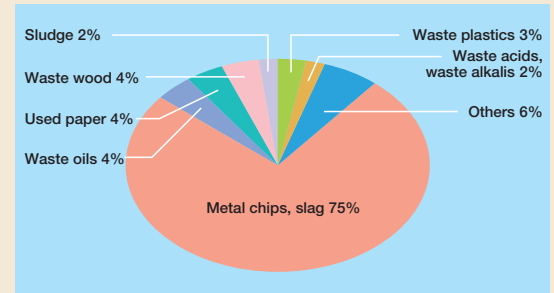
We are striving for a total ban on the use of PCB-containing equipment.

Our plants and works in Japan still have electrical equipment that uses PCB. This equipment will be completely replaced with non-PCB devices and facilities step-by-step before 2010. In accordance with the Special Provision Law Concerning PCB of 2002, we registered with the relevant authorities 25,000 items of disposed PCB-containing ballast for lighting fixtures and 16,000 items of lighting device that use PCB.

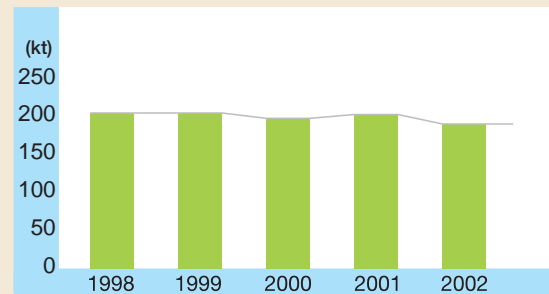


Confirmation of Status of PCB Safekeeping

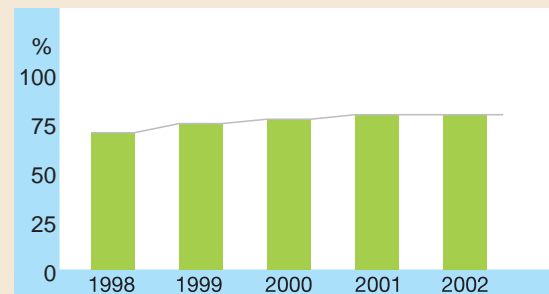
Generation Status of Waste Materials by Type



Transition of Amount of Generated Waste



Transition of Recycle Rate



Waste and Recycling Usage

Category	Use
Paper	Recycled paper
Waste wood	Fuel chips, plywood chips
Rages	Reused after cleaning
PET bottle	RDF, material for PET bottles
Vinyl chloride	Roadbed material, gas fuel
Bottle, glass	Roadbed material
Waste oil	Recycled fuel
Waste paint	Recycled fuel, pavement bricks
Sludge	Charcoal, roadbed material
Garbage	Fertilizer
Concrete clod	Roadbed material
Ash	Roadbed material, cement material

MHI strictly controls the use and storage of frequently-used chemical substances (PRTR) such as solvents contained in paint.

MHI strictly controls the safe use and storage of necessary chemical substances. We have been collecting and managing data of such chemical substances since 1997, through our participation in the PRTR pilot project initiated by the Environment Agency (prior name), and promotion of the guidelines of the Keidanren (Japan Federation of Economic Organizations) Voluntary Action Plan on the Environment. Each of our plants and works manages its own MSDS (Material Safety Data Sheet) to ensure the safety of customers and employees.

Chemical substances we handle in large volumes are solvents contained in paints such as xylene, toluene, ethylbenzene, and epoxy resins of type A bisphenol. To reduce the volumes of these substances, we are devising improved methods of painting and are using more amounts of organic solvent-free paints.

By developing substitute substances and alternative production methods, we are striving to minimize emissions of organic chlorine chemical substances.

We aim to control the emissions of organic chlorine compounds, focusing especially on the emissions of dichloromethane, trichloroethylene, and tetrachloroethylene. We have been doing our utmost to minimize emissions of these organic chlorine substances by changing cleaning facilities and processes, and by switching to alternative washing products.

The chlorine solvent, dichloromethane, was used for stripping off paint films and coatings, but we changed the method for this process to the shot-blast method using plastic media, in order to decrease the amount of dichloromethane used. We will keep on conducting extensive research and study for alternative substances and alternative methods.



Paint is frequently used in constructing ships.

PRTR: Release and Transfer Amount of Environmental Pollutants (2002)

Unit: tons

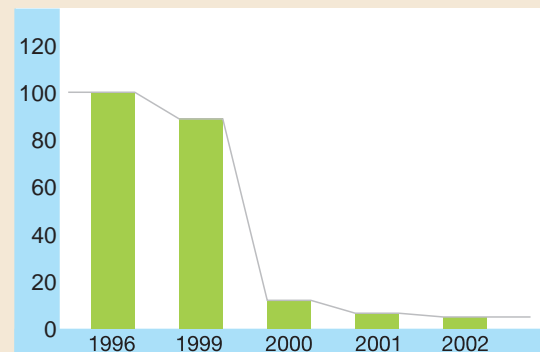
Substance No.	Name of Substance	Emission Amount	Transfer Amount
30	Bisphenol A Type Epoxy Resin	0.5	39.5
40	Ethylbenzene	290.5	16.9
43	Ethylene Glycol	0	1.0
63	Xylene	1201.4	83.1
68	Chromium and Chromium (III) Compounds	1.7	82.2
69*	Chromium (VI) Compounds	0	10.6
85	Chlorodifluoromethane (HCFC-22)	0.9	13.0
99	Vanadium Pentoxide	0	1.0
132	1,1 Dichloro-1-Fluoroethane (HCFC-141b)	30.0	1.4
145	Dichloromethane	8.8	8.1
177	Styrene	20.0	1.6
179*	Dioxins	69.5	590.1
200	Tetrachloroethylene	1.1	6.0
211	Trichloroethylene	4.7	16.8
224	1,3,5-Trimethylbenzene	1.7	0
227	Toluene	465.1	33.6
231	Nickel	0	2.1
299*	Benzene	0	0
311	Manganese and its Compounds	0	5.5

Notes 1: *shows class 1 specified chemical substances.

Notes 2: The total emission and transfer volume is recorded for more than 0.5 tons of designated class 1 specified chemical substances, and more than 5 tons of other class 1 specified chemical substances.

Notes 3: The unit for dioxins is mg-TEQ.

Emission of Substances of Organic Chlorine by Year



*Calculated with the 1996 level as 100

Countermeasures against Fluorocarbons*

As a manufacturer of air-conditioning & refrigeration systems, we take strict countermeasures to reduce fluorocarbons to protect the ozone layer. We are making greater effort than ever to switch to HFCs, and to establish a system of recovering fluorocarbons.

We will take various measures for a total ban on the use of HCFCs by 2020.

Fluorocarbons was developed in 1930, as the "miracle gas" for its safety (low toxicity and inflammability) and notably good characteristics (cost effective, reliable, durable, and serviceable) as a product. It has been used for a wide range of applications such as refrigerants for air-conditioning & refrigeration systems, cleaning media for precision devices, atomizing media for aerosols, and as foaming agents for urethane foams.

However, at the beginning of the 1980's, the following facts were proved:

1. The ozone layer protecting the earth's surface from the sun's ultraviolet rays is destroyed by the chlorine contained in CFCs and HCFCs.
2. The green-house effect of fluorocarbons is several-hundreds to several-thousands times as strong as that of carbon dioxide.

These findings triggered the restrictions of fluorocarbons.

It takes a considerably long time (ten years as the unit) to see the correlation between the causes and the results of ozone depletion and global warming. The material currently destroying the ozone layer is fluorocarbons that were released more than ten years ago. It is said that, even if the use of fluorocarbons were completely banned and stopped at the present point, the effects of this would only appear in ten or more years.

In 1987, with the adoption of the "Montreal Protocol on Substances that Deplete the Ozone Layer," CFCs were to be totally banned by 1995. HCFCs are scheduled to be phased out by 2020, except those used as refills.

We are striving to switch to alternative HFCs at an early stage.

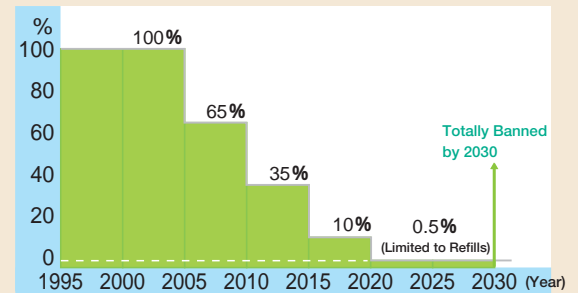
We are putting our efforts into replacing traditional refrigerants for our air-conditioning units with HFCs, which are the best solution in modern chemistry, aiming for early completion of the replacement. HFCs do not destroy the ozone layer, but unfortunately, they are amongst the gases that produce a greenhouse effect as stipulated in the Kyoto Protocol. Therefore, we will pursue measures to reduce HFC emission in accordance with the "RESPONSIBLE USE PRINSIPLES FOR HFCs "

Through technical training courses and other educational programs, we aim to establish emergency procedures.

We have been holding technical training courses for the recovery of fluorocarbons in the servicing sections of our air-conditioning & refrigeration divisions, aimed at providing the staff with updated information and skills. Other subsidiaries and affiliates are also involved in such education and training. They have been working hard to strengthen their fluorocarbons recovery systems, exploiting the fluorocarbons emission incident between July and August 2002.

A responsible person is clearly designated to strengthen these recovery systems, and emphasis will be placed on preparing a recovery manual, preparing better recovery equipment and materials, providing education and establishing emergency procedures.

Phase-Out Schedule for HCFCs

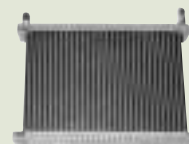


Residential Use Split Air-Conditioner SRK28SE that Uses HFCs as Refrigerants. The achievement ratio of the energy conservation standard is 121%.

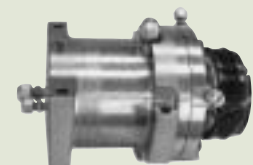
Topic Air-Conditioning System Using CO₂

We have developed a car air-conditioning system that does not use substances harmful to the ozone layer.

We have developed an air-conditioning system for cars, which does not use substances harmful to the ozone layer, by making use of CO₂ in the atmosphere. The new system realizes excellent performance, higher than that of the conventional system using HFC-134a. We are in the merchandising and product planning stage, completing the development of actual size prototypes for commercial use, hoping to offer the first car airconditioning systems utilizing CO₂ in the world at an early point.



Evaporator



Compressor



Gas cooler

* Fluorocarbons : Chlorofluorocarbons (CFCs), Hydrochlorofluorocarbons (HCFCs) and Hydrofluorocarbons (HFCs)

Examples of Improvements in Environmentally Conscious Production Activities – 1

The development of new environmentally conscious production methods is one of our most important missions. For MHI that is widely engaged in various production activities at works and plants, developing and promoting new environmentally conscious production methods is a task for the whole company. We have achieved successful results in this development and promotion each year. We are also positive in “green purchase” (purchase of environmentally friendly goods) that burdens the environment less.

At the Yokohama Machinery Works, a large refurbishing plan to revive a ship of more than 20 years old is in progress.

We can considerably extend the life of a ship that has already passed its originally scheduled operational period of 20 years by conducting large-scale repairs. In No. 1 Dry Dock of our Yokohama Machinery Works, life-extension work for the “Tenaga Satu,” a 130,000 m³ LNG carrier with Liberian Registration, was carried out over 102 days. The main engine control system was renewed, and other repairs such as re-painting the ballast tanks carried out. As a result, the “Tenaga Satu” was reborn. Life-extension work for four other sister ships are in progress. These five LNG carriers will soon operate worldwide.



Picture of Life-Extension Work for Two Ships

Generator Replacement Work

Engineer's Voice

I realized the importance of reuse through the refurbishment work.

Yokohama Machinery Works
Ship Repair Department
Kosuke Niizuma



I was in charge of the general repair of the hull, mainly steel work. Since the ship was old, additional work was required. It was a hard job to coordinate and control the whole work schedule by understanding the relationship among 1,000 work programmes. However, when I saw the ship completely refurbished and reborn, I really thought that reusing a product instead of purchasing a new product would become mainstream environmental preservation work in the future. From now on, I will strive to work positively in the spirit of craftsmanship that is kind to the global environment.

Topic Purchasing “Green Goods”

Outline of the Basic Policy on Green Purchase

The MHI 2002 Environment Committee decided on basic issues to promote the purchase of raw materials, parts, and supply goods that work to reduce the burden on our environment on a planned basis, in order to build an ecologically oriented society.

Green Purchase of Non-production Goods

We have launched a company-wide movement to promote purchasing of environmentally friendly goods, mainly of nonproduction goods. Emphasis is given not only to purchasing goods which are labeled “environmentally friendly,” but also to always planning well for the purchase of goods bearing in mind the importance of the three R’s, “Reduce, Reuse, and Recycle.”

Nagasaki Shipyard & Machinery Works issues “News release on green purchase” to raise awareness among employees. The company plans to spread these efforts by individual divisions or plants horizontally across the company to eventually expand the range of green purchase to industrial goods.

Purchasing Green Electricity

To support the “Green Power Certification System” scheme proposed by the Japan Natural Energy Co., Ltd., MHI decided to annually purchase one million kWh of wind-generated power for 15 years starting from April 2002. In addition, we are developing large-output wind power-generation systems that can efficiently supply green electricity even to limited areas in Japan, and we have delivered a 2,000-kW system to Gusigawa City, Okinawa Prefecture.



Nagasaki Shipyard & Machinery Works House Journal (on green purchase)



“Green Power” Label Indicates that some of the electricity we use is green power.



Only Domestic 2,000-kW Class Wind Power Generators Made by MHI

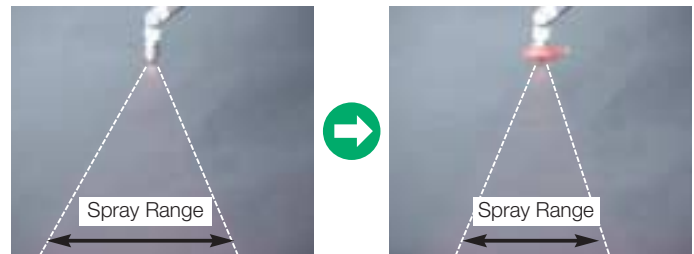
Examples of Improvements in Environmentally Conscious Production Activities – 2

In Nagasaki Shipyard & Machinery Works, a new painting method has been developed, and waste paint has been reduced by 45%.

Coating paints to prevent rusting on ships' bodies are important for longer service life. Anticorrosive paint is applied even to surfaces of products with complex external shape, such as boilers. In outdoor painting work, a large amount of paint is wasted since paint is scattered by wind.

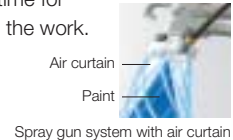
Considering this, a spray gun system with an air curtain has been adopted so that painting can take place without being affected by wind. As a result, waste paint has been reduced by 45%, and 3% of energy has been saved. We can now smoothly proceed with painting work.

Spray Gun System with Air Curtain



Conventional:
Spray guns are used outdoors to apply paint onto boiler components. Mist drifting is caused by wind, and lowers the paint spreading efficiency rate.

New:
The spray gun system with air curtain is adopted, resulting in decreased mist drifting, and a shorter time for finishing the work.



At the Nagoya Aerospace Systems Works, emission of dichloromethane has been reduced by introducing dry paint-removing equipment.

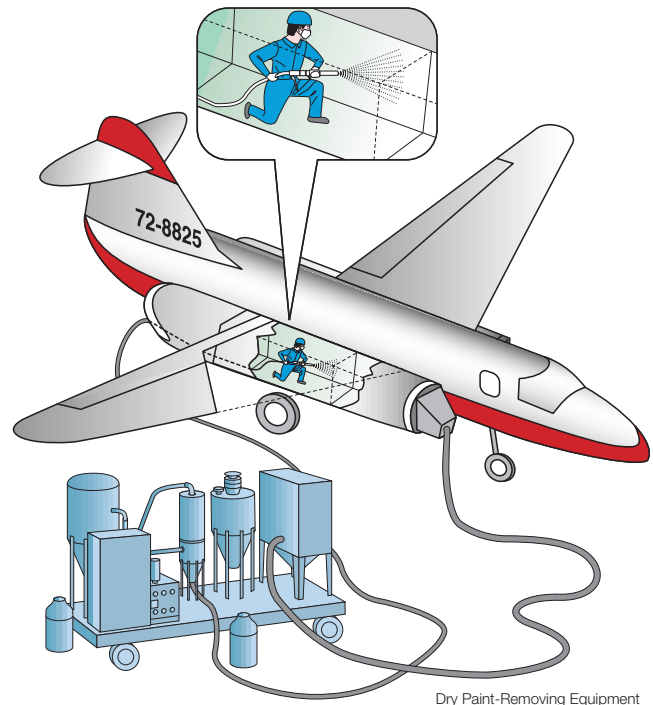
The paint on the body of an aircraft plays an important role in long-term safe flying.

At the Nagoya Aerospace Systems Works, dry paint-removing equipment has been adopted to remove paint on the body at aircraft repair or inspection.

With the conventional method, since dichloromethane is contained in the paint-removing solution, it was feared that the solution was harmful to the human body and that emission of dichloromethane would pollute the air. However, emission of dichloromethane has been reduced by adopting the new method that uses dry paint-removing equipment. With this new method of paint removal, instead of using the previous solution, plastic media are used, which are ejected at high speed from the ejection nozzle to remove the paint.

Removed paint is separated in the recovery hopper into paint dregs and recyclable plastic media. Recovered paint dregs are discarded, but the recyclable plastic media can be reused after circulation in the unit.

We have realized an environmentally conscious workplace by introducing equipment useful for reducing harmful substances and conserving resources.



Products and Technology Related to the Environment



Environmentally Conscious Research/Development and Design

see Page 19

Promoting Environmentally Compatible Design and Development

Environmentally Conscious Products

see Pages 21 – 25

LNG Carriers Page 21

- The first LNG carrier in the world that obtained “Environmental Protection Notation,” the classification notation concerning environmental protection

Gas Engine for Power Generation Page 22

- A power-generation efficiency ratio of 43.5 %, which is the highest in the world, has been attained by adopting the pilot ignition system.

Waste Processing System Page 23

- The amount of final exhaust emission has been reduced by 35% by adopting the oxygen-rich combustion system and the exhaust gas re-circulation unit.

Forklift Trucks

- For forklift trucks that use compressed natural gas as fuel, NOx is reduced by 13% and CO₂ by 20% compared to vehicles running on gasoline.

Air-Conditioning System Page 24

- The highest level of efficiency in the world has been realized by using HFC-134a with zero level ozone layer depletion potential. Centrifugal Liquid Chiller.
- By using zero level ozone layer depletion potential, periodical electricity consumption has been reduced by 53%. Inverter Air-Conditioning Unit for Storage and Office Use.

Injection Molding Machine

- By adopting the high performance servomotor and echo servo pump, power consumption has been cut by more than 60% compared to the conventional hydraulic pump.

Machine Tool Page 25

- Since no oil is used in cutting, no waste oil is produced. A total of 30% of energy has been saved compared to the conventional tool.

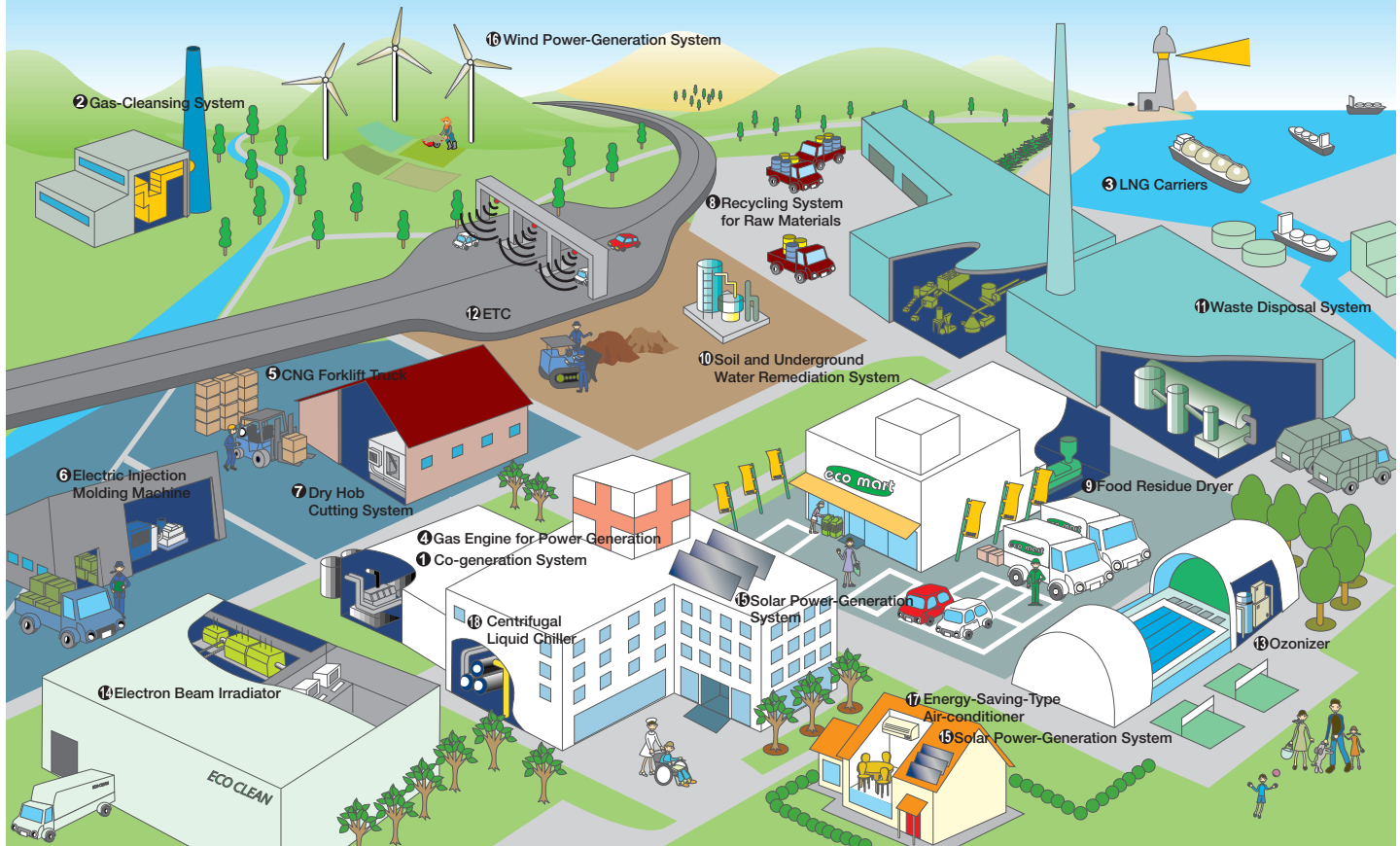
New Technology that Creates the Future World

see Pages 26 – 29

- Active Soft Edge Noise Barrier and Shape Memory Polymer Screw P26
- Fuel Cell and Production of Dimethyl Ether P27
- Battery Soater and Countermeasures Against CO₂ P28
- Motor for Electric Vehicles and Greening of Deserts P29

Environmentally Conscious Research/Development and Designing

MHI is striving for an environmentally compatible design to realize a “circulation-type economic and social system.”



We are engaged in manufacturing “environmentally conscious” products.

MHI has been striving, through its business activities, to play a useful role in developing society and improving people’s lives. The understanding that this is the original intent of manufacturing and craftsmanship has remained unchanged since the founding of the company. Up to now, we have constructed power-generation plants bringing affluence to society, and have developed products forming social infrastructures such as bridges and ships, taking environmental matters into consideration. We are ready to develop and manufacture products that people really want and that conform to environmental requirements, by applying designs and development methods that incorporate the latest technologies.

Our “Environmentally Compatible Design Standards Sub-Committee” is promoting the “three R’s” activities.

Our Environment Committee has set up a sub-committee for “Environmentally Compatible Design Standards” as a company-wide organ that will highlight activities related to the “three R’s” (Reduce, Reuse and Recycle) to further promote the traditional activities of environmentally compatible design.

In addition, we participate in preparing guidelines for environmentally compatible design taken up by the Japan Machinery Federation.

The “LCA Evaluation Method*,” which has been adopted for products related to the environment in advance of other products, will be used extensively for other products.

“LCA,” as adopted in environmentally related products and air-conditioning units, will be used extensively for various other products of our company, and we shall put further effort into manufacturing environmentally friendly products.

*LCA stands for Life Cycle Assessment. With this method, the environmental effect of a product is quantitatively evaluated all through its life cycle from manufacturing to disposal as waste.

Product	Description
Environmental Unit	During the development of new products, evaluation of the effect on reducing the environmental load and harmful substances is performed in connection with emission materials and re-circulated resources.
Facilities of the Cultural City	The effect of reducing the environmental load, as in using natural energy, is evaluated by measuring the amount of CO ₂ emission.
Air-Conditioning Units	Efforts are made in improving COP to reduce power consumption during operation by evaluating the amount of CO ₂ emission.

We develop and design environmentally friendly products in various fields, fully using the latest technologies.

MHI has devised many technologies in various fields that consider environmental protection. For example, we have developed new power-generating systems using fuel cells and biomass in the area of power-generating equipment and facilities through finding the best mix of resources to lessen the environmental burden based on national policy. We also seek ways of developing the ultimate environmentally friendly ships in accordance with the changing needs of the time.

Our scope of development includes transportation systems, which alleviate traffic congestion and reduce CO₂ emissions, such as the Integrated Transportation System (ITS) and the Electronic Toll Collection System (ETC). We design and develop many other products, seeking to further save energy and resources and to reduce CO₂.

Supporting Industries

Co-generation system

The co-generation system, using gas fuel, realizes an overall efficiency of **75%**. With greatly improved performance in terms of the economy and the environment, this compact design product can be installed in small buildings, where previously installation was deemed difficult, and can also be applied for industrial use.

Gas-cleansing system

Exhaust gas from boilers in power plants and factories contains SO₃ that causes air pollution by forming sulfuric acid mists when released into the atmosphere. This system efficiently removes sulfuric acid mists with electrostatic processing.

LNG carrier see Page **21**

Gas engine for power generation see Page **22**

CNG forklift trucks see Page **23**

Electric injection molding machine see Page **24**

Dry hob cutting system see Page **25**

Recycling waste materials

Recycling system for raw materials

Municipal governments and autonomous bodies across Japan are trying hard to cope with separating, recycling and reducing waste. Our recycling facilities and equipment are an optimum system for waste recycling.

Food residue dryer

We have developed a food residue dryer in line with the “Law for Promotion of Recycling of Food Residue.” The dryer uses heated air and microwave to dry cooked rice and similar residues, effectively turning them into animal feed.

Soil and underground water remediation system

We provide an integrated service for soil remediation, assessing the degree of contamination, delivering the systems and devices, and processing for purification. Our approaches prevent contamination and promote purification of air, water, soil and underground water.

Waste disposal system see Page **23**

In our every day lives

Electronic Toll Collection System (ETC)

The ETC system has started operation across Japan and is contributing to reducing CO₂ and NO_x emissions caused by congestion at tollgates. We delivered the world’s first Electronic Road Pricing (ERP) system in Singapore. This system controls the traffic volume in urban areas, and contributes to environmental improvement.

Ozonizer

This device purifies water in large swimming pools and public baths by generating ozone through water electrolysis. Water quality can be maintained as the device uses special ceramic reactors that we have developed.

Electron beam irradiator

The electron beam is safer than sterilizing gas or radiation, and has no effect on the environment. Our electronic sterilization system is frequently used in medical and food device manufacture for its high reliability.

Solar power-generation system

Our solar cell is of the amorphous silicon type. Compared to the crystal type, the amount of silicon used is one-several hundredth, and the energy required for production is only one-fourth or one-fifth. Our solar cell is a very environmentally friendly product.

Wind power-generation system see Page **16**

Energy-saving-type air-conditioner see Page **24**

Centrifugal liquid chiller see Page **24**

Environmentally Conscious Products

We are making efforts to design and develop environmentally conscious products in various fields such as ships, engines, environmentally related systems, physical flow machinery, air-conditioning equipment, injection molding machines and machine tools. The products that we develop and manufacture contribute to reducing the environmental burden and conserving energy.

The LNG carrier built by MHI obtained “Environmental Protection Notation,” issued by the classification society concerning environmental protection, for the first time in the world as an LNG carrier.

LNG Carrier

The LNG carrier is an environmentally friendly ship that transports liquefied natural gas, a clean energy, on the sea. MHI completed the LNG carrier, the “ABADI,” which incorporates the latest environmentally friendly design and facilities, and has obtained “Environmental Protection Notation” *1 from the Lloyds Register of Shipping. This is the first acquisition of EP notation in Japan.

The “ABADI” was built for the LNG project in Brunei. It was completed in June 2002 and is now in service in good condition. To obtain EP notation, in addition to complying with the environmentally related regulations of the International Maritime Organization (IMO) and the International Convention for the Prevention of Pollution from Ships (MARPOL), additional environmental requirements for the classification society must be satisfied. In ship design and facilities, various considerations have been given to cope with pollution, such as the use of HFCs (fluorocarbon substitutes), prevention of oil outflow *2, proper treatment of waste water, prevention of air pollution and safe replacement of ballast water *3. It is expected that these considerations will be globally extended. We will also obtain EP notation for three other LNG carriers that we are going to build for Royal Dutch Shell group.

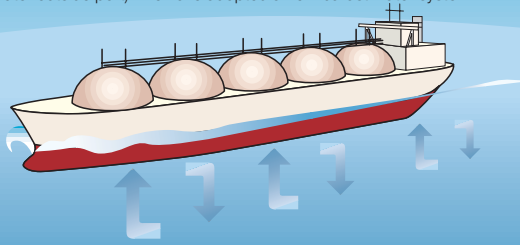
*1: To obtain the classification notation, various requirements must be satisfied, such as restriction of NOx and SOx emissions, no use of CFC, no use of halon for extinguishing fire, prohibition of TBT, establishment of regulations to prevent oil contamination, for waste disposal, for ballast water and for treatment of waste water.

*2: To prevent pollution of seawater due to oil outflow from damaged hulls, the ship fuel tanks have a double-hull structure.

*3: There are ports in a number of countries such as Australia where regulations do not allow ships carrying polluted ballast water to dock. It is necessary to replace polluted water with clean seawater little by little during the voyage.

Procedure for replacing ballast water on the “ABADI”

On the “ABADI,” ballast water is taken in or out automatically during the voyage. When the ballast water is discharged at port, the ballast tanks are filled with clean seawater that have replaced the polluted water on the open sea (accordingly, ballast water is not polluted with overseas seawater outside port). We have adopted a new ballast water system.



NOx emissions are reduced to

94.5% compared to VLCCs.

(Very Large Crude Oil Carriers)

SOx emissions are reduced to

99% compared to VLCCs.

Note: Comparisons have been made to VLCCs since we have no data on LNG carriers.



The “ABADI” on a Voyage

Engineer's Voice

We developed a method of replacement that maintains the proper ratio of replacement water and ensures the safety of the ship.

Ship & Ocean Engineering Department
Shipbuilding & Ocean Development Headquarters
Project Manager

Hiroyuki Ohira



Recent investigations have revealed that ballast water used on ship and discharged at port is a very likely cause of seawater pollution in ports. As a result, we need a system for automatically replacing ballast water. We have developed a system that enables the automatic exchange of ballast water on the open sea under computer control, considering the position and strength of the ship.

The system for changing ballast water that we have adopted is called the “replacement method” (a method for filling the ballast tanks with fresh seawater after discharging all of the original ballast water). We had to find the way of maintaining the proper ratio of efficiency of ballast water replacement and controlling the position of the ship at the time of replacement. We finally succeeded in developing a replacement procedure without error in operation by keeping the draft and trim of the ship within a certain range.

Up to now, we have given too much consideration to transportation of cargo, but now we realize afresh that ballast water is also transported by ship. Recognizing that what we do as a matter of course affects the global environment, it is necessary to review the work I am now doing.

We have succeeded in developing a gas engine, MACH-30G, with a power-generation efficiency of 43.5%, the highest level in the world, and CO₂ emissions have been considerably reduced.

Gas Engine for Power Generation

The MACH-30G is a series of V-type 4- cycle, supercharged engines with line-up of 12 to 18 cylinders, providing 3.7 to 5.8 MW output power. They adopt the pilot ignition system*2 with an electronically controlled common rail injection device instead of conventional spark plugs and thus have improved combustion condition. In addition, the independent electronic control of individual cylinders, in combination with the advanced pilot injection ignition, offers the world's highest level generation efficiency of 43.5%. The above pilot injection ignition has also solved one of the conventional demerits of a gas engine, that is, its lower output power compared to diesel engines. The system delivers a comparable output power to current diesel engines. Furthermore, the NOx emission of 0.5 g/kWh or less is realized by the optimum combustion in lean burning condition. Another environmentally friendly technology is here. Of course, they contribute to CO₂ emission reduction through their improved energy efficiency.

*1 : In this system, the pilot fuel, which can be spontaneously combusted by compression, is sent to the sub-combustion chamber and ignited in the main combustion chamber. A small amount of pilot fuel has a power 10,000 times greater than the ignition plug type.

The World's Highest Level Power-Generation Efficiency

43.5% accomplished



Gas Engine MACH-30G

Topic Our Products that have Won Awards

Gas Engine "MACH-30G Series"

At the "2002, 23rd Excellent Energy Saving Machinery Awards" hosted by the Japan Machinery Federation, 12 products were selected from among 41 candidates. Our "MACH-30G" was highly evaluated for its development and practical use as a highly energy-saving industrial machine, and received a commendation from the Director-General of the Agency for Natural Resources and Energy.

Miller Cycle Gas Engine "GSR Series"

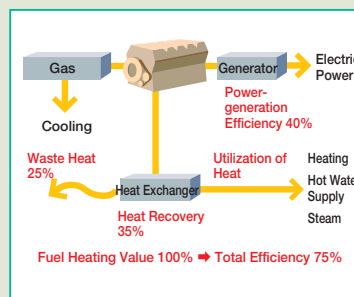
Based upon the Miller Cycle invented by R.H. Miller of USA, we have succeeded in developing the Miller cycle gas engine "GSR Series" as the world's first developer of such an engine. By adopting the Miller Cycle in the lean-burn gas engine, a power-generation efficiency of 40%, which is the highest in this class of engines, was accomplished.

Further, we developed a co-generation package with an improved total power-generation efficiency of about 75% by combining the GSR series with the generator and the waste heat-recovery unit. By connecting them to the 4-cycle engine of straight-type 6-cylinders · V-type 12-cylinders · V-type 16-cylinders, an output of 280 kW to 740 kW can be achieved. Moreover, in addition to reducing NOx emission to 150 ppm or less by combining the NOx system with this package system, we contribute to reducing CO₂ emissions through improved efficiency.

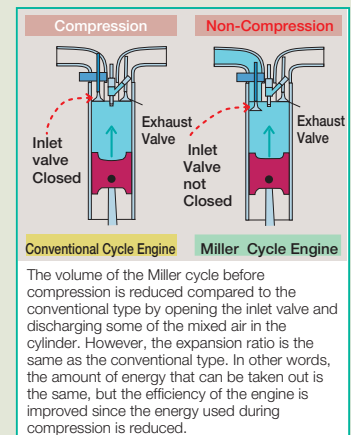
The lean-burn Miller Cycle gas engine co-generation system was highly evaluated for its high energy-saving efficiency and environmental friendliness, and we received for this system, together with our co-developer Osaka Gas Co., Ltd., the 2003 Technology Award from the Japan Gas Association.



Co-generation package



Total Co-generation Efficiency



Mechanism inside the Miller Cycle Engine Cylinder

The oxygen-rich combustion system, when mixed with high-density oxygen, increases the combustion temperature and significantly reduces dioxin emission.

Waste Disposal System

Users have great confidence in the oxygen-rich combustion system, which delivers a high-temperature combustion solution, as a next-generation waste-processing system that reduces both the environmental burden and exhaust emission. The combination of MHI's proved, proprietary stoker furnace*1 and the oxygen condensation system (PSA: Pressure Swing Absorption) supplies the primary combustion chamber with oxygen-rich air containing about 27% oxygen. This raises the combustion temperature by 100°C to 200°C, thus significantly reducing dioxin emission. It also offers about a 50% reduction in CO emissions, ash dust and heavy metal elution. Furthermore, the additional exhaust gas re-circulation system reduces chimney gas emissions to 65% (reduced by 35%) of the conventional level.



Inside the Stoker Furnace

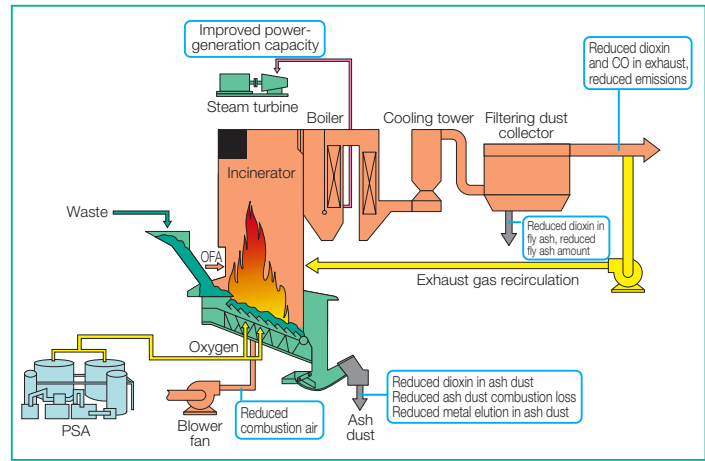
*1: In this system, waste is placed on the stoker (a square fire grate made of cast iron) in the furnace and burned using air from outside.

Elution of ash dust and heavy metal is reduced by

50%

Emission of exhaust gas is reduced by

35%



System Configuration

CNG forklift trucks that use compressed natural gas (CNG) as fuel are environmentally friendly products.

Forklift Trucks

Environmentally-friendly forklift trucks, that utilize compressed natural gas (CNG) as fuel for the purpose of prevention of air pollution from engine exhaust emissions, as well as utilizing alternative energies and further fuel saving. Natural gas, with methane as the major component, does not generate SOx and soot when combusted. In the CNG engine, the emissions of other pollutants such as CO₂, a global warming gas, and NO_x, cause of oxidase smog, are also reduced in comparison to gasoline engines. The fuel consumption per working hour may be as low as 44% of that for gasoline engines, and 56% of that for LPG engines, depending on the conditions. We have been introducing CNG Forklift trucks as an option for working environment improvement, in our General Machinery & Special Vehicle Headquarters as part of the model project for CNG utilization since September 2001.



CNG supply stand

Nitrogen oxide (NO_x) is reduced by

13%

compared to the gasoline engine.

Carbon dioxide (CO₂) is reduced by

20%

compared to the gasoline engine.



CNG forklift trucks

MHI has had a significant effect in energy saving and ozone layer protection in this technological domain.

Centrifugal Liquid Chiller

This chiller is an environmentally-friendly design that adopts HFC-134a for the refrigerant, which achieves zero level in the ozone depletion potential (ODP) ^{*1}. HFC-134a is one of the alternative refrigerants that is widely used in other industrial products and therefore easily available. The chiller utilizes refrigeration cycle with 2-stage compressor, economizer and sub cooler to achieve best-in-the-world level energy efficiency, COP^{*2}6.1. This amounts to 20% greater energy efficiency than conventional chiller.

^{*1}: This is the relative value to CFC that depletes the ozone layer, assuming the value of CFC is 1.

^{*2}: COP (coefficient of performance) indicates the efficiency of energy. The higher the value, the greater the efficiency.



Centrifugal Liquid Chiller

There is an increase in energy efficiency of **20%** compared to the conventional type.

Inverter Air-Conditioning Units for use in Offices and Stores

By considerably improving the efficiency of inverters and motors, we have developed an energy-saving-type inverter air-conditioning unit that has the highest COP in this field. With this unit, periodical consumption of electricity can be reduced by about 53% compared to conventional constant speed units. In addition, we have adopted a new refrigerant, R407C, with an ozone layer-depletion coefficient of zero.



Hyper-Inverter

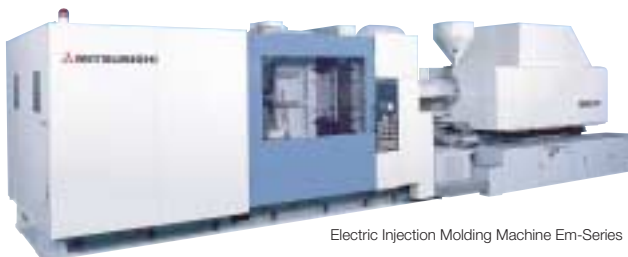
There is a reduction in periodical electricity consumption of **53%** compared to the constant speed type.

The electric injection molding machine fully utilizes the latest electronics technologies and its energy-conservation effect is high.

Injection Molding Machine

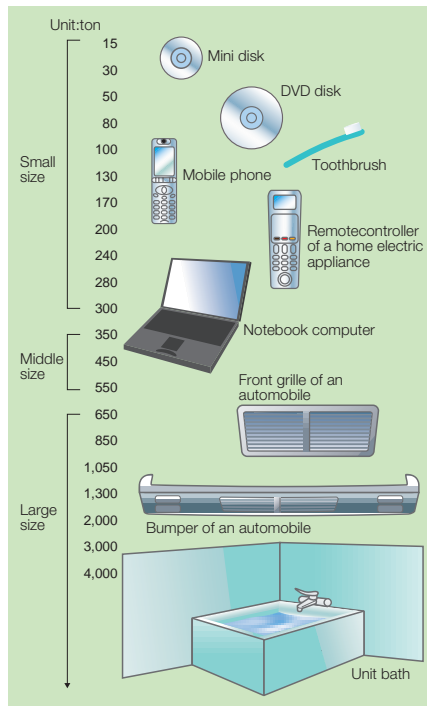
The large-size electric injection molding machine "em" series achieves remarkable energy saving and space efficiency. The overall length is 15% shorter than our competitor's in the same class.

This achieves the smallest size for a machine of this type in the world. Furthermore, the compact size of each unit of this machine has reduced the necessary materials and the area of the foundation work.



Electric Injection Molding Machine Em-Series

There is a reduction in electricity consumption of more than **60%** compared to the hydraulic type.



Examples of Molded Products

The dry-cut gear-shaping machine does not use cutting oil, and the energy-saving effect of the machine amounts to 30% compared to the conventional-type machine.

Machine Tool

The gear-shaping machine is used for processing gears with a gear-shaped tool. The dry-cut gear-shaping machine*1 that we developed does not use cutting oil, and contributes to a clean, safe working environment. In addition, it eliminates the need for waste fluid disposal and reduces waste, as well as eliminating the risk of fire due to cutting oil. Furthermore, the oil-free operation saves a significant amount of electric power that may otherwise be consumed for cutting oil-related systems such as lubrication pumps, mist collectors and oil coolers. The energy-saving effect amounts to 30% compared to the conventional type in the case of a typical automotive gear-shaping machine.

*1: This is a kind of machine tool for processing gears. In the case of usual gear cutting, a large amount of oil is used to prevent wear of the tool and to wash out chips, but in the case of dry cutting, no such oil is used.



There is a **30%** reduction in energy consumption compared to the conventional type.

There is a **100%** reduction in cutting oil compared to the conventional type.

Engineer's Voice

I tried to solve the two antithetic concepts, chip shoot and bed rigidity, on a high level.

Machine Tool Division
Engineering Department
Toshifumi Katsuma



I was in charge of machinery design and the verification test. I engaged in technical calculations required for satisfying the performance target, prepared the drawings resulting from these calculations, planned the method of verification to confirm the performance of the machine completed and implemented the verification test.

With the machine that we developed, we made efforts to reduce the environmental burden by adopting dry-cut without using coolant. I racked my brains to find a method of treating chip generating during processing. Since coolant is not used and chips cannot be washed out with coolant, it was necessary to adopt a whole bed built of the shoot structure. It was a difficult job to keep the required rigidity of this structure. I repeated the rigidity calculations and design alterations, and finally succeeded in maintaining the rigidity.

Advice from senior designers was very helpful in solving these problems. Frankly speaking, I felt relieved when the matters that had been worrying me were cleared at the verification test. I thought our work always brought good results, corresponding to the efforts made. I have re-confirmed the importance of doing things thoroughly without giving up halfway.

Topic Our Products that have Won Awards

In February 1999, our gear manufacturing machinery, as exemplified by our dry hob cutting system, received a Minister of International Trade and Industry commendation, the highest award given at the 1998, 19th annual Excellent Energy Saving Machinery Awards, hosted by the Japan Machinery Federation.

Dry hob cutting system

Background

When gears are machined and cut from metal stock, a large amount of oil is required to protect the tool surface and to flush away scrap material. The inevitable spreading and misting of the oil degrades the work space, making it dirty and dangerous. Hobbing machines generally use water insoluble oil that represents a fire hazard. Thus a dry-cutting system is desirable from the standpoint of safety, environmental friendliness, and waste oil management.

Features

<Clean and safe work environment>

Because our dry-cutting system uses no oil, the workspace is greatly improved compared with that of conventional systems. As well, waste-oil treatment is unnecessary and the risk of fire eliminated.

<Productivity>

Compared to the conventional speed of 100 m/min., a high cutting speed of 200 m/min. is achieved, thus doubling productivity.

<Economical>

Owing to a special coating, tool life has been extended five-fold. As well, power consumption is reduced, cutting-oil cost eliminated, and labor costs reduced due to the improved working environment. Finally, operating costs are reduced by 45% through the elimination of oil-related components such as a circulation pump, mist collector, and cutting oil cooler.

<Energy-saving effect>

The energy saved by eliminating oil-related components results in a cost reduction of 37% in case of typical automotive gear parts in comparison to conventional type. H.S.S. material hob cutter "Super Dry"



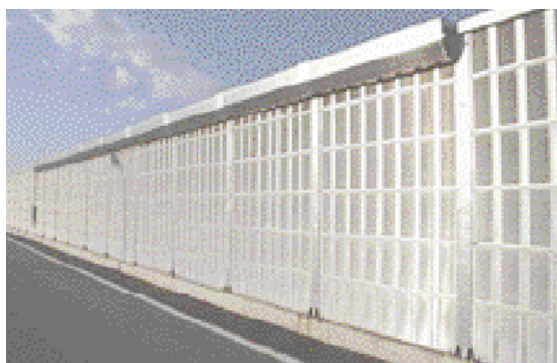
Super Dry Hob Cutting System

New Technology that Creates the Future World

We develop new technology that offers a base for building a circulation-type economy and society by using natural energies and new materials.

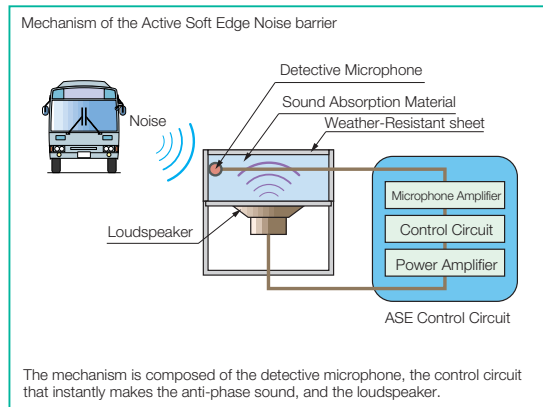
By adopting the “active soft edge noise barrier” that generates anti-phase sound, we have succeeded in significant reduction of the traffic noise.

Roadways are filled with the noise of various vehicles. To cope with this noise, we have developed together with the National Institute for Land and Infrastructure Management the “active soft edge noise barrier” that reduces noise on roadways by continuously and instantly generating anti-phase sound, and succeeded in commercializing this product for the first time. With a noise barrier of this type, a 60-cm-wide active noise-reducing device in the shape of an inverted triangle is fitted to the upper edge of an ordinary noise barrier. As a result of installing this device, the noise reduction effect is about 5dB greater than that of an ordinary noise barrier without changing the height of it. This is equal to the effect of reducing road traffic by nearly 70%.



The active noise-reducing device is fitted on the top edge of the wall (active soft edge noise barrier).

The noise reduction effect corresponds to reducing traffic by



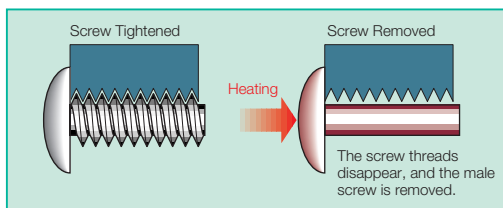
The “shape memory polymer screw,” whose threads disappear when heated, exerts its power when home-use electrical products are disassembled.

MHI has succeeded for the first time in developing a “shape memory polymer screw” that changes its form when heated. A screw of this type has been developed for home-use electrical products such as TV sets and air-conditioners, and for IT products such as mobile phones. Disassembling these products starts with removing screws, but this work requires a lot of labor and time. Rust is also a problem. A new idea to solve this problem has been long sought.

The newly developed “shape memory polymer screw” can be easily removed since the screw threads disappear with heat. This is a great advantage when disassembling products. The introduction of home-use electrical products using these screws is scheduled for 2004. This is an excellent product since not only it reduces the burden when disassembling products. We expect this shape memory polymer screw to make a great contribution to realizing the circulation-type economy and society.



By heating the “shape memory polymer screws,” the threads of the screws disappear, and the screws can be easily removed.



Engineer's Voice

I am exerting efforts to develop an epoch-making method and material that promotes recycling.

Advanced Technology Research Center
Technical Headquarters

Chief Researcher

Dr. Shunichi Hayashi



I was in charge of the development of fasteners and fastening structures such as screws using shape memory polymer. In recycling activities, it was a problem that we had to spend so much energy, cost and labor for dismantling jointed parts of home-use electrical appliances and IT products. I hope that developing a screw that uses shape memory polymer will settle this problem technically.

The first task was to investigate the theme of material reforming. It was necessary to develop shape memory polymer that recovers its original shape at temperatures as high as 120°C. We accomplished this by using the polymer design technology we had so far acquired and introducing new knowledge. In future, we shall further promote the practical application of this technology together with customers.

We have striving to develop a next-generation high efficiency “fuel cell.”

MHI for years has delivered a significant number of thermal power plants ranging from the large type for power plant projects to the medium/small types for factory use. Their advanced technology features, reliability, and high efficiency have been given favorable reputations from the customers. Now, based on these technological achievements and experiences, MHI is developing some fuel cell technologies as a new-generation high-efficiency power-generation solution. Of all fuel cell technologies currently available, MHI's selections are the polymer electrolyte fuel cell (PEFC) and the solid oxide fuel cell (SOFC).

Solid oxide fuel cell (SOFC)

SOFC, with a high operating temperature, allows high-efficiency power generation when combined with a gas turbine. They offer potential for wide application from distributed power networks to thermal power plants.



Polymer electrolyte fuel cell (PEFC)

PEFC, with a low operating temperature, has several excellent properties such as “quick start” “allows compact size and lightweight” and “low cost materials”. They are expected to be used widely, especially for home co-generation systems.



We are engaged in developing a next-generation clean liquid fuel, “dimethyl ether.”

Dimethyl ether (DME)*1 is attracting world attention as a clean liquid fuel that does not contain sulfur, heavy metal or aromatics. This fuel is expected to be used as a replacement fuel for home-use LPG, for automobiles and for power generation. DME is not only friendly to the environment, but is also highly efficient in ignition and combustion. In addition, DME can be comparatively easily transported and stored. There are various methods of producing DME. Among them, we introduce the three methods that we are now studying.

Method of Refining Biomass*2 into Methanol*3 and Converting Methanol into DME

In our research and development, biomass such as trees and plants, materials produced by tree thinning and waste construction materials are gasified in accordance with the entrained bed system. This gas is composed into methanol, and DME is removed from the methanol. For this development, we will complete an experimental plant within 2003. In addition, we are proceeding with research and development to produce biomass fuel on isolated islands of the Pacific Ocean with the cooperation of PICHTR (Pacific International Center for High Technology Research), a Japan-USA joint research organization.

Method of Producing DME by Changing the Quality of Natural Gas

Research on this method is ongoing for the effective use of still abundant natural gas.

Method of Producing DME by Reacting Carbon Dioxide with Hydrogen

We are also studying a method of producing DME by reacting carbon dioxide generated from power plants or chemical plants with hydrogen.

Engineer's Voice

I am making efforts to develop technology considering user's requirements and the key points for successful development.

Technical Headquarters
Chief of PEFC Development Center
Hirohisa Yoshida



I am in charge of research for making the polymer electrolyte fuel cell (PEFC) fit for practical use as an electric power source for vehicles and home-use electrical appliances. The point of the development is that power generation efficiency should be improved, and from this viewpoint, we had to improve the efficiency of the reforming equipment, the cell and the auxiliary machines. The next tasks are how we can increase the reliability and durability of the cell, decrease the production cost, and maintain satisfactory performance and price for use in vehicles and home-use electrical products. Manufacturers of the world are currently competing hard to accomplish these tasks. We are also putting our best efforts into developing this technology.

In the case of developing a product such as a fuel cell for which concentrated use of advanced technologies is required, it is necessary to develop the product steadily considering users' needs. I will strive to develop technology with this in mind.

We are making efforts to develop a DME transportation and storage system, and a power-generation system using DME as fuel by fully utilizing our power.

- *1: Dimethyl ether is a kind of ether similar to propane and butane. It is a colorless and transparent, inflammable, and odorless gas.
- *2: Biomass is created from CO₂ in the air that solidifies into trees and plants through solar energy. Biomass is abundant in nature, and the amount of CO₂ in the air does not increase even if it is used as fuel. Therefore, the use of biomass is ideal as a self-sustaining energy and for solving the problem of CO₂ emission.
- *3: Methanol (also called methyl alcohol) is a colorless, odorless gas, with high flowability and inflammability.



Source of Biomass



Biomass Gasification Methanol Production Plant



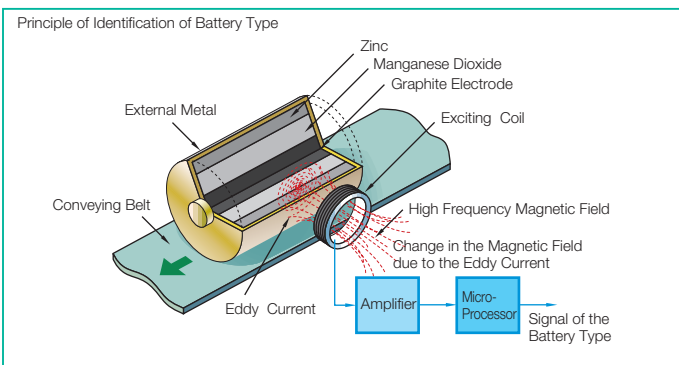
Natural Gas Reforming Plant

We have developed a battery sorter that separates batteries into classified groups at the speed of 10 units per second.

The battery sorter separates batteries into classified groups for the efficient recycling of used batteries that still contain precious resources. The battery sorter can separate batteries into Size D, C and AA battery groups, or separate them into various material groups such as alkaline, manganese, nickel-cadmium, at a speed of 10 units per second. This system is composed of a hopper, an aligning device, a carrying conveyor, a separation sensor and an air nozzle. The original electromagnetic sensor*1 identifies the internal structure and components of the batteries and automatically separates them into groups. As a result, very quick and efficient recycling of batteries is possible. Actual products are currently in

operation and are highly valued by those working on battery separation sites.

*1: When a high frequency magnetic field is given on a battery, an eddy current is generated inside the battery. The generated eddy current differs depending upon the internal structure and components. Therefore, by detecting change in the magnetic field caused by the eddy current, we can identify the type of the battery.



Battery sorter

We are engaged in developing technology that prevents an increase in CO₂ emission to more than the present level.

MHI is making efforts in research to prevent an increase in CO₂ that is closely related to the health and life of the people. We introduce two research cases, one on the “underground retention system” (CO₂ is recovered as it is where it has been generated, and it is returned underground), and the other is on “ocean sequestration” (generated CO₂ is transported on the sea and stored in the depths of the ocean).

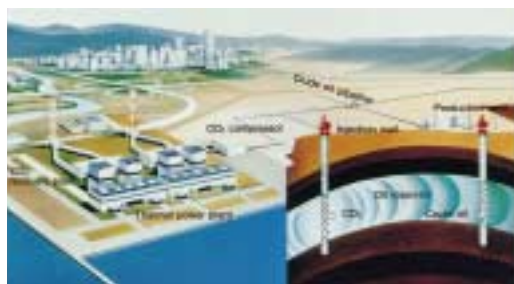
CO₂ recovery/underground retention system

This system is to recover CO₂ emitted from power plants at low cost by means of our unique technology, new absorptive fluid (with more than 20% greater energy efficiency), and permanently retain the CO₂ in aquifers located deep under the ground.

In EOR (CO₂ Enhanced Oil Recovery), another type of underground retention system which will also contribute to heavy oil production, the recovered CO₂ is injected into the underground oil layer and readily absorbed in the crude oil. Because the absorbed CO₂ remarkably improves the fluidity of the heavy oil, much more crude oil can be extracted from under the ground.

The CO₂ absorbed in the extracted crude oil is separated from the oil and injected again into the underground oil layer. The result is that the oil layer under the ground is finally replaced by CO₂. Thus, significant amount of CO₂ will be retained underground without being released in the air.

MHI is working to develop necessary technologies to enlarge the capacity of these systems, improve the crude oil extraction efficiency, and dispose of



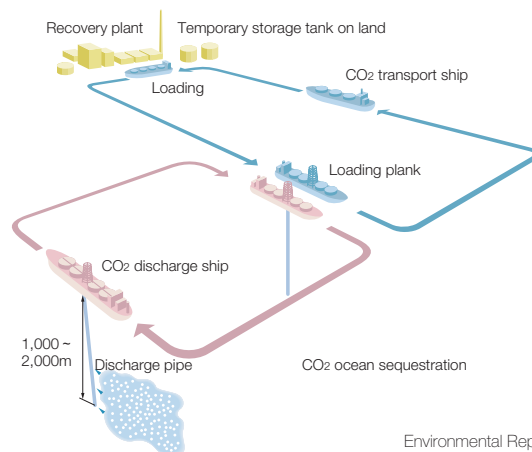
Underground Retention System

CO₂ emissions on a reliable basis.

CO₂ ocean sequestration

This system is based on the concept of recovering CO₂ generated by burning of fossil fuels and using the ocean to absorb it. This approach has many advantages such as compatibility with existing energy supply systems, freedom of site location selection, direct processing of a large amount of CO₂, and relatively low cost. However, to materialize this concept, it is necessary to identify the time until CO₂ in the sea is released into the air, and evaluate what impact is expected on the oceanic environment. In addition, a reliable methodology to predict the behavior of CO₂ in the sea must be established.

MHI has participated in the Study on Environmental Assessment for CO₂ Ocean Sequestration to Mitigate Climate Change, a Ministry of Economy, Trade and Industries project begun in 1997, and has continued studying the fundamental concept for a feasible CO₂ Ocean Sequestration system.



We have developed a compact, highly efficient, high-power motor for electric vehicles.

In August 2001, an electric vehicle developed by Mitsubishi Motors Corporation, named "Eclipse EV" achieved a round trip in the Shikoku island (about 780 km mileage in total) in 25 hours. The electric vehicle was equipped with an electric motor and motor control unit (MCU) developed by MHI. These units, with light weight and high efficiency, significantly helped the vehicle to achieve a long mileage per full charge exceeding 400 km.

Recently some electric motor-based vehicles such as EV, hybrid, and fuel cell EV have attracted more attention as next generation automobiles. The motors used in these vehicles must be compact, highly efficient, and very powerful. To meet these requirements, MHI has developed a compact, lightweight, and high-efficiency motor with higher power than our competition's by adopting an interior permanent magnet motor (IPM motor) and optimizing the layout of magnets and solenoids.

The EV technology competition in the automotive industry is increasingly heating up. These low-pollution vehicles are expected to spread gradually in the market as a solution for the problems of environmental destruction and fossil fuel resource exhaustion. We intend to make further progress in our R&D activities for smaller, lighter and more reliable electric motors to satisfy the automotive industry needs.



Motor system for driven EV

Motor output has improved by **300%** compared to other motors of the same capacity.



Round trip in Shikoku Island (780 km)
Vehicle performance (Eclipse)
1. Max. speed: 180 km/h
2. Range (mileage per full charge): 450 km

Eclipse EV

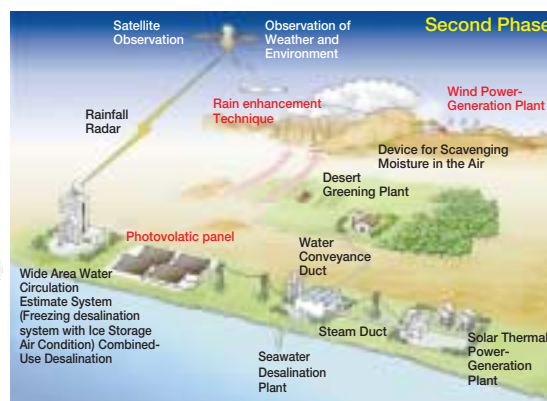


We are continuing our efforts in the greening of deserts by forming a consortium of industry, government and the academic world.

To create oases in deserts, which would be a dream come true, MHI is exerting its best efforts to integrate scientific technology to estimate variation of climate and watercycle with the engineering and agricultural technology for prevention of desertification, and for effectively reaching the objective of desert greening through considering social science and restraining the use of energy as much as possible. MHI formed a consortium of industry, government and the academic world, composed of Kyoto University, Tottori University, Sophia University, the National Research Institute for Earth Science and Disaster Prevention, the Frontier Research System for Global Change and the Earth Simulator Center, mainly to conduct contract research for the Ministry of Education, Culture, Sports, Science and Technology (5-year plan), and work with the cooperation of the Government of Saudi Arabia.



General Idea



Harmonization with Local Communities

MHI, as a corporate citizen of local communities, positively participates in local community activities to preserve the local environment through production operations rooted in local communities.

We positively participate in local community activities such as cleaning public areas and campaigning to beautify the town.

To increase employee awareness of the importance of environmental protection, in the 'Environmental Week' of each June since 1970, we have conducted company-wide activities, such as environmental patrols by the heads of the Works or by environmental protection managers, hosting sightseeing tours of environment protection facilities, collecting garbage around factory during lunch time, and other activities which allow employees to gain firsthand experience.

These activities were highly evaluated by the relevant ministries and agencies, and cited as a valuable precedent in Japan. Each Works participates aggressively in the campaign to eliminate unlawful littering, and tries to improve the cleanliness of the local community.

	Times	Number of Participants	Amount of Waste Recovered
1999	206	4,422	4,411kg
2000	306	4,756	4,911kg
2001	397	5,909	4,288kg
2002	190	5,245	4,747kg

Planned by MHI

We promote activities in our plants to preserve living creatures such as "medaka" and birds

The Hiroshima Machinery Works is promoting preservation of killifish (called medaka in Japan) and fabrication of birdhouses utilizing scrap wood from the factory. The killifish live in the approximately 4,000 m drainage canals that ring the compound. Every year, the Works donates part of the increasing killifish to local kindergartens and elementary schools for use in lessons. As for the birdhouses, the Hiroshima Works regularly hosts a competition of birdhouse fabrication through which employees have strengthened their awareness for waste reduction and preservation of natural life. The fabricated birdhouses are posted on trees in the premises. The facility intends to continuously maintain these natural environments in the premises, which allows them to see killifish and birds.

We have donated used personal computers to children of South Africa.

As one of our activities to support school students in South Africa, we donated 10 used personal computers scheduled for scrapping through "Digital Partnership Japan (DPJ)." DPJ is a secretariat in Japan of "Digital Partnership," a project promoted by NPO "the Prince of Wales International Business Leaders Forum." DPJ appeals mainly to enterprises to donate used personal computers to offer an Internet service to children in South Africa who lack a proper education and are currently without network facilities. Donation of more than 1,000 computers is expected from various enterprises. The personal computers collected will be sent to South Africa through DPJ, and after conversion to the local specifications, they will be used at e-learning centers to be opened at 20 schools.



Cleaning Areas around Bus Stops (Nagasaki Shipyard & Machinery Works)



Members of our company participate in a river-cleaning campaign (General Machinery & Special Vehicle Headquarters).



Kindergarten children visit our plant to observe "medaka" (killifish) (Hiroshima Machinery Works).



Nest Boxes (Hiroshima Machinery Works)

Communication with Society

The confidence of society in an enterprise depends not only on the products, but also on the information disclosed and published by the enterprise. We believe that we should listen to our customers and positively offer environmental information to obtain customer confidence in MHI.

We have a positive attitude toward communication with society.

MHI discloses environmental information in environmental reports and on our Internet site, and responds to every inquiry via communication means such as e-mail received from our customers. We are also aggressive in having discussions with autonomous bodies and industrial associations to review our environmental policies from an objective viewpoint. These activities as well as our products released to the public were evaluated and rewarded for their environment-oriented technologies.

We attended environment-related events in 2002 sponsored by groups in our neighborhood or by autonomous bodies.

Board of Directors / General Meeting	28 times
Council / Liaison Conference / Meeting for Exchange of Opinions	42 times
Informal Gathering for Discussion (Social Gathering) / Gathering	34 times
Training (Study) Course / Lecture Class	25 times
Visit	15 times
Lecture Meeting / Explanation Meeting	132 times
Cleaning Local Area / Tree Planting	35 times

These were planned by groups in the neighborhood or by autonomous bodies.

Product Commendations

Date(year/month/day)	Host	Description
1999.6.14	Ministry of International Trade and Industry, Agency for Natural Resources and Energy, Director General, Yasuhiro Inagawa	The compact, thermal ice-storage package air conditioner "ECO ICE mini," jointly developed with Daikin Industries and two other companies, received the "Director General of the Agency for Natural Resources and Energy commendation" in the 1st Electric Load Equalization Equipment/System Awards.
2000.4.19	Prime minister, Yoshiro Mori	"Development & Implementation of Combined-Cycle Power Plant utilizing high-efficiency large-capacity gas-turbine," jointly developed with Tohoku Electric, Mitsubishi Electric, received the "Prime Minister's award" in the 29th Japan Industrial Technology Grand Prize.
2001.3.14	Ministry of Economy, Trade and Industry, Agency for Natural Resources and Energy, Director General, Hirofumi Kono	The Mitsubishi Minatomirai Industrial Museum received the "Director General of the Agency for Natural Resources and Energy commendation" in the Japan Productivity Center for Socio-Economic Development, Energy Education/Enlightenment and Facility/Activity Awards.
2001.6.27	Ministry of Economy, Trade and Industry, Minister, Takeo Hiranuma	Our "PCB detoxification plant" received the Minister of Economy, Trade and Industry commendation in the Japan Society of Industrial Machinery Manufacturers Excellent Environmental System Awards.
2002.2.6	Kenichiro Aikawa, Chairman of the Japan Machinery Federation	The HFC134a centrifugal liquid chiller developed by MHI using the two-stage compression economizer and the subcool cycle received a Japan Machinery Federation Chairman commendation as an excellent energy-saving device in 2001.
2002.2.6	Kenichiro Aikawa, Chairman of the Japan Machinery Federation	The high-speed large-capacity pumping-up power-generation system with 700-m class ultra-large head developed by MHI together with the Tokyo Electric Power Co., Inc. and other three companies received a Japan Machinery Federation Chairman commendation as an excellent energy-saving device in 2001.
2002.6.13	Shin-ichiro Ryoki, Chairman of the Japan Gas Association	The development of the lean-burn Miller cycle gas engine cogeneration system conducted by MHI together with Osaka Gas Co., Ltd. received the 2002 Technology Division Grand Prize.
2002.11.26	Naomichi Hirayama, Chairman of the Westech Execution Committee	MHI's battery sorter received the New Technology Division Prize in the WESTEC Awards 2002.
2003.2.6	Takeo Hiranuma, Minister of Economy, Trade and Industry	The low-noise high-efficiency variable speed gearless windmill that uses the permanent magnetic multi-polar synchronous generator developed by MHI together with Mitsubishi Electric Corporation received a Minister of Economy, Trade and Industry commendation, the 7th new energy grand prize sponsored by the New Energy Foundation.
2003.2.20	Kenichiro Aikawa, Chairman of the Japan Machinery Federation	The pilot ignition gas engine with combustion control (MACH-30G) received a commendation from the Director General of the Agency for Natural Resources and Energy in 2002.

New Head-Office Building

Mitsubishi Minato-Mirai Industrial Museum

The Mitsubishi Minato-Mirai Industrial Museum, the exhibition facilities of MHI, introduces its latest technologies in six zones related to the universe and energy, and in the experience corner, one can design ships and aircraft on the personal computer. The "environmental zone" was renewed considering the "time for comprehensive study" introduced in primary schools and junior high schools in 2002. In addition to introducing actual environmental problems and technologies for environmental protection, we now display new impressive exhibitions that adults and children may see from their own viewpoint, and which allow them to consider what they can do around them. These new exhibitions are highly appreciated by those concerned with education. For spending the time for comprehensive study, we devised our own programs in tie-up with nearby primary schools, and a number of children have undertaken various studies in accordance with these programs. After finishing the programs, children frequently visit the museum together with friends and family. The number of visitors is increasing continuously, and 20,243 people visited the museum in 2002. The total number of children visiting the museum for studies outside school since its opening in 1994 exceeded 140,000.

Furthermore, we hold a number of events concerning the environment. We offer opportunities to think about the global environment and recycling through lectures, handicraft classes, experiments and classes for making toys using recycled materials. In addition, we arrange various other events such as handicraft & experiment classes and ocean classes that are held four times a month. A large number of pupils visit the museum for out-of-school studies from all parts of Japan, and these pupils account for 30% of the total number of the visitors to the museum. The need of those concerned with education for these events seems to be increasing. We shall make further efforts for better exhibitions and events so that more people become familiar with technology.

New Head-Office Building

Through a long history since foundation of the company at the beginning of the Meiji Era with its head office in Marunouchi, the present MHI has been constructed. In May 2003, the new head-office building was completed, and the functions of the head office moved to this new building near Shinagawa Station in Tokyo. The basic design was prepared by MHI, and maximum environmentally conscious functions have been incorporated into the building.

Firstly, the electric system attracts the most attention. On the common-use passage roof and the wall, panels for solar power generation are installed, and there are environmentally friendly co-generation facilities that simultaneously supply electric power and heat. Fluorescent lamps of the power-saving type have been adopted, and have function to control the luminosity of the room according to that outside. The midnight electric power is used for the water heater in the kitchen. An air-conditioning system of blowing-out from the window side and the floor, which is kind to the human body, has been adopted, and high-functional heat reflection glass is used to reduce the burden on air-conditioning units. With the combined effect of the facilities, we have realized an energy saving of 30% due to the increase in energy efficiency compared to conventional buildings.

Furthermore, we have put meticulous effort into saving resources. We use recycled water (controlled by the Bureau of Sewerage), reuse rainwater and water discharged from the kitchen, and adopt water-saving type toilets. In constructing the building, we separated the waste materials generated during construction into 12 categories for thorough recycling to reduce the burden on the environment.

After trying our best to reuse the office fixtures and equipment of the old Marunouchi Building, we donated those that remained but that we could not use, such as desks and chairs, to 35 bodies and organizations in and outside Japan. As a result of our efforts for the effective use of resources, we have succeeded in accomplishing a recycle ratio of 95%.

At Mitsubishi Minato-Mirai Industrial Museum, we arrange exhibitions and events where you can experience the technology directly.



Environment Zone



Handicraft and Experiment Class



Ocean Class



Children Visiting the Museum for Out-of-School Study



Comprehensive Study / Preparation of Data for Reporting in Class



Environmental Event
"Lecture, experiment and handicraft in connection with recycling"



Appearance of Mitsubishi Minato-Mirai Industrial Museum



New Head-Office Building



Co-generation Facility



Separation of Construction Waste Materials

History of Environmental Activities

To fulfill its responsibilities as a comprehensive heavy industry company, MHI has always been prompt in responding to domestic or overseas environmental trends since the establishment of our Environmental Management Office in 1973. We undertake company-wide environmental activities, for example, ISO 14001 certification acquisition by all the works.

Year	MHI	Events domestic/foreign (Japan / Worldwide)
1967		Enactment of the Basic Law for Environment Pollution Control
1970	Completed the first domestic PWR power plant	
1971		Establishment of the Environment Agency The United Nation's Environment Conference held in Stockholm <Adoption of the United Nations Human Environment Declaration> <Establishment of the United Nation's Environment Program (UNEP)>
1973	Established an Environmental Management office	
1978	Began conference for managers in charge of environmental management	
1987		Adoption for the Montreal Protocol
1988		Enactment of the Ozone Layer Protection Law
1989	First internal company CO ₂ counter measures conference First internal company fluorocarbon counter measures conference	
1991		Enactment of the Keidanren (Japan Federation of Economic Organizations) Global Environment Charter
1992		United Nation's Conference for the Environment and Development (Earth Summit) held in Rio de Janeiro <Adoption of the Rio Declaration on Environment and Development> <Adoption of Agenda 21> Ministry of International Trade and Industry requested companies to formulate the Voluntary Plan for Environment
1993	MHI voluntary plan formulated Company guideline towards environmental problems	Enactment of the "Basic Law for Environmental Pollution Control"
1995		The 1st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP1) held in Berlin
1996	Established policy on environmental matters Established an Environment Committee	The 2nd Conference of the Parties to the United Nations Framework Convention on Climate Change (COP2) held in Geneva Issued ISO14001
1997	Yokohama Dockyard & Machinery Works received an ISO14001 certification, the first one given in Japan's heavy industry Commercialized air-conditioner with the new coolant R410A	The 3rd Conference of the Parties to the United Nations Framework Convention on Climate Change (COP3) held in Kyoto Guidelines of the Keidanren (Japan Federation of Economic Organization) Voluntary Action Plan on the Environment
1998	Developed a hydrothermal PCB decomposition system	The 4th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP4) held in Buenos Aires Amendment of the "Energy-Saving Law" Enactment of the "Climate Change Law"
1999	Delivered a combined-cycle power plant using the latest model gas-turbine "M701G" with the world's highest efficiency	The 5th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP5) held in Bonn Enactment of the "Pollutant Release Register or Management Promotion Law" Enactment of the "Law concerning Special Measures against Dioxins"
2000	All 13 of our production sites received an ISO14001 certification	Enactment of the "Basic Law for the Promotion of the Formation of a Ecologically-Oriented Society" Enactment of the "Waste Management and Public Cleaning Law" Amendment of the "Law for Promotion of Utilization of Recyclable Resources" Enactment of the "Law for Promotion of Recycling of Construction Waste" Enactment of the "Law for Promotion of Recycling of Food Residue" Enactment of the "Law concerning the Promotion of Environmentally Friendly Goods Procurement by the State" The 6th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP6) held in Hague
2001	Our engineering activity received an ISO14001 certification.	The 7th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP7) held in Morocco Enactment of the "Law concerning Special Measures against PCB Wastes" Enactment of the "Law concerning the Promotion of Freon Recovery and Depletion"
2002	Mid- and long-term objectives for environmental activities were established	The "World Summit on Sustainable Development" Held in Johannesburg Approval of the "Kyoto Protocol" Enactment of the "Soil Contamination Prevention Law" The 8th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP8) Held in New Delhi

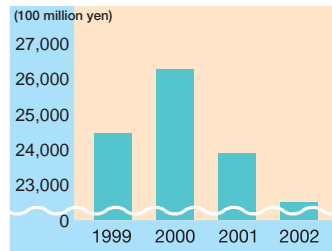
Company Profile

Corporate Activities other than Production Business

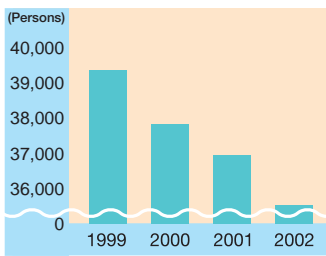
Company Profile

Name of Company: Mitsubishi Heavy Industries, Ltd.
 Foundation: July 7, 1884
 Establishment: January 11, 1950
 Representative: President Kazuo Tsukuda
 Head Office: 16-5 Konan 2-chome, Minato-ku, Tokyo
 Capital: 265.6 billion yen (as of end March, 2003)
 Sales: 2,171.8 billion yen (in 2002)
 Number of Employees: 35,530 (as of end March, 2003)
 Number of Headquarters and Divisions: 14
 Number of Research and Development Centers: 6

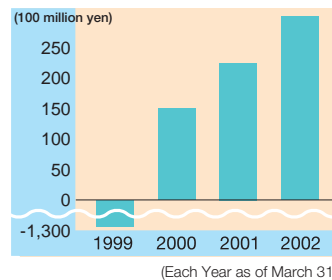
Change in Sales



Change in the Number of Employees



Change in Profit after Tax



Main Business Operations

The company's main operations includes the manufacture, installation, sales, and repair of the following:

Shipbuilding and Marine Products

Oil tankers, container ships, passenger ships, car ferries, special carriers such as LPG/LNG carriers, defense and patrol vessels, marine structures

Power Systems

Boilers, turbines, gas turbine, diesel engine, water turbines, wind turbines, nuclearpower system/facility, auxiliary equipment/system for nuclear-power system, nuclear fuel, denitrification system, marine machinery

Machinery and Steel Structures

Waste treatment, desulfurization system, various gas-scavenging/exhaust systems including fuel exhaust treatment system, traffic system, transportation vehicle, chemical plants including petrochemical plant, petroleum and gas production plants, machinery for chemical industry, seawater desalination systems, steel manufacturing plants, wind/hydraulic power-generation system, packaging machinery/system, steel bridges, hydraulic gates, cranes, smoke stack/funnel, sky parking system, tanks, sports/culture and leisure-related facilities, and other steel structures

Aerospace

Various types of aerodyne including fighter airplanes; helicopters, airframe components for private transport airplanes, aircraft engines, missile guidance units, torpedoes, aircraft hydraulic equipment/systems, spacecraft and components

Mass and Medium-Lot Manufactured Machinery

Forklifts trucks, construction machinery, machines for transportation and ground leveling, medium/compact-sized engines, superchargers, special vehicles/carriages, air-conditioning systems for houses, business and industrial use, and vehicles, refrigerators, chillers, plastic-related machinery, food-related machinery, industrial robots, power transmission device, papermaking, paper converting machinery, printing machinery/systems, machine tools

Locations

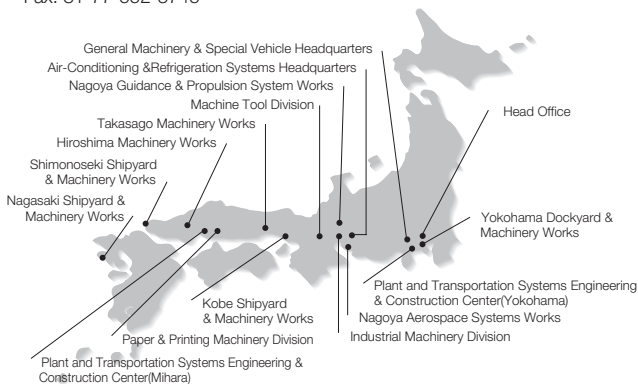
*In April 2003, the Plant Engineering Center (MCEC) and the Mihara Machinery & Transportation Systems Plant were unified, and the Plant and Transportation Systems Engineering & Construction Center was newly established.
 *In May 2003, the Head Office moved to Konan, Minato-ku, Tokyo.

Headquarters & Divisions

Head Office
 16-5 Konan 2-chome, Minato-ku, Tokyo, Japan
 ZIP: 108-8215 Phone: 81-3-6716-3111 Fax: 81-3-6716-5800
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 3000, Tana, Sagami-hara-shi, Kanagawa
 ZIP: 229-1193 Phone: 81-42-761-1101 (General Affairs Dept.)
 Fax: 81-42-763-0800
Air-Conditioning & Refrigeration Systems Headquarters
 3-1, Asahi-cho, Nishi-Biwajima-machi, Nishi-Kasugai-gun, Aichi
 ZIP: 452-8561 Phone: 81-52-503-9200 (General Affairs Dept.)
 Fax: 81-52-503-3533
Industrial Machinery Division
 1, Aza Takamichi, Iwatsuka-cho, Nakamura-ku, Nagoya-shi
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 Fax: 81-52-412-1399
Paper & Printing Machinery Division
 5007, Itozaki-cho, Mihara-shi, Hiroshima
 ZIP: 729-0393 Phone: 81-848-67-2054 (General Affairs & Labor Section)
 Fax: 81-848-63-4463
Machine Tool Division
 130, Roku-jizo, Ritto-shi, Shiga
 ZIP: 520-3080 Phone: 81-77-553-3300 (General Affairs Dept.)
 Fax: 81-77-552-3745

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Shimonoseki Shipyard & Machinery Works
 16-1, Hikoshima Enoura-cho 6-chome, Shimonoseki-shi, Yamaguchi
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Yokohama Dockyard & Machinery Works
 12, Nishiki-cho, Naka-ku, Yokohama-shi
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Hiroshima Machinery Works
 6-22, Kan-on-shin-machi 4-chome, Nishi-ku, Hiroshima-shi
 ZIP: 733-8553 Phone: 81-82-291-2112 (General Affairs Dept.) Fax: 81-82-294-0260
Takasago Machinery Works
 1-1, Arai-cho Shinhama 2-chome, Takasago-shi, Hyogo
 ZIP: 676-8686 Phone: 81-794-45-6125 (General Affairs Dept.) Fax: 81-794-45-6900
Nagoya Aerospace Systems Works
 10, Oye-cho, Minato-ku, Nagoya-shi
 ZIP: 455-8515 Phone: 81-52-611-2121 (General Affairs Dept.) Fax: 81-52-611-9360
Nagoya Guidance & Propulsion System Works
 1200, O-aza Higashi Tanaka, Komaki-shi, Aichi
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Plant and Transportation Systems Engineering & Construction Center [Mihara]
 5007 Itozaki-cho, Mihara, Hiroshima Prefecture
 ZIP: 729-0393 Phone: 81-848-67-2072 (General Affairs & Labor Section)
 Fax: 81-848-67-2816
[Yokohama]
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 Fax: 81-45-224-9932
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 3-1 Minatomirai, 3-chome, Nishi-ku, Yokohama ZIP: 220-8401 Phone: 81-45-224-9031
 Fax: 81-45-224-9902





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Recycled paper with a used-paper ratio of 100% has been used for this report, aroma-free bean oil ink has been used as printing ink, and the "no water printing method" that does not use moistening water containing alkaline developing fluid and isopropyl alcohol has been adopted for printing.