

Changes for the Better

CSR | Corporate Social Responsibility
Environmental Topics



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Environmental Topics



▶ From the President



Sharing our precious Earth with future generations. President & CEO Setsuhiro Shimomura addresses new targets and challenges in helping to realize a sustainable society.

▶ Guide to Environmental Technologies



Products
Cutting-edge Technology

▶ Reducing CO₂ During Production



Reducing CO₂ from Product Usage
Reducing CO₂ Emissions during Production
Example 1: Fukuyama Works
Example 2: Raising Production Efficiency

▶ Innovative Products and Production



Product Innovations
Production Process Innovations
Engineers' Perspectives
Working with the Community for the Environment

▶ PV Power Generation



Increasing Efficiency
PV Popularization
Perspectives

▶ Rebuilding and Developing Automotive Equipment



Rebuild Operations:
Recycling in Action
Providing Cutting-Edge Alternators
Initiatives to Reduce Waste

▶ Recycling of Waste Plastics



Large-Scale, High-Purity Plastic Recycling
Technology for Separating Plastics
Technology for Improving Plastic Quality
Using Recycled Plastic in Products

▶ Towards Zero Emissions



Birth of a Recycling System
Recycling Examples
Future Development

▶ Fostering Environmental Awareness



Outdoor Classroom Objectives
A Handmade Virtuous Circle
Reports from the Field
Outdoor Classroom Case Studies
Nature Conservation Leader Perspectives



Sharing Our Precious Earth with Future Generations

New Targets, New Challenges

Initiatives to Date

In recent years, environmental issues such as climate change and resource depletion have become increasingly serious on a global scale. Last year also saw the arrival of a worldwide economic recession, which created a severe operating environment for companies. Even under conditions such as these, however, I believe the importance and urgency of environmental measures remain unchanged, and that immediate action continues to be required.

The Mitsubishi Electric Group has set contributing to the realization of a sustainable society as one of its most important management tenets. Accordingly, we have continued moving steadily along this path in our business operations and through efforts to reduce the environmental impact of our products and services. Specifically, since March 1993, we have formulated a mid-term environmental plan every three years. In the 5th Environmental Plan, which lasted from fiscal 2007 through fiscal 2009, Mitsubishi Electric achieved its goal of reducing CO₂ emissions from production per unit of real sales to 65% compared with fiscal 1991 levels, and reducing its final waste disposal rate to 0.15%.

Setting New Targets, Taking on New Challenges

At the same time, recognizing the need to take a longer-term approach to environmental preservation, in October 2007 we established the Mitsubishi Electric Group Environmental Vision 2021. With the objectives of preventing global warming and creating a recycling-based society, we set targets such as reducing total CO₂ emissions from production by 30% by fiscal 2021 as a clear, long-term direction of environmental management for the Mitsubishi Electric Group.

Our first environmental plan after formulating this vision is the 6th Environmental Plan, which went into effect in April 2009 (fiscal 2010). Of primary concern were three perspectives: setting targets and action plans for environmental performance to realize Environmental Vision 2021; responding to social changes and imperatives surrounding environmental issues; and contributing to the creation of a sustainable society through the expansion of environment-related business. Building on the 5th Environmental Plan, we have defined the following points of emphasis for this new three-year period. One point is the setting of environmental performance targets in alignment with our Environmental Vision, such as changing the way of managing CO₂ emissions during production from a per unit of net sales basis to total volume basis, as well as selecting products targeted for initiatives to reduce CO₂ from product usage and to reduce the input of resources, and then implementing planned reductions. Another point is the expansion of global environmental management—such as enhancing activities to reduce our environmental impact at overseas operations. A third point is the expansion of environment-related businesses such as the strengthening of businesses to counter global warming. Each of these points of emphasis makes for a higher standard of activity than in past environmental plans. They provide an opportunity for growth and help us meet the challenge of achieving our new targets.

Helping Each Individual Appreciate the Importance of the Environment

Another key to environmental management is each individual's mindset regarding the environment—that is, environmental awareness. To this end, the Mitsubishi Electric Group has created a number of opportunities to put people in touch with nature, such as through the Mitsubishi Electric Outdoor Classroom and "Satoyama" Woodland Preservation activities. Such activities help cultivate environmental awareness by fostering an understanding of the importance of nature. Each year the number of participants increases at these activities, which are conducted on a voluntary basis.

I also participate in the Fuji Sanroku forestry cultivation program. Each time I do so, I am reminded of the magnificence of nature, and this compels me to renew my personal efforts towards environmental management. To my mind, what is important is not how many trees are planted, but the opportunity to interact with nature and for each participant to sense the wonders of the environment and experience its importance.

Participating in such activities helps participants arrive at new discoveries and insights. For example, taking a bus on the way to an afforestation activity might prompt a participant to wonder, "We're planting trees to reduce CO₂, but what about the CO₂ that this bus emits?" I believe that this mindset, these discoveries, build up a true environmental awareness that can be passed on through our work activities into product development, on-site improvements and proposals to clients.

Earnestly Addressing the Environmental Issues Is Important from Four Perspectives

From a company standpoint, I believe that earnestly addressing environmental issues is important from four perspectives.

First, it allows us to contribute directly to preserving the global environment and participate in establishing a sustainable society.

Second, it strengthens the company's constitution to build a strong operational foundation. Manufacturing that uses few resources and little energy is the epitome of improved productivity.

Third, it encourages the creation of even better products, services and technologies. These achievements raise corporate competitiveness, and contribute to the environment through the expansion of environment-related businesses.

Fourth, and I believe most importantly, it instills a major sense of satisfaction in each and every one of us.

This sense of contributing to environmental preservation drives the creativity to develop products and technologies that contribute to the environment, and the enthusiasm to encourage their use.

I wouldn't consider these perspectives the solitary domain of the Mitsubishi Electric Group. Rather, I suspect that they are shared by people throughout the world. We must broaden our horizons as much as we can, encouraging each other in contributing to the creation of a better society.

I have grandchildren. For better or for worse, the activities of our generation will impact their lives. Each time I look into my grandchildren's eyes, I realize that we share our precious Earth with future generations, and I ask myself what we can do right now for their sake. When I imagine future generations living happily on this beautiful planet that we call the Earth, I think in terms of the phrase that we employ throughout the Mitsubishi Electric Group, "Changes for the Better." I believe that step by step, we are making steady progress in that direction.

President & CEO
Setsuhiro Shimomura



Environmental Topics

Guide to Environmental Technologies

Through continued development of energy-saving technologies and energy-efficient products, Mitsubishi Electric is working towards its target of reducing carbon dioxide emissions from product usage by 30% by 2021. This section introduces and provides examples of some products with environmental features, using easy-to-understand animations.

Products

▶ Air Conditioners with Energy Conservation Sensors

Featuring cutting-edge sensor technology—the new "Human-Sensing Move-Eye"—as well as an automatic cleaning function and other innovations, the energy efficiency of these air conditioners is truly striking.

[More](#)

▶ Photovoltaic (PV) Systems

Robust power generation is achieved with a high performance PV inverter and PV module.

[More](#)

▶ AXIEZ Machine-room-less Elevator

This advanced eco-elevator is machine-room-less to save resources; energy efficient thanks to an inverter motor; and effectively uses electricity that it stores itself.

[More](#)

▶ Ozone Generators

This device uses minimal power to efficiently generate ozone (O₃), which is a powerful sterilizer and purifier.

[More](#)

▶ Dry Air Insulated Switchgear

Rather than using a greenhouse gas (SF₆), this switchgear is insulated with dry air.

[More](#)

Cutting-Edge Technology

▶ Next Generation Power Capacitor

Capacitors last longer than condensers and provide more instantaneous power than batteries. This new storage device makes motors more energy efficient and is helping to popularize photovoltaic power systems.

[More](#)

▶ SiC Power Device

Next-generation silicon carbide (SiC) power devices are drawing attention for their energy efficiency potential and as a replacement for silicon power devices, which have reached their limit for power loss reduction.

[More](#)

▶ Gradationally Controlled Voltage Inverter

This next-generation technology accelerates energy efficiency by minimizing power conversion loss with a combination of three inverters that feature different voltages.

[More](#)

▶ Pumpless Water Cooling System

This heat exchanger is powered by heat generated by the electric device itself, so it does not use any electricity.

[More](#)

▶ Life Pattern Sensor

This technology contributes to the conservation of energy by capturing the current waveforms of electrical appliances that are switched on, making their power consumption visible.

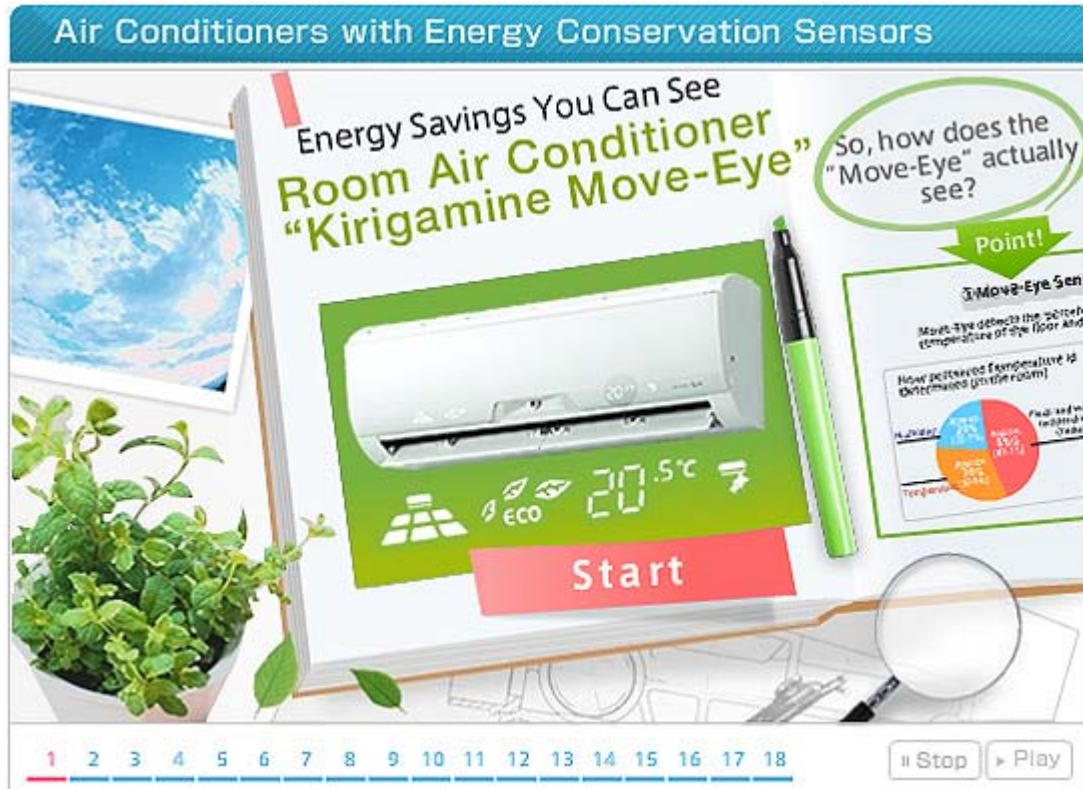
[More](#)

Products

- ▶ Air Conditioners with Energy Conservation Sensors
- ▶ Photovoltaic (PV) Systems
- ▶ AXIEZ Machine-room-less Elevator
- ▶ Ozone Generators
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Cutting-Edge Technology

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- ▶ Gradationally Controlled Voltage Inverter
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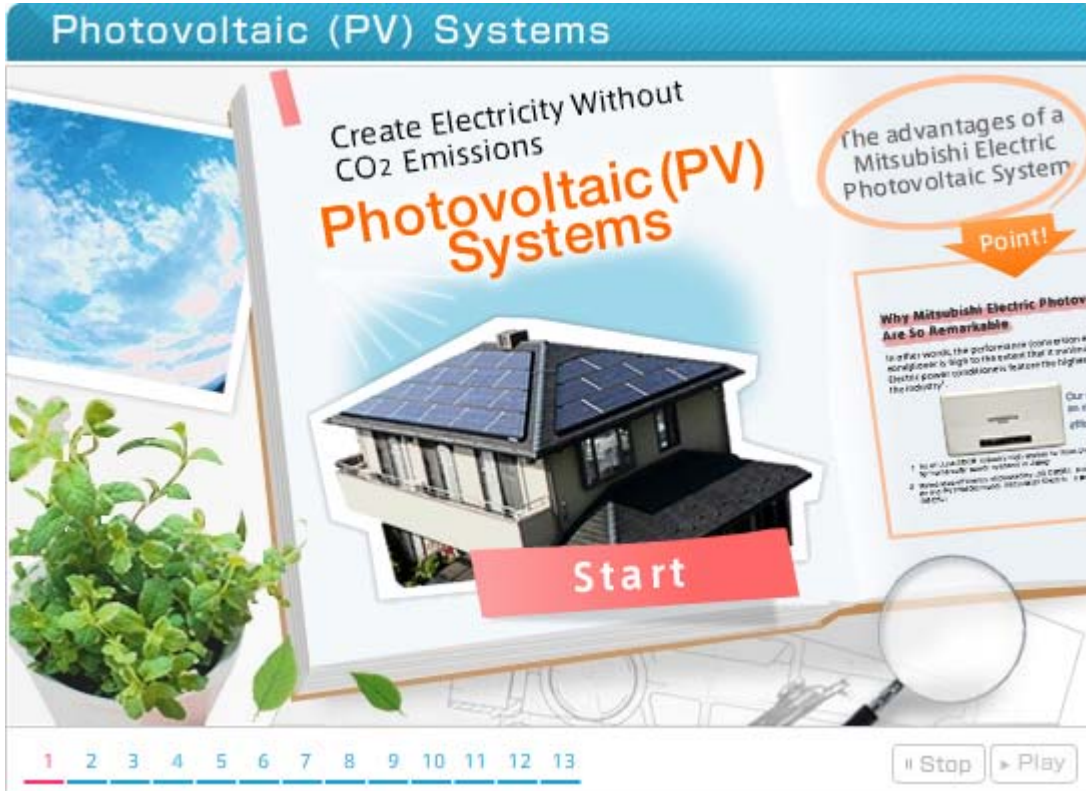
Air conditioning accounts for around 25% of household power consumption (in Japan). Mitsubishi Electric air conditioners conserve energy by up to 50% thanks to the inclusion of cutting-edge sensing technology ("New Human-Sensing Move-Eye"). Controlling perceived temperature by monitoring the temperature of the floor and walls keeps the room comfortable even when the temperature is set relatively high when cooling and relatively low when heating. This makes it possible to save energy without having to put up with any discomfort. Move-Eye also senses the whereabouts of people in the room and learns their movement patterns for even greater efficiency. There is also a display that lights up and shows the level of energy savings.

Products

- ▶ Air Conditioners with Energy Conservation Sensors ▶ **Photovoltaic (PV) Systems**
- ▶ AXIEZ Machine-room-less Elevator ▶ Ozone Generators ▶ Dry Air Insulated Switchgear

Cutting-Edge Technology

- ▶ Next Generation Power Capacitor ▶ SiC Power Device
- ▶ Gradationally Controlled Voltage Inverter ▶ Pumpless Water Cooling System
- ▶ Life Pattern Sensor



Photovoltaic power generation systems are primarily made up of two components: PV modules, which convert solar energy into electrical energy, and a PV inverter, which converts the power produced by the modules into a form that can be used in the home.

Photovoltaic system performance depends on the performance of these two components. Mitsubishi Electric has developed both components in-house. Our PV module offers industry-class performance (for a polycrystalline silicon-based, domestic mass-produced module) and our PV inverter provides the best conversion efficiency in the industry (as of June 2008), for a system that generates robust power.

- > Environmental Topics: PV Power Generation
- > Product Site

Products

- ▶ Air Conditioners with Energy Conservation Sensors
- ▶ Photovoltaic (PV) Systems
- ▶ **AXIEZ Machine-room-less Elevator**
- ▶ Ozone Generators
- ▶ Dry Air Insulated Switchgear

Cutting-Edge Technology

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- ▶ Gradationally Controlled Voltage Inverter
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- ▶ Life Pattern Sensor



AXIEZ saves resources by reducing the thickness of the hoist and control panel, essential parts for elevators, by making them compact and eliminating the machine room previously required. Precise control of the motor rotary speed by the inverter also leads to a reduction of power loss; moreover, the electric power generated when applying the brake is also used efficiently.

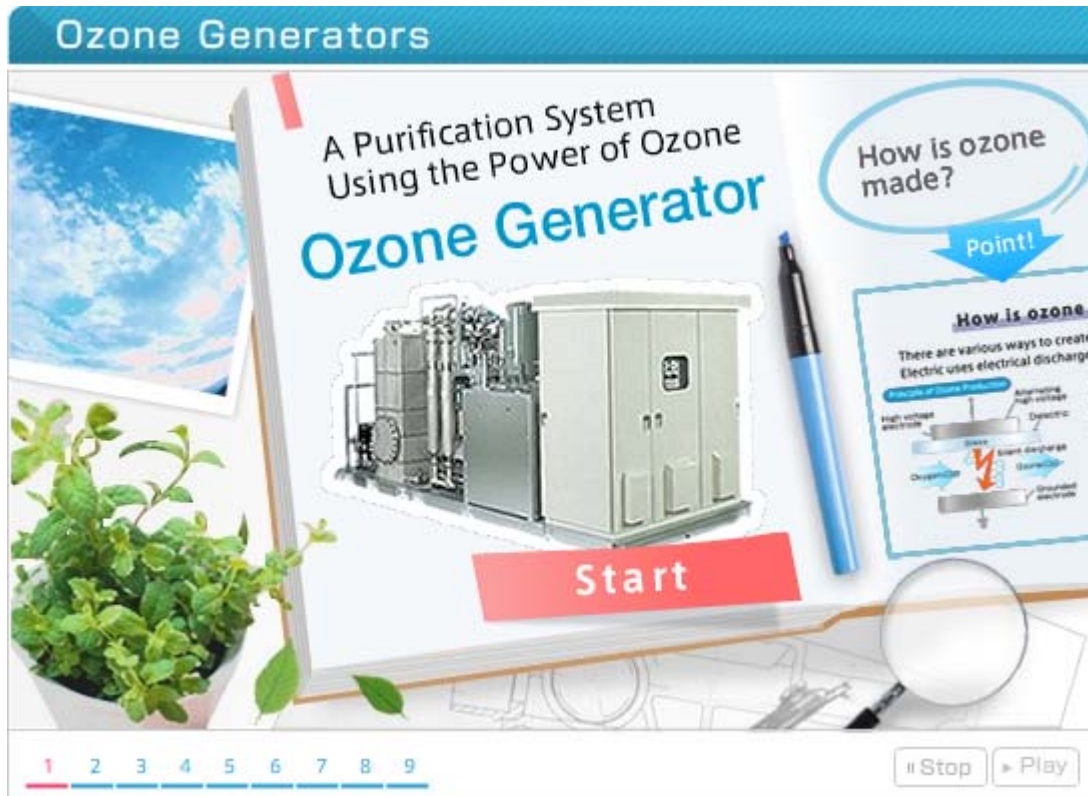
> [Product Site](#) 

Products

- ▶ Air Conditioners with Energy Conservation Sensors
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Ozone is comprised of three oxygen atoms and is one of the gases that make up the air. It has the power to sterilize, deodorize, de-colorize and purify, so it is used in a wide variety of applications, including water purification and food sterilization. Mitsubishi Electric has developed technology capable of efficiently generating ozone using minimal electric power through a unique method that utilizes electrical discharge.

Guide to Environmental Technologies

Products

- ▶ Air Conditioners with Energy Conservation Sensors
- ▶ Photovoltaic (PV) Systems
- ▶ AXIEZ Machine-room-less Elevator
- ▶ Ozone Generators
- ▶ **Dry Air Insulated Switchgear**

Cutting-Edge Technology

- ▶ Next Generation Power Capacitor
- ▶ SiC Power Device
- ▶ Gradationally Controlled Voltage Inverter
- ▶ Pumpless Water Cooling System
- ▶ Life Pattern Sensor



Switchgears are located in buildings and factories to control electricity flow from power plants, ensuring that it is distributed safely. Switchgears also minimize damage from sudden accidents due to electrical leaks or power outages. Internal switchgear insulation technology is essential to ensure safety along the electrical path. SF₆, which is commonly used as an insulator, is also a greenhouse gas. As an alternative, we employ a proprietary insulating method using dry air, which has no greenhouse effect.

Products

- ▶ Air Conditioners with Energy Conservation Sensors ▶ Photovoltaic (PV) Systems
- ▶ AXIEZ Machine-room-less Elevator ▶ Ozone Generators ▶ Dry Air Insulated Switchgear

Cutting-Edge Technology

- ▶ **Next Generation Power Capacitor** ▶ SiC Power Device
- ▶ Gradationally Controlled Voltage Inverter ▶ Pumpless Water Cooling System
- ▶ Life Pattern Sensor



Capacitors have more lasting force than condensers, and more instantaneous force than batteries, making them an electric power storage device that has the advantages of both. The capacitors developed by Mitsubishi Electric are capable of charging and discharging in just one second, and are also capable of boosting storage energy with increased voltage endurance. They are new types of devices that serve to further energy-saving in motors and photovoltaic power generation systems.

Products

- ▶ Air Conditioners with Energy Conservation Sensors ▶ Photovoltaic (PV) Systems
- ▶ AXIEZ Machine-room-less Elevator ▶ Ozone Generators ▶ Dry Air Insulated Switchgear

Cutting-Edge Technology

- ▶ Next Generation Power Capacitor ▶ **SiC Power Device**
- ▶ Gradationally Controlled Voltage Inverter ▶ Pumpless Water Cooling System
- ▶ Life Pattern Sensor



Power devices widely used today are made from Si (silicon), and it is said that reductions in power loss from these devices has come close to reaching its limit. Now SiC (silicon carbide) is garnering attention due to its excellent physical and electrical performance, and is expected to reduce loss in power conversion far better than Si. Mitsubishi Electric has developed a power module that is composed of all power semiconductors made from SiC and has a prototype inverter with 3.7kW output. The SiC inverter prototype, a step closer to practical use, has successfully reduced power loss by over half compared to conventional inverters using silicon semiconductors.

> R&D Highlight: SiC Power Device

Products

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Cutting-Edge Technology

- ▶ Next Generation Power Capacitor
- ▶ SiC Power Device
- ▶ **Gradationally Controlled Voltage Inverter**
- ▶ Pumpless Water Cooling System
- ▶ Life Pattern Sensor



Gradationally controlled voltage inverters are devices designed so that three inverter units, each with a different voltage, are combined and the sum of each inverter's output voltage generates a pseudo sine wave. It has better response than conventional methods in that a single unit controls a whole voltage range, thus reducing power loss. Employing gradationally controlled voltage inverters will improve energy efficiency in a variety of equipment and systems.

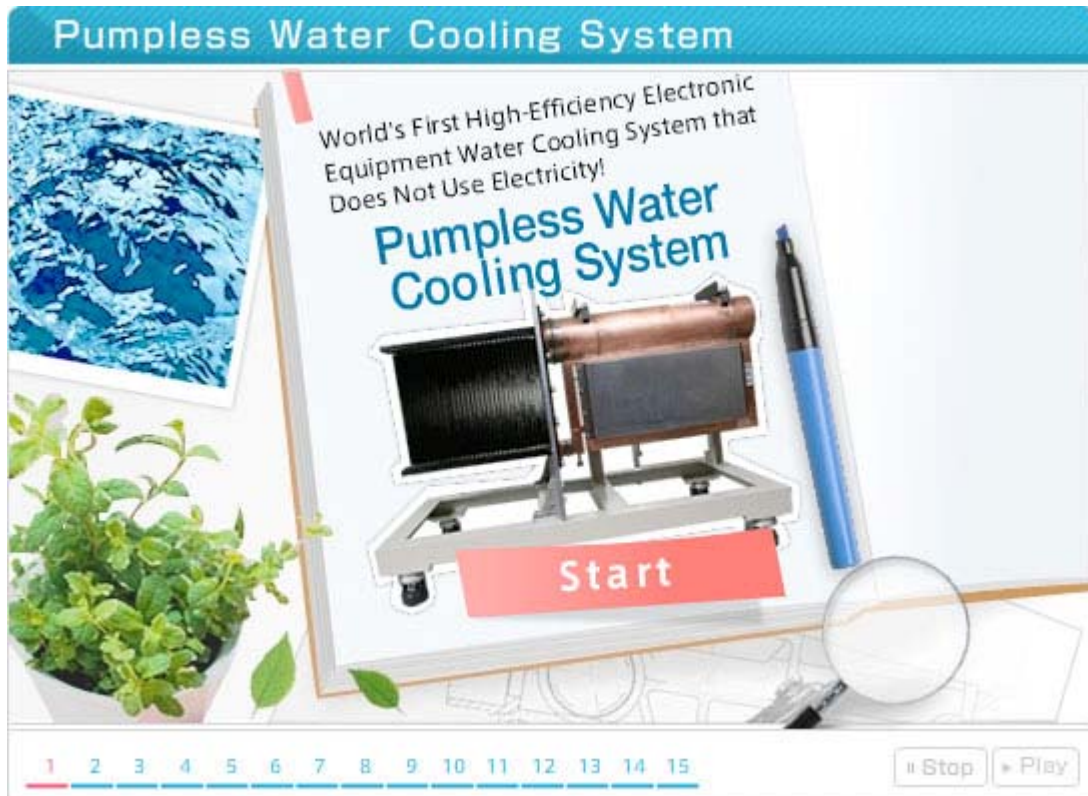
Guide to Environmental Technologies

Products

- ▶ Air Conditioners with Energy Conservation Sensors
- ▶ Photovoltaic (PV) Systems
- ▶ AXIEZ Machine-room-less Elevator
- ▶ Ozone Generators
- ▶ Dry Air Insulated Switchgear

Cutting-Edge Technology

- ▶ Next Generation Power Capacitor
- ▶ SiC Power Device
- ▶ Gradationally Controlled Voltage Inverter
- ▶ **Pumpless Water Cooling System**
- ▶ Life Pattern Sensor



The parts inside electronic equipment generate heat when electricity flows through them. If nothing is done about this heat, it can cause the equipment to malfunction or breakdown. This is why all types of electronic equipment have cooling mechanisms. The Pumpless Water Cooling System is a heat exchanger that uses no electricity because it is powered by heat given off by the electronic equipment itself.

Products

- ▶ Air Conditioners with Energy Conservation Sensors
- ▶ Photovoltaic (PV) Systems
- ▶ AXIEZ Machine-room-less Elevator
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- ▶ **Life Pattern Sensor**



After simply installation onto a distribution board, the Life Pattern Sensor (LPS) detects the total power consumption in a home, as well as the usage status of individual electrical appliances. The LPS records the signals of each appliance and detects the current waveform of appliances that are in use, making their power consumption visible. If all a home's appliances are operating at the same time, for example, the LPS can show how long each appliance has been running. The ability to see home power consumption at a glance allows a homeowner to detect waste, playing an ongoing role in energy conservation.

Environmental Topics



Reducing CO₂ During Production

▶ Reducing CO₂ from Product Usage

Carbon dioxide emissions during the period a product is used far exceed emissions given off when it is produced. Our goal is to improve the energy efficiency of our products in order to cut CO₂ emissions from product usage by 30% by 2021.

[More](#)

▶ Reducing CO₂ Emissions during Production

We have successfully met our voluntary targets thanks to energy conservation initiatives on the production floor and proactive investment in energy-efficient facilities. Starting in fiscal 2009, we will strive to cut total CO₂ emissions from production by 30%.

[More](#)

▶ Example 1: Fukuyama Works

Introducing Fukuyama Works as a case study in energy conservation. The plant has generated results by fully utilizing Mitsubishi Electric's energy efficiency support devices and by making energy use highly visible in order to manage specific energy consumption.

[More](#)

▶ Example 2: Raising Production Efficiency

Introducing Air Conditioning and Refrigeration Systems Works as another case study in energy efficiency. The plant has achieved considerable efficiency by eliminating over-committing, inconsistency and inefficiencies in all production processes and improving productivity.

[More](#)

Reducing CO₂ during Production

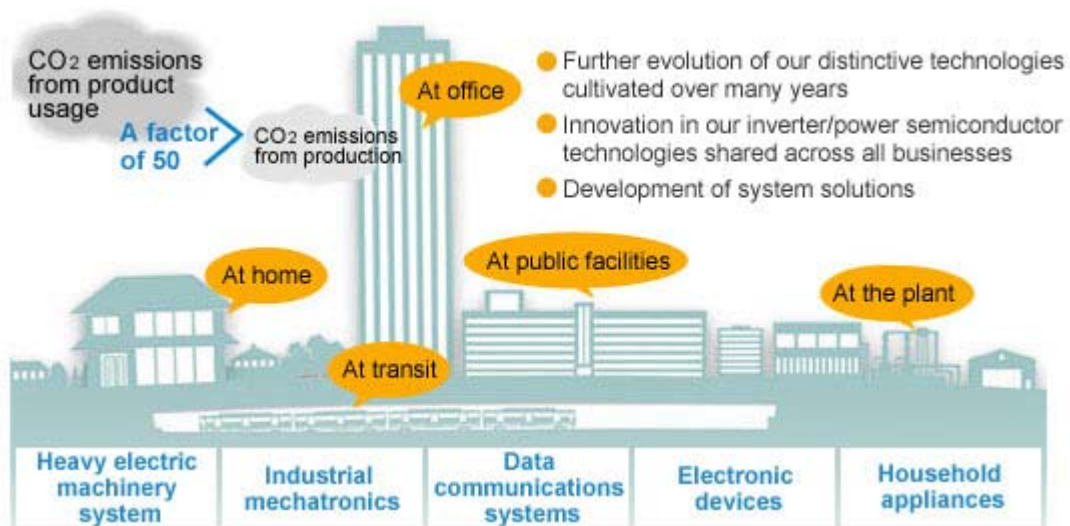
Reducing CO₂ from Product Usage

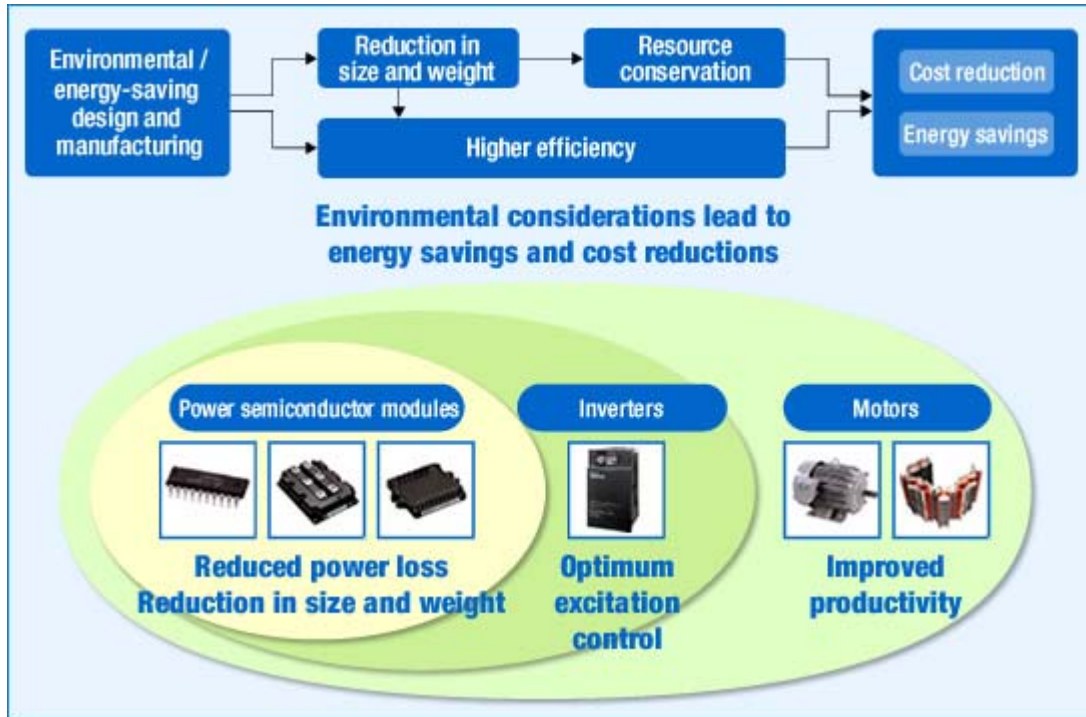
From Improving the Energy Efficiency of Production to Raising the Energy Efficiency of Products

Mitsubishi Electric's Environmental Vision 2021 calls not only for reducing CO₂ emissions from production but also for lowering emissions from product usage. Our approach is to focus on improving the energy efficiency of products while continuing to raise the energy efficiency of production. This is because many, many times more CO₂ is emitted during product usage than production.

We currently emit around 474,000 tons of carbon dioxide (based on fiscal 2008 levels) a year. Reducing this figure by 10% requires that we lower emissions by 47,000 tons. Improving the energy efficiency of products while they are in use by just 1%, however, would cut CO₂ by tens of thousands of tons.

Mitsubishi Electric is fully committed to helping prevent global warming, so we have set a target of reducing CO₂ emissions from product usage by 30% by 2021. We intend to accomplish this by continuing to develop innovative technologies for energy efficiency and delivering a range of energy-saving products to the market.





Environmental Report: Reducing CO2 from Product Usage →

Reducing CO₂ during Production

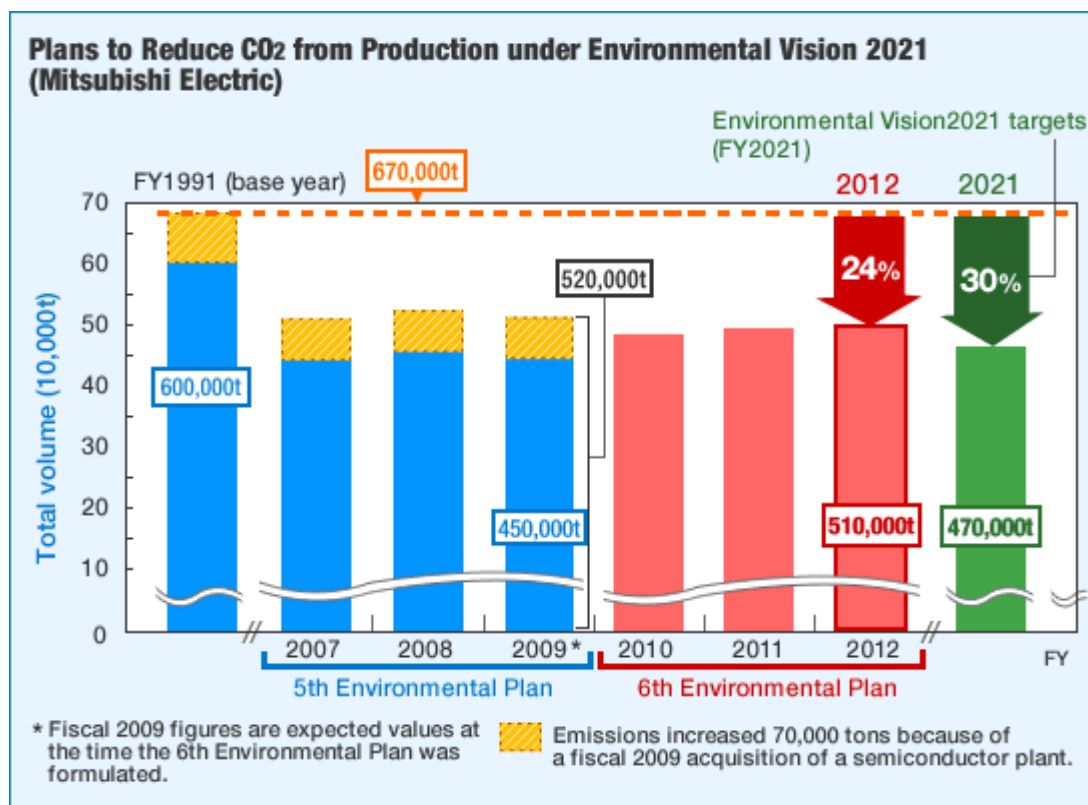
Reducing CO₂ Emissions during Production

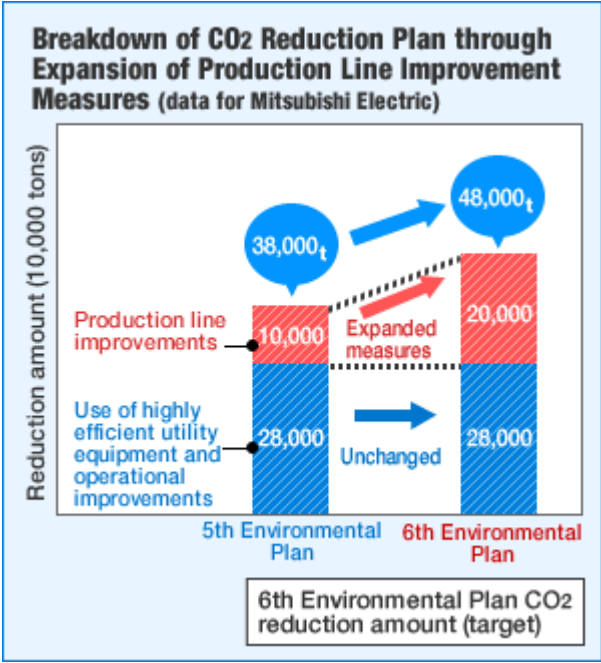
Emphasizing production line improvements to achieve Environmental Vision 2021 targets

One target of Environmental Vision 2021 is reducing total CO₂ emissions from production by 30%. After formulating Environmental Vision 2021, the 6th Environmental Plan (FY2010–2012, years ending March 31) – the first plan since formation of the Vision – sets a CO₂ emission volume of 510,000 tons as its objective for the final year of the plan, fiscal 2012. This target amounts to a reduction of 48,000 tons over the three-year period from fiscal 2010 through fiscal 2012.

To meet these targets, in addition to continuing the improved and efficient use of air conditioning, lighting and other utility equipment, we will make improvements to our production lines and equipment as part of our efforts to bolster CO₂ reduction activities.

Action plans call for further measures to be introduced to reduce energy consumption volumes at each manufacturing base. We are working introduce new activities to reduce CO₂ emissions, by clarifying energy usage at each production line and facility (such as by heating furnaces, press processing, heat processing, assembly lines, transportation and testing facilities etc.) and identifying areas of waste.





Making Problems Visible and Finding the Knowledge to Solve Them

Efforts to improve production lines begin by listing facilities and equipment. Different from improving utility equipment and making it more efficient, which involves investments to upgrade aged equipment, improving production lines requires first discovering problem areas, and then having the necessary knowledge to solve them. As improving production lines can involve raising quality and productivity by changing the conditions under which production processes take place, actually implementing measures requires liaison with production technology and quality assurance departments.

In addition to on-site improvement activities, representatives from the Corporate Total Productivity Management & Environmental Programs Group visit production bases, working with on-site staff and engineering departments to make problems visible and uncover the knowledge that is required to resolve such problems. We also examine positive developments and look for ways to apply such activities more widely. Based on the idea that applying knowledge will cause waste to become apparent and result in CO₂ reduction activities that represent changes for the better, for the sake of mutual understanding we conduct energy-saving diagnoses, form activity liaison committees and hold energy-saving manual activity exchanges. We also use energy saving checklist manuals and work to introduce positive developments more widely. Such activities are all part of our efforts to support the discovery and development of knowledge that will help reduce CO₂.



Energy-saving diagnosis

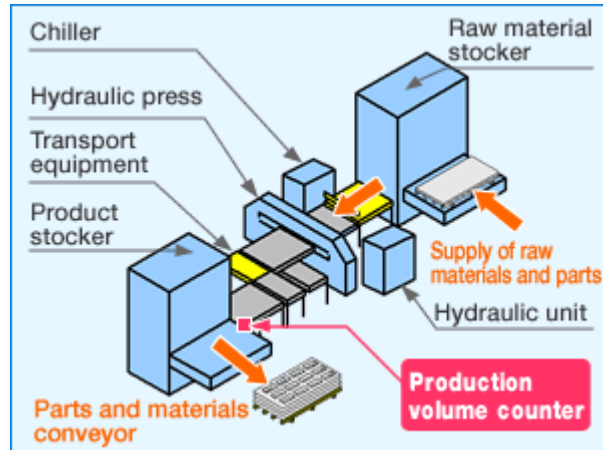


Energy Loss Minimum (EM) activities presentation

Improving Processing Equipment for Punching Metal Plates using a Turret Punch Press (TPP)

Case Study 1. Reviewing Unnecessary Line Operation and Reducing Energy Used when Errors Occurred during Unmanned Nighttime Operation

In the past, main production lines automatically came to a halt when trouble occurred during unmanned nighttime operation, but hydraulic pumps and other equipment continued to operate. By making visible the amount of energy used by hydraulic pumps per unit produced, the waste of energy during non-production times became apparent.



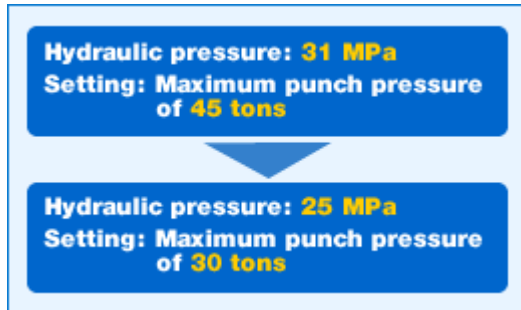
On the post-improvement line, automatic power switch-off functions were added to units that use substantial amounts of power, such as the hydraulic unit, chiller unit and scrap conveyor. Control units, however, remain powered to allow process recovery after the line restarts and make effective use of in-process materials. These improvements resulted in an annual savings of 70 MWh of electricity.



Case Study 2. Revising Output Levels

Power Reduced after Reviewing Pressure Needed to Operate TPP Hydraulic Unit

Previously, the maximum hydraulic pressure for punching units at TPP facilities was set to 45 tons (hydraulic pressure of 31 MPa). After reviewing the pressure required to handle various materials, thicknesses and dies, it was determined that punching operations could be handled adequately with a maximum pressure of 30 tons (hydraulic pressure of 25 MPa). Reducing this maximum power requirement saved 31 MWh per year.

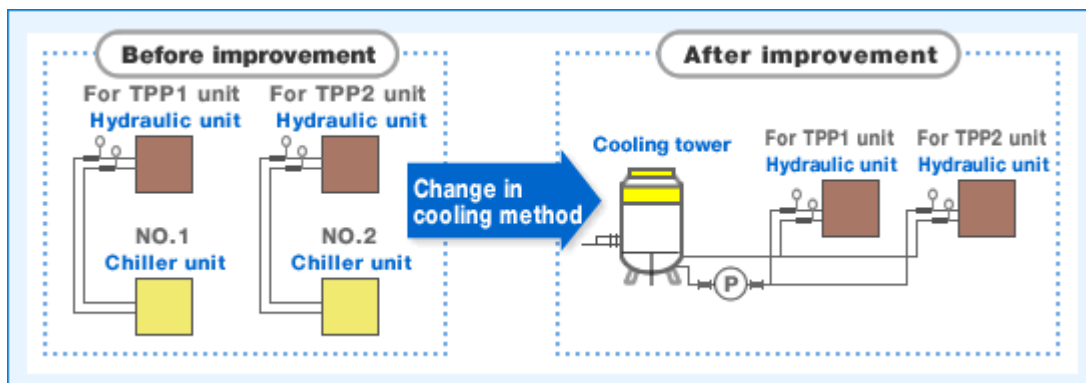


Punching at a TPP facility

Case Study 3. Saving Energy through a Change in Cooling Method

Power Consumption Reduced by Changing Air Conditioning from Two Chiller Units to One Cooling Tower

Formerly, one chiller unit was used for each TPP line, similar to the setup used on room air conditioners, and these chiller units cooled the oil used on the lines. However, the aged chiller units were upgraded through conversion to a single cooling tower. This improvement saved approximately 221 MWh of electricity per year, as well as reducing the cost of upgrading equipment. This case study is a good example of how production line improvements can be made through a simple variation in approach.



Opinion



Yoshio Kasuga
Promotion Group Manager
Corporate Environmental Sustainability Group

Through the introduction of Just in Time (JIT) activities, production bases have grown familiar with the idea of activities that eliminate waste, and the idea that conserving energy helps reduce waste is gaining currency. Particularly in the currently difficult management environment, companies are searching for ways to reduce waste and reinforce their production systems. I believe Mitsubishi Electric's activities to reduce energy use at production lines and facilities support these efforts, and that full-fledged efforts in this area can be linked to JIT activities and regularized.



Masaaki Ikegami
Promotion Group
Corporate Environmental Sustainability Group

To achieve the target values established in the 6th Environmental Plan as measures to meet the objectives of Environmental Vision 2021, we will have to redouble our efforts in such areas. Although production lines represent a substantial challenge to improvement, we need to realize that success results from the accumulation of many small successes. Activities need not end at the level of individual bases. Rather, this knowledge should be shared throughout the Group and linked to new activities to be introduced in the future.

Reducing CO₂ during Production

Example 1: Fukuyama Works

Proactive Energy Conservation by Managing Specific Consumption

Demonstrating the Benefits of Energy Efficient Products Using Our Own Factory

Fukuyama Works began full-fledged energy loss minimization (EM) activities in 1997. The aims of the activities were to give consideration to the environment and pursue economic efficiency, while at the same time demonstrating the benefits of support devices and systems for energy efficiency developed and manufactured by Mitsubishi Electric.

At that time, the sales division of Fukuyama Works listened to the concerns of many of our customers, who said that energy efficiency was definitely an important issue for them, but that greater energy efficiency would be meaningless if it caused decreased productivity. We were also asked what the actual benefits would be of installing support systems for energy efficiency, and customers would tell us that they would not be able to take the plunge without knowing what those benefits would be.

We were able to immediately show customers test data on the performance of individual energy efficiency support products. But the benefits of operating these products as a system cannot be demonstrated except on an actual production floor. We decided to conduct this demonstration on the floor of one of our own factories. It was a strategy with dual significance: we would work for environmental consideration and improved productivity by promoting energy conservation using Mitsubishi Electric products, and we would show customers the effectiveness of our products on an actual production floor.



Managing Specific Energy Consumption for Each Facility

The basis of energy conservation activities is tracking the current state of affairs on the production floor, which means measuring energy usage. At Fukuyama Works, we moved ahead by first clarifying power consumption by each division, then further refining the process to measure each shop (group) and each facility. We then made improvements, prioritizing shops and facilities that consumed the most power.

It is not effective to make improvements on the basis of simple measurements of power consumption alone. Almost like a living organism, a production line is in constant state of flux. When production volume increases, energy consumption also naturally goes up. However, this increase alone does not necessarily amount to energy loss. Rather, it was crucial to discover when and where energy was being used inefficiently.

To do this we began tracking specific energy consumption. This involves managing energy usage using energy consumption per unit of production volume as an indicator. Detailed measurements of specific energy consumption for each division and each facility enable inefficiency and loss to be identified.

As a result of fully implementing improvement activities based on specific consumption in each division in accordance with ISO 14001 management techniques, we were successful in greatly improving energy efficiency and raising production efficiency over a short period of time. In 1998, the year after the project was launched, we were awarded the Energy Conservation Center, Japan Chairman's Award for Excellence in Energy Conservation. We also started a factory tour to actually show customers the benefits of energy conservation on the production floor.

Based on know-how acquired through promoting EM activities at our own factories, Fukuyama Works subsequently began developing devices and systems for efficiently and effectively supporting energy conservation.



Graph shows specific consumption

Fukuyama Works Employees Work Together to Develop Devices and Systems

In 1998 we developed the EMU Power Meter, which efficiently measures power consumption by individual facilities, and in 2000, we advanced the technology and developed the EcoMonitor, a multi-circuit power meter that simultaneously measures power over multiple circuits. We subsequently developed a series of industry-leading new device and software products designed to support energy conservation from novel perspectives. In 2002, we created EcoServer II, an energy efficient data collection server that handles everything from collecting energy efficiency data to transmitting it over the web. In 2003, we developed E-Energy, an energy efficient demand-monitoring server that monitors and controls power demand.



In developing these products, we had employees in the factory's various divisions serve as monitors to verify their usability and workability from the customer's perspective, and provide valuable advice to the development division. All employees of Fukuyama Works truly came together to create these highly practical devices and systems.



EcoMonitor II
- A multi-circuit power meter



EcoServer II
- An energy efficient data
collection server



E-Energy
- An energy efficient demand-
monitoring server

Clarifying Areas of Improvement with Real-Time Measurement of Specific Consumption

These Mitsubishi Electric products are currently in operation all around Fukuyama Works. EcoMonitors have been installed on the power distribution boards of each facility to measure power consumption and production volume. This measurement data is sent to EcoServer II, which instantly calculates specific energy consumption. Trends in power consumption and specific consumption are graphed in an easy-to-understand manner so that they can be checked in real time via a LAN by the plant manager and division managers as well as by all other employees at their own computers.

On the basis of these efforts to make energy usage readily apparent, we have set targets for the factory as a whole, for each division, and at the production floor level for each product. We have also established systems for making specific improvements. In this way the entire process can be readily grasped.

If specific consumption worsens for some reason, the situation is checked against actual conditions on the production floor, which allows the causes, whether a setup mistake, equipment failure or idling machinery, to be immediately uncovered and appropriate improvement measures taken. Thoroughly eliminating energy loss in this way makes it possible to use the necessary energy for production at the necessary time, in the necessary places and in the necessary amounts -- a "just-in-time energy" system.

This initiative at Fukuyama Works has earned high praise from various quarters in Japan. In 2004 we received the Chugoku Bureau of Economy, Trade and Industry Director-General's Award for Excellence in Energy Conservation, in 2006 we were honored with the Chugoku Bureau of Economy, Trade and Industry Director-General's Award for Outstanding Energy Conservation at Factories, and in 2007 we were honored with the ECCJ Chairman's Award for Outstanding Energy Conservation Programs.



Contributing to Society with Best-in-Class Energy Efficiency Support Devices

The challenge continues at Fukuyama Works. Since fiscal 2006, we have worked to more thoroughly and appropriately manage demand by linking E-Energy, our energy efficient demand monitoring server, with the G50, a web-compatible centralized controller for air conditioning developed by Wakayama Works. In addition, we have upgraded to high efficiency air conditioners in administrative buildings and made operational improvements that include automatic operational curtailment (rotation control), preset temperature restrictions, and prevention of shutoff oversights.



Fukuyama Works

As a result of these initiatives, in fiscal 2008, we successfully reduced energy consumption per unit of production output by 27% from fiscal 1991 levels. We have also been converting from fuel oil and LPG to electricity and city gas, and in fiscal 2007, we replaced heating equipment used for steam from models powered with fuel oil to models run on electricity. This served to substantially reduce fuel oil usage.

We intend to continue to make improvements and ramp up energy loss minimization activities in order to make all forms of energy, not just electricity, readily apparent and easily understood, including fuel oil, steam, gas, air and water. Our goal is to have our production floors lead the way in Japan. We hope that the initiatives taking place at Fukuyama Works will serve as a reference for many customers and that our expertise in this area will help customers promote energy efficiency at their own factories. This is another social contribution that Mitsubishi Electric can make.



A showroom at Fukuyama Works presents features of energy efficiency support and system outlines in an easy-to-understand manner.

Reducing CO2 during Production

Example 2: Raising Production Efficiency

Air Conditioning and Refrigeration Systems Works

Environmental JIT (E-JIT) as a Symbol for Energy Conservation

The Air Conditioning and Refrigeration Systems Works has goals of reducing energy consumption per unit of production value by 25% from fiscal 1991 levels and reducing carbon dioxide emissions derived from energy by 2% every year. To achieve these goals the plant is engaged in energy conservation initiatives that center on saving energy with high-efficiency equipment, expanding the scope of JIT to include energy conservation activities, and installing energy efficiency support devices.

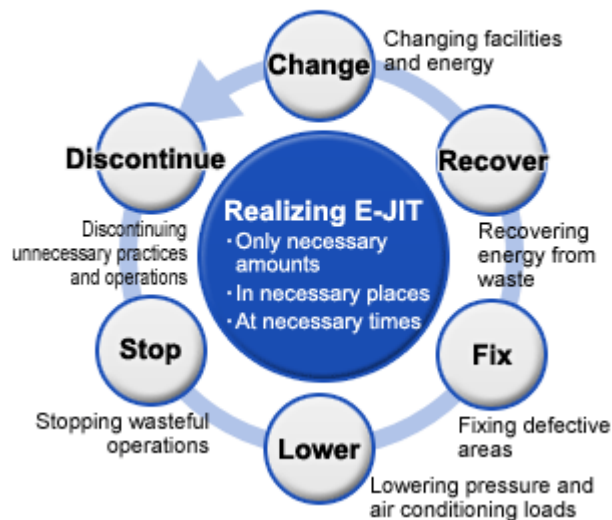
Of these initiatives, the plant is putting particular emphasis on expanding the scope of JIT to include energy conservation activities, an effort being promoted by each and every employee involved in production. The term JIT, short for "just in time," is normally used to mean having the necessary things in the necessary amounts at the necessary times. The Air Conditioning and Refrigeration Systems Works was the first of all our manufacturing plants to use Environmental JIT (E-JIT) as a Symbol for Energy Conservation activities. Saving energy does not mean not using energy; it means using it in the necessary amounts at the necessary times in the necessary places. Based on this thinking, the plant has adopted six perspectives--Change, Discontinue, Stop, Lower, Fix, Recover--that it uses to verify energy usage and carry out specific improvement initiatives.



Air Conditioning and Refrigeration Systems Works

Six Perspectives

— Practicing Energy Conservation from Six Perspectives —



Case Example 1: Change

Practicing "Change," means changing facilities and energy. This section introduces three examples.

Updating to High-Efficiency Lighting

We replaced conventional rapid-start fluorescent lighting (40W) with highly efficient high-frequency (HF) fluorescent lighting (32W). HF fluorescent lights provide bright light while consuming less power, so we were able to reduce the number of lighting fixtures used. As an example, at our two-storey administrative office, lighting fixtures were reduced by 32%, from 377 to 256. The resulting energy savings exceeds 6,884 kWh per month. Changing the fixtures to pull-switch models also succeeded in making employees more diligent about turning off the lights.



Before: 377 fixtures → After: 256 fixtures
32% reduction

Installing High-Efficiency Transformers

We replaced the transformers at onsite transformer substations with super high-efficiency models. We also installed automatic power factor adjustment devices that adjust the power factor in line with load fluctuations. This served to reduce power loss by 11.4%, from 257,653 kWh to 228,530 kWh.



Before: 257,653 kWh → After: 228,530 kWh
Power loss reduced by 11.4%

Converting to Alternative Fuels

Converting from fuel oil A and LPG, which have large CO₂ emissions coefficients, to city gas (13A), has enabled us to reduce CO₂ by 443 tons per year.



Ichiro Oka, Compressor Group Manager

Identifying and making as many improvements as possible eventually leads to major energy savings. For example, on the compressor processing line there are some 100 processors. Changing the indicator lights on the machines, which are green, orange and red, from incandescent lights to LED alone allowed us to save around ¥300,000 a year in electricity charges.



Kanji Nakano, Unit Group Manager

E-JIT not only saves energy but also helps reduce waste and improve productivity. For example, as a part of our packaging improvement efforts, we stopped packaging with cardboard and polypropylene bands and began just loading the products on a specialized truck (supplying just the actual product). This simple change raised assembly productivity and improved quality. It also helped reduce packaging at our partner factories, which in turn lowered processing costs.

Case Example 2: Discontinue

"Discontinue" refers to discontinuing unnecessary practices and operations. Two examples are introduced here.

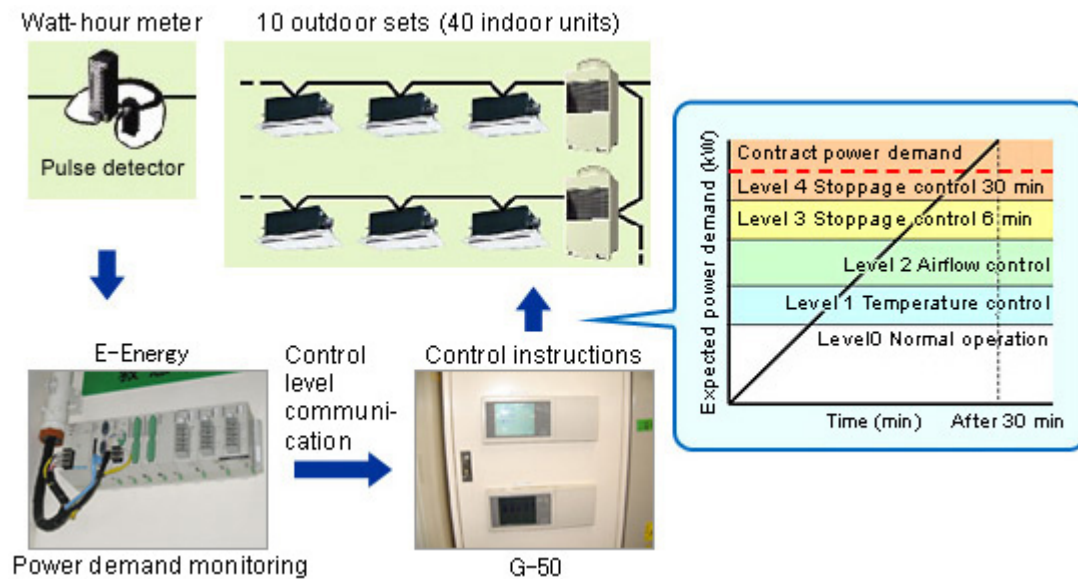
Thinning Out Onsite Lighting

Surveying the plant surprisingly turned up areas where lighting was unnecessary. We thinned out fluorescent lighting in places where people are not engaged in work and limited lighting to only places where it is necessary. We removed 433 of the four factories 1979 total lights, saving some ¥935,000.



Conserving Energy through Automatic Air Conditioning Control

We use a centralized air conditioning controller, G-50, and a demand monitoring server, E-Energy, which are both made by Mitsubishi Electric. They allow us to remotely monitor air conditioning with use of a computer and preset an operating schedule. Air conditioning is automatically controlled, including heating and cooling, airflow and stoppage, in line with the level of demand. This enables us to limit power usage and lowers our basic electricity bill.





Nobuyoshi Miyamoto, Stock Management Group Manager Waryo Technica Co., Ltd.

We store a wide variety of parts in the parts warehouse. Before, we stored these parts on automated racks, but in order to comply with a short schedule, multi-cycle production and reduce excess stock through greater transparency, we eliminated the automated racks and switched to fixed shelves.

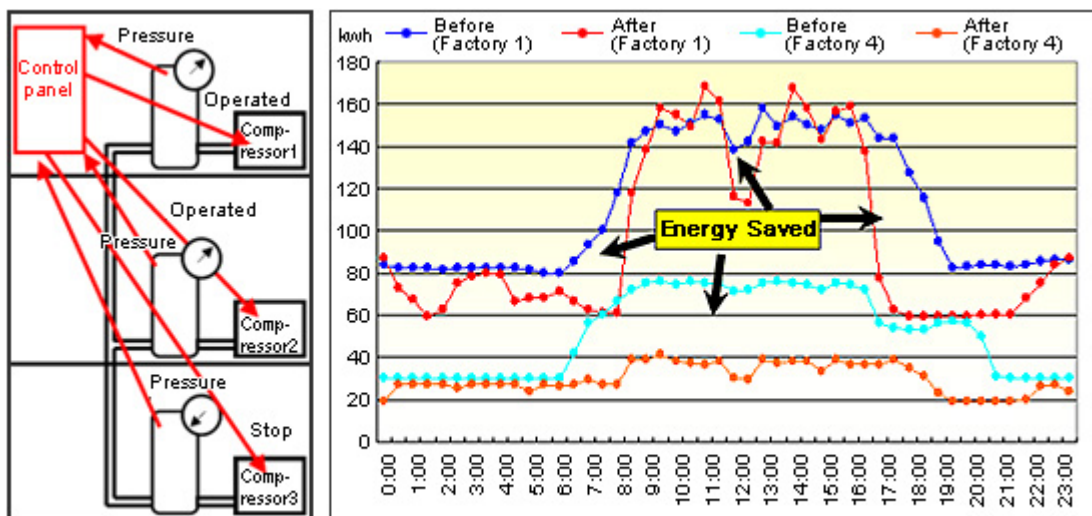
The shelves are currently laid out to make everything easy to see and we work to keep things organized, orderly and clean. If the workplace is clean and well organized, abnormalities are readily spotted. When abnormalities are known, improvements can be made.

Case Example 3: Stop

"Stop" refers to stopping wasteful operations. Two case examples are introduced here.

Limiting Numbers of Air Compressors in Operation

We linked air compressors on each level through a control panel in an effort to save energy by automatically turning the compressors on or off depending on pressure standards. At Factory 1 and Factory 4, which use the control system, we succeeded in reducing annual energy consumption by 452,745 kWh, producing economic benefits of ¥6.97 million.



Before: 2,117,610 kWh After: 1,664,865 kWh Reduction of 452,745 kWh

Energy Savings Day on Second Saturday of Every Month



On the second Saturday of every month, we cut the electricity to circuits for which it is possible to do so.

Breakers that have been turned off are labeled as such to indicate energy savings.



Osamu Ueno, Parts Production Section Manager

The Parts Production Section is responsible for production of key parts for air conditioners, including metal parts, molded plastic parts, heat exchangers, and refrigerant valves. These parts are made via a series of processes, but we are working to consolidate the processes to shorten lead times and reduce tasks under a policy of only using the necessary amounts of the necessary items at the necessary times. Connecting the processes should eliminate intermediate tasks like reloading and conveyance and thereby raise productivity and save energy.

In fiscal 2008 we made it possible to track electric furnace production volumes and power consumption. We plan to carry out additional energy efficiency measures by analyzing correlations between the two.

Case Example 4: Lower

"Lower" refers to our efforts to lower pressure and air conditioning loads. Three examples of this initiative are introduced here.

Changing the Hydraulic Oil Used in Resin Molding Equipment

At the Air Conditioning and Refrigeration Systems Works, we switched to a low viscosity, low specific gravity hydraulic oil (in consultation with the oil manufacturer) in order to reduce the amount of power consumed by resin molding processes. Switching to a different oil reduced pressure loss in the equipment piping as well as power consumption when starting up the equipment. In terms of energy savings, we reduced power consumption by 13% on a per-hour basis. Switching oils has benefited us in another way as well. The previous oil was classified as a hazardous substance, but the new type is non-hazardous, so its handling is more straightforward.



Coating Roofs with a Reflective Paint

We coated our factory roofs with a reflective paint in order to reduce the air conditioning load and confirmed a drop in room temperatures directly below the roof of around two to three degrees. In terms of outdoor temperature, this would be equivalent to moving the factory from Wakayama north to Aomori. Based on our estimates, the power load from cooling has been reduced by around 7%.



Shortening Assembly Conveyors and Instituting a Dolly-Based Production System

The workflow for parts and product assembly normally involves the use of conveyors. At the Air Conditioning and Refrigeration Systems Works we substantially shortened conveyor length by closing gaps between work processes. This was a part of our E-JIT reform initiative and involved having the necessary things in the necessary places at the necessary times. We also introduced a dolly-based production system in which assembly takes place on top of moving platforms without the use of conveyors. The system was introduced in order to make it easier to accommodate changes in production volume, to better balance the burden among workers, and to shorten manufacturing lead times. These productivity improvements also make a substantial contribution to energy conservation.





Yutaka Maeda, Cooling Group Assistant Manager Waryo Technica Co., Ltd.

Waryo Technica, which is contracted to produce some of the product lines at Mitsubishi Electric's Air Conditioning and Refrigeration Systems Works, is actively involved in E-JIT. Improving productivity and closing gaps between processes to shorten assembly conveyors has lessened power costs, reduced onsite lighting and otherwise helped save substantial amounts of energy. We are currently working to have parts delivered from suppliers without packaging to save resources and reduce waste.

Case Example 5: Fix

"Fix" involves working to conserve energy by fixing defective areas.

Replacing Worn Out Steam Piping

At the Air Conditioning and Refrigeration Systems Works, we replaced and reinstalled worn out steam piping and steam headers, which reduced the amount of city gas used by steam boilers by 2%.

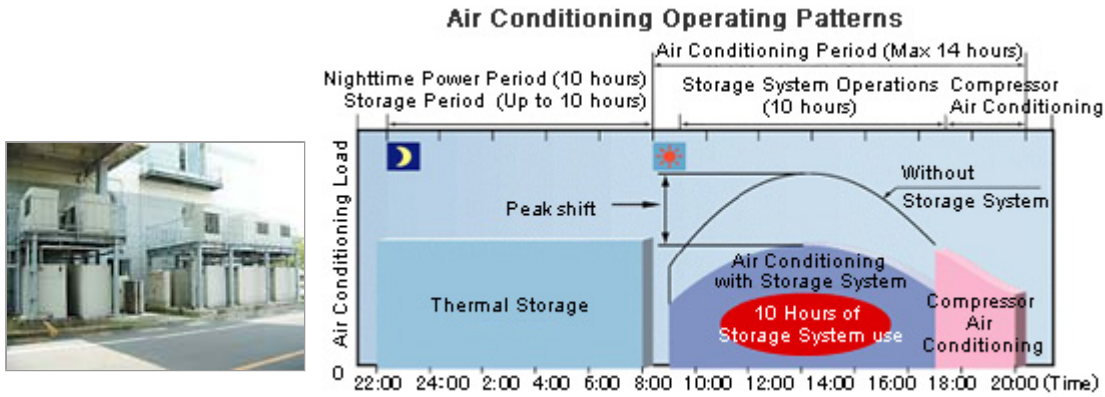


Case Example 6: Recover

"Recover" refers to activities to recover energy from waste. Three examples of these activities are introduced here.

Installing Ice-Thermal Storage Air Conditioning Units

We installed ice-thermal storage air conditioning units to shift and reduce peak power usage. The units use inexpensive power at night to make ice and hot water that is used in the daytime for cooling and heating.



Heating Soft Water for Boilers by Recovering Steam Drain

We recover heat trapped in condensation from saturated vapor after production process work has been completed and reuse it to heat soft water used in city gas through-flow boilers. Doing so reduces the amount of city gas used by the boilers by 3% and raises the soft water temperature from 40-45° C, what it was before installation of the system, to 57-83° C.



Active Promotion of E-JIT

The Air Conditioning and Refrigeration Systems Works is progressively conserving more energy by steadily carrying out activities on the basis of six perspectives. In fiscal 2008, we reduced energy consumption per unit of production value to 59.5% of fiscal 1991 levels (for a 40.5% reduction). The plant is not only involved in energy conservation but also in promoting E-JIT activities for the environment more broadly.

To reduce releases of harmful substances, we have begun using coatings with low solvent content. We developed a specialized thinner for use in solvent coatings and reduced the volume of toluene and xylene, both of which are classified as harmful substances, by half. Completely eliminating harmful substances would be ideal, but inadequate coating performance (rust resistance) would be problematic. So, we opted for low-solvent coatings instead of seeking to completely eliminate the chemicals. This has reduced our use of toluene and xylene by 1,300 kg annually.

Also, in an effort to reduce waste, we switched to translucent waste receptacles to make it possible for people to see what has been thrown out and made sorting waste more straightforward. We are also working to eliminate cardboard by switching to reusable pallets to transport a variety of materials.

Our watchword will continue to be E-JIT, and we will continue to make improvements, with every employee acutely aware of environmental issues, in order to conserve energy and help protect the environment.

Comments of Environment Control Section Members Responsible for Promoting Environmental E-JIT



Yasushi Takeda

The key to JIT activities is participation by all employees. It is essential that everyone try to eliminate waste immediately, even if the result is not perfect. Air Conditioning and Refrigeration Systems Works is a production plant for energy efficient products, so we have a special responsibility to promote energy conservation in manufacturing as well. We will continue to innovate and experiment in various ways in order to help protect the environment.



Mikio Hisamura

Making large capital investments is one way of bringing about energy savings, but steady, everyday improvement efforts are also important. Making steady improvements day to day also fosters an environmental mindset.



Shusei Tsumori

The six perspectives of Change, Discontinue, Stop, Lower, Fix and Recover are important in promoting greater energy conservation. Constantly thinking about which perspectives apply will inevitably lead to innovations.

Environmental Topics

Innovative Products and Production:

The Eco-Compatible minimo



The minimo motor for compact ventilators meets Mitsubishi Electric's goals of energy efficiency and resource conservation. The motor is the result of concurrent engineering, which refers to various engineers cooperating on design, manufacturing technology and facilities development to make the best product. This section introduces the eco-compatible minimo.

45-mm minimo® — The World's Smallest* Fan Motor
A little package full of ingenuity and innovation

* Among AC capacitor start motors for compact ventilators.
As of Feb. 2009, Mitsubishi Electric survey.

ENVIRONMENTAL VISION
2021
TECHNOLOGY & ACTION

Environmental Manufacturing Ideals

▶ Product Features

▲ Closeup 01 ▲ Closeup 02 ▲ Closeup 03

The graphic features a hand holding the fan motor next to a ruler. The background includes a blue sky with birds, green trees, and a city skyline at the bottom. Navigation buttons for 'Closeup 01', 'Closeup 02', and 'Closeup 03' are located at the bottom.

Contents

▶ Product Innovations

minimo—the world's smallest* fan motor—greatly reduces the environmental impact of housing.

- minimo is energy efficient and conserves resources
- minimo provides outstanding environmental performance

*According to a Mitsubishi Electric survey, minimo was the world's smallest fan motor as of 2009, among fully automatic capacitor start motors for compact ventilators.

▶ Production Process Innovations

Superior process pooling Mitsubishi Electric's strengths in motor design, manufacturing technology and facility development

- Concurrent engineering is the DNA of the Nakatsugawa Works
 - The development stage combines the Company's technologies, knowledge and experience
 - Concurrent engineering evolves in the Iida Creation Lab
-

▶ Engineers' Perspectives

▶ Working with the Community for the Environment

World's smallest fan motor greatly reduces the environmental impact of housing

"minimo" is energy efficient and eco-compatible

Motors in pipe fans used to ventilate living rooms, bathrooms and other rooms are installed in the airflow channel. So a smaller motor provides less wind resistance and greater airflow. However, as the size of the motor is reduced, the power efficiency declines, as does the ventilator's performance.

Mitsubishi Electric solved this problem with minimo, a substantially smaller yet high-performance motor. minimo's outer diameter is 43 millimeters, making it the world's smallest motor of its kind. Compared with similar conventional motors, the compact minimo has 68% less volume and is 73% lighter. Pipe fans that employ a minimo use around 22% less power yet still provide 25% more airflow than typical models. Being compact, minimo saves valuable limited resources by substantially reducing the plastic, iron, copper and other raw materials needed to produce it.



The world's smallest capacitor start motor for compact ventilators: minimo

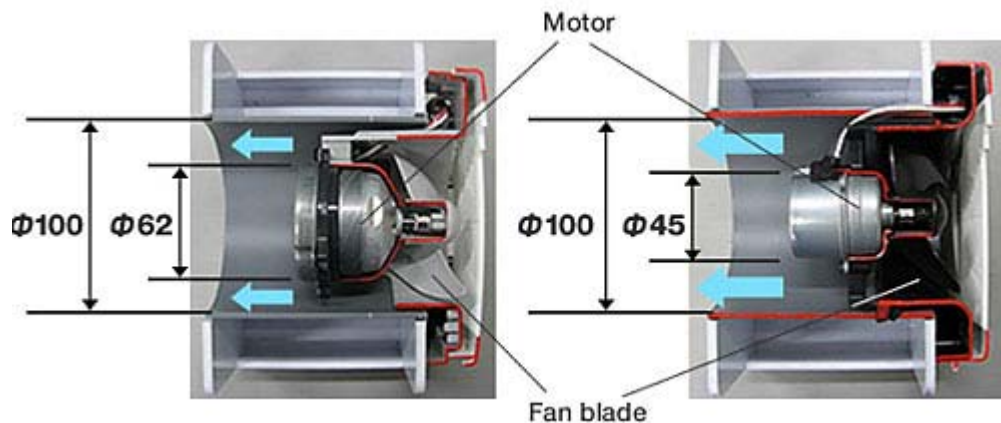
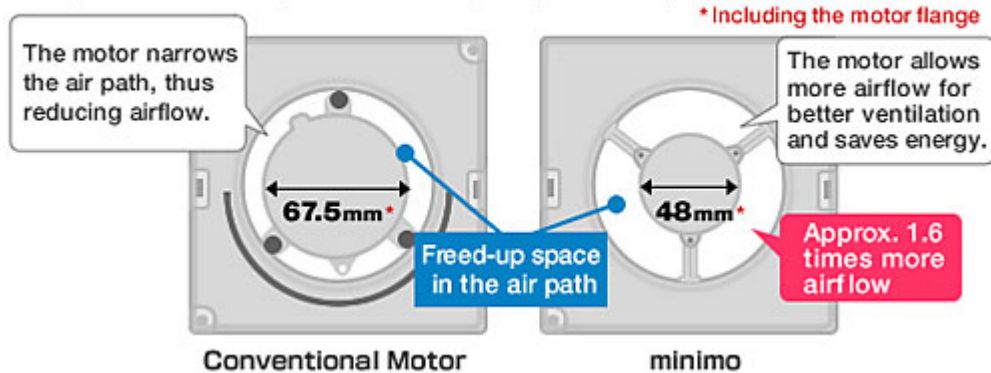
Higher airflow and less energy consumption

In conventional motors with a diameter of 67.5 millimeters, including the flange, part of the motor blocks the airflow. This part takes up 56% of the cross-sectional area, compared to only 28% for fans equipped with the minimo. Moreover, mimimo fans reduce air resistance (boosting airflow by 25%), yet at the same time lower power consumption by 22%.

Compactness saves resources



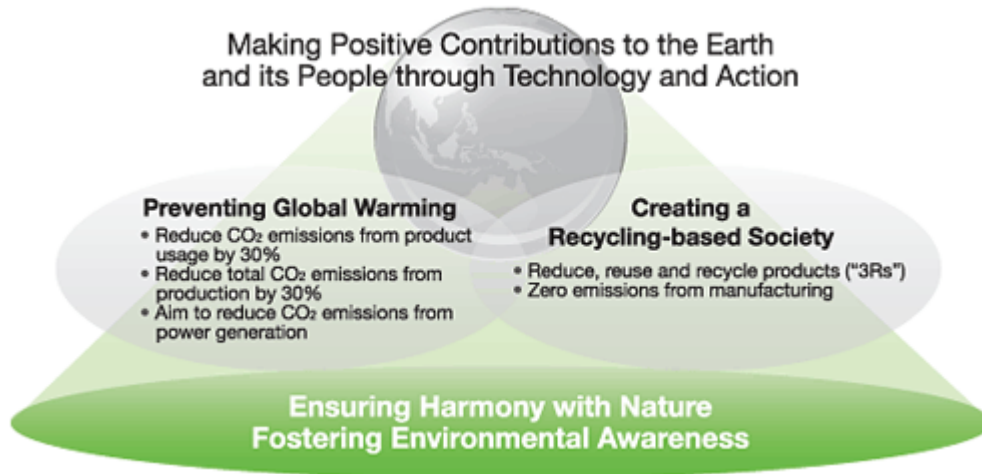
Comparison of free space in the air path (Back view)



Watch a video of minimo

Environmental Vision 2021 and minimo

Environmental Vision 2021 sets targets to be achieved by the year Mitsubishi Electric celebrates its 100th anniversary. Major objectives include reducing CO₂ emissions from production and product usage to prevent global warming, and actively promoting 3R (reduce, reuse, recycle) initiatives to bring about a recycling-based society. The innovative minimo, which is energy efficient and eco-compatible, contributes to these objectives. minimo is a model for Mitsubishi Electric's product development efforts.



Excellent environmental performance possible because ventilators generally not seen

Customers are not usually aware of the performance of the pipe fans preinstalled in the homes they purchase. However, the energy they consume is significant.

Pipe fans account for about 30% of the ventilators used in Japan, according to a 2007 survey by the Japan Electrical Manufacturers' Association. Following revisions to the Japanese building code in 2003, full-time ventilation has become a requirement for most new dwellings, and pipe fan installations are expected to increase.

Pipe fans are used in most houses, but they are seldom chosen directly by consumers. For this reason, Mitsubishi Electric has accepted responsibility for providing products with exceptional environmental performance. Our minimo-equipped pipe fan received the 2007 Energy Conservation Grand Prize from the Director-General of the Agency of Natural Resources and Energy.

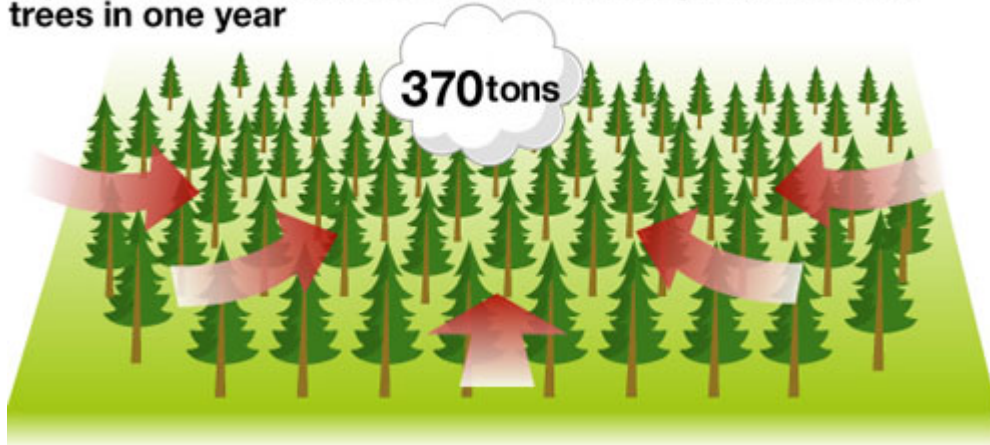


How much does minimo benefit the environment?

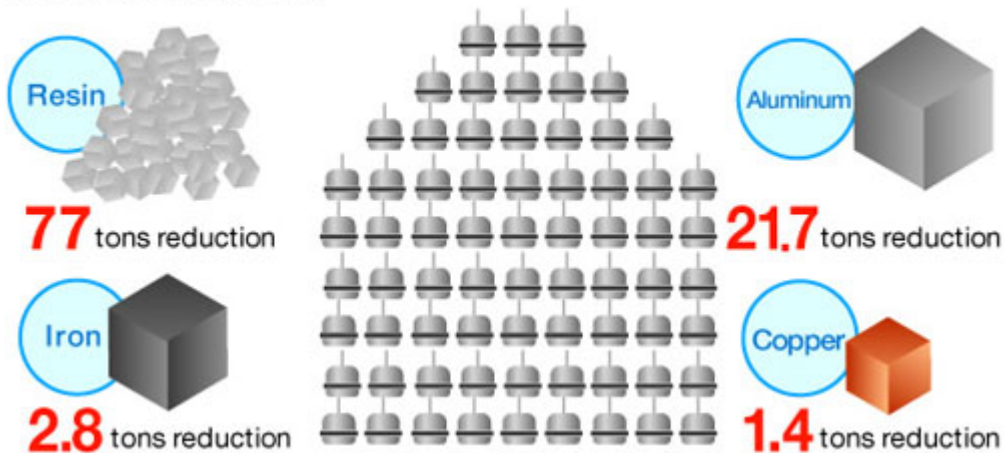
If all the pipe fans sold by Mitsubishi Electric were equipped with minimo, the energy saving would equal some 370 tons of CO₂ a year. Using minimos would also reduce resource usage: plastics by 77 tons, aluminum by 21.7 tons, iron by 2.8 tons and copper by 1.4 tons. These savings by minimo would make a significant contribution to preserving the environment.

* Assuming half of the pipe fans sold by Mitsubishi Electric are run 24 hours a day and the other half five hours a day.

Equivalent to amount of CO₂ absorbed by 26,000 cedar trees in one year



Materials equivalent to around 200,000 conventional models are saved



Superior production process combining the strengths of motor design, manufacturing technology and facility development

Concurrent engineering: the DNA of Nakatsugawa Works

minimo was developed by a project team from the Iida Factory at the Nakatsugawa Works. For the project, engineers specializing in motor design, manufacturing technology and facility development gathered at the factory. This concurrent engineering resulted in the development of this product.

The Iida Factory is one of Japan's leading facilities for ventilator production. It manufactures duct ventilators, pipe fans and other models. As competitors shift production overseas, the Nakatsugawa Works has remained focused on production in Japan while pursuing a high market share and customer satisfaction through high-quality products matched to the needs of the Japanese market.

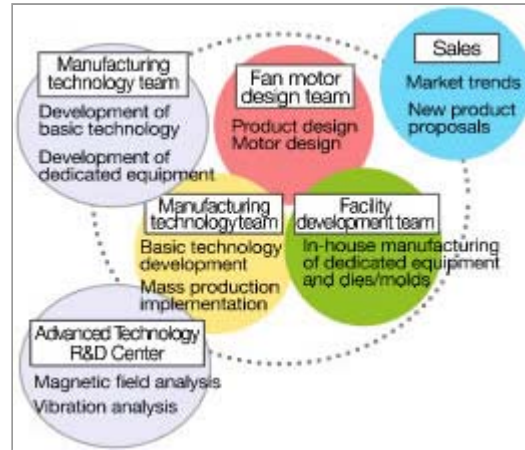
The Iida Factory makes highly competitive products because of its ongoing factory automation. The Nakatsugawa Works can handle production from line design to the design and development of automation equipment and molds. The factory combines these technologies to build automated, high-efficiency, high-precision production lines that cannot be imitated. Product development does not follow a typical pattern of design production. Instead, an automated production line is a prerequisite, and so divisions collaborate to create the optimal motor design, production line configuration and equipment molds. The Company has used this development process for many years. Long before concurrent engineering became widespread, the Nakatsugawa Works applied this approach to product development, a process it terms its DNA.



Motors produced at the Nakatsugawa Works. At front, a motor produced at the Iida Factory. The Nakatsugawa Works has produced ventilators since 1943 and made its 100 millionth product in 2006. The Iida Factory had manufactured more than 40 million as of 2005. The high-quality, highly reliable products that come off these facilities' automated production lines have made Mitsubishi Electric the No. 1 manufacturer for four straight years, as chosen by material and equipment manufacturers, according to a survey by Nikkei Architecture.

Combined technologies, knowledge and experience at the development stage

The Nakatsugawa Works' DNA was evident in the development of minimo. To create the ultimate fan motor, top staff members from sales, motor design, manufacturing technologies, facility development and other divisions participated. Also enlisted was the Manufacturing Engineering Center, which provides technical support for all of Mitsubishi Electric's production sites around the country. Highly experienced employees were invited to the Iida Factory. This new team pursued the best product development process by combining and fusing technologies, knowledge, and experience cultivated on the production floor, the front line of product manufacturing.



Technology Development System for minimo

As the team developed concurrent technology, a key was technical innovations related to integrating design with manufacturing. For example, the motor coil was separated from the insulating framework and insulated after winding the copper wire as densely as possible and inserting other parts. This new technology shattered conventional views about fan motors and is why minimo is compact and efficient. The minimo is the direct result of combining a new manufacturing perspective with motor design. The Nakatsugawa Works is well known for this type of innovation.

Technical innovations went beyond designs. Concurrent engineering resulted in many manufacturing innovations as well. An experienced employee in fan motor design was put in charge of production technology, a move that infused a new perspective. Similarly, staff from the Manufacturing Engineering Center worked closely with team members in charge of facility development and combined their respective expertise. Efforts were made to reduce loss in every process, including the development of a work conveyance system. The team constantly innovated to ensure the best product was manufactured with high-precision efficiency.



minimo: a product of concurrent engineering



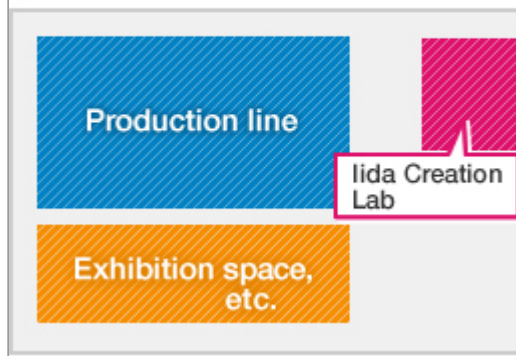
Project Members for minimo
From left: Deguchi (design leader), Yamaguchi (production technology leader), Kinoshita (project leader), Miyake (production technology development assistance)

lida Creation Lab: Source of concurrent engineering

The lida Creation Lab at the lida Factory was a key element in the concurrent engineering used to develop minimo. This lab houses parts and components for experiments and product development. It also hosts meetings at which project members exchange ideas.

The lida Factory is a production site without a formal development division. At the start of the project, space was created next to the factory entrance of the where all development team members could meet. The development site was located within a few steps of the production line to aid in fusing design and production.

lida Factory: manufacturing factory for motors and ventilators



Creation Lab located next to the production line

Many manufacturing facilities aspire to concurrent engineering, but their actual development process typically involves technology developed separately because of the high degree of specialization required, with regular meetings to coordinate these disparate efforts. In contrast, all team members gather at the lida Creation Lab to inspect the manufacturing line that will be used and debate how to improve mechanisms and processes. Rather than trying to coordinate their efforts in a meeting room at a later date, the team members meet at the actual production site, making the lab an essential tool for effective concurrent engineering.



Engineers gather in the Creation Lab.



All team discuss ways to create the best product.

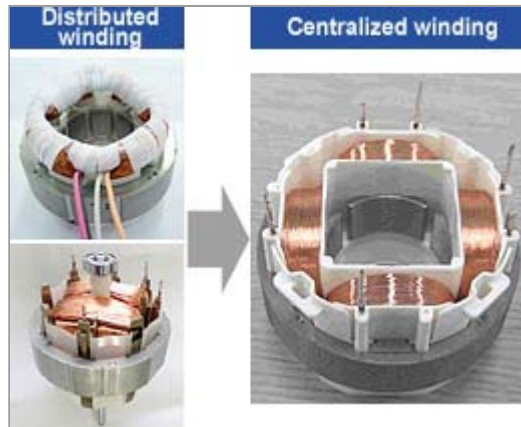
New technology born from concurrent engineering – the minimo innovation

Reducing primary loss, which accounts for 40% of power loss

Centralized winding used to reduce coil resistance by half

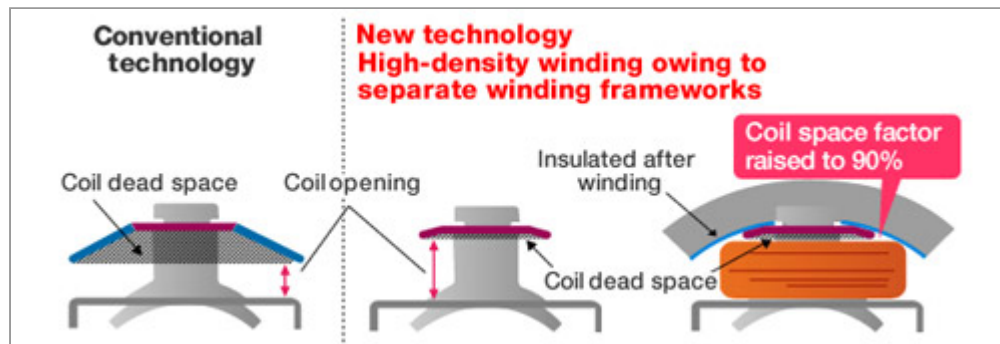
Reducing the size of a motor typically reduces its output and power efficiency. Coil innovations provide a way to make a motor compact while maintaining its efficiency.

Primary loss, the major power loss by a motor, refers to power lost due to heat from electrical resistance when current flows through the coil connected to the power source. This loss accounts for around 40% of losses in compact capacitor start motors. To reduce this primary loss, minimo uses concentrated winding in which the copper wire is directly coiled on the stator (the part of the fan motor that does not revolve), which differs from regular distributed winding. As a result, primary power loss from coil resistance is reduced by about half.



Coil space factor increased to reduce coil resistance 20%

A problem with centralized winding, which involves few slots, is that the amount of dead space increases. Dead space is where the copper wire cannot be wound because it is blocked by the framework that insulates the coil. To solve this problem, the framework was separated and the wire was wound around a portion that could not be used previously. Other insulating parts were inserted on the portion that juts out after the coil was wound. The coil space factor (ratio of the space occupied by the copper wire to the area of the slots) was increased 12% over conventional models, which enabled primary loss to be successfully reduced another 20%.



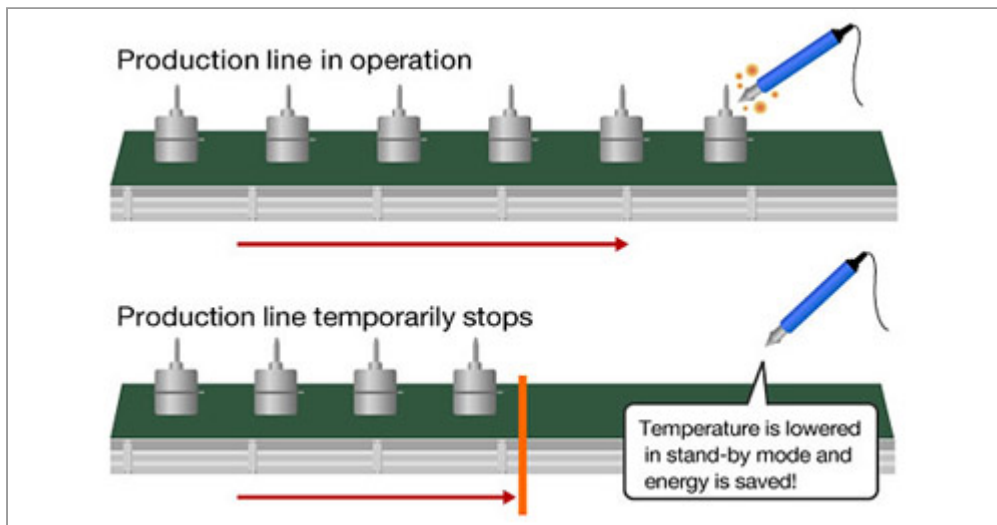
[Watch a video of minimo](#)



A high-speed, low-shock conveyor. To ensure the high precision required by minimo, the Manufacturing Engineering Center and Facility Development Division worked to develop a conveyor that is smooth, fast and does not jolt parts. Development of this equipment was not outsourced; instead, the production line was built concurrently with the design of minimo.



With conventional models, parts are supplied to the line by a robot that lays them out on a pallet. Switching to a direct-parts supply system made possible by a parts feeder manufactured in-house eliminated the manual laying out process upstream on the line.



The soldering trowel features a new mechanism that lowers the temperature in stand-by mode when the line stops temporarily. Thorough efforts were made to totally rationalize energy efficiency.

Engineers' Perspectives

Concurrent engineering that integrates development and manufacturing is one ideal pursued by Mitsubishi Electric. This section presents the comments of the engineers who put concurrent engineering into practice to develop minimo, the ultimate fan motor.

Building the best-ever production line for fan motors

Over the past 20 years, the Nakatsugawa Works has developed many exceptional fan motors, thanks to across-the-board automation. We have always engaged in concurrent engineering, which involves all divisions—sales, fan motor design, production technology and facility development—working to tackle challenges. When I was assigned to lead this project, I wanted to pass on the Nakatsugawa DNA to a younger generation. Moreover, I wanted to keep Japanese manufacturing alive. The goals of this project were to develop the "ultimate fan motor" while at the same time creating the best-ever production line for fan motors. I was confident that if we maximized the power of our concurrent engineering we would build the best production line, not only in terms of quality but also delivery times, cost and environmental factors.



Haruo Kinoshita
Project Leader
Nakatsugawa Works, Iida
Factory

Passing on concurrent engineering to the next generation

We established the Creation Lab with a great view of the production floor as a place where team members could exchange ideas. This lab was created to put concurrent engineering into practice. The team members met for discussions almost daily, which resulted in innovations in motor design and manufacturing. Using this lab, we created minimo, but the biggest achievement for me was passing down the Nakatsugawa DNA to the younger generation. The Creation Lab concept is now not only at the production site, but at the Manufacturing Engineering Center. The lab will continue to be used for projects such as the development of elemental technologies.

I expect our younger employees to practice concurrent engineering and advance product development and manufacturing in a way that contributes to society and the environment.

Objectives achieved without compromises

On this project, I was most pleased that we made exactly what we intended to make—minimo. Normally in the development process, compromises are dictated by circumstances faced by each division, but on this project, all team members—fan motor design, manufacturing technology and facility development—did not compromise.

By not compromising, we achieved the project's objectives. Also, as team members with different specialties discussed issues in the Creation Lab they shared a common awareness of the goal. They developed minimo by working together at the Iida Factory. Design leaders tend to focus solely on product performance, but through this experience I learned that developing products that benefit society is done best with our approach.

In future projects, I plan to engage in development from a wide range of viewpoints, including those from the production floor and market identified by the sales team, and develop products with less environmental impact.



Manabu Deguchi
Design Leader
Nakatsugawa Works

Think of products from design and manufacturing perspectives



Hideya Yamaguchi
Manufacturing Technology
Leader
Nakatsugawa Works Iida
Factory

I had been in the Motor Design Division for many years, but when this project started I was transferred to the Production Technology Department and put in charge of developing manufacturing-related technologies. I learned many things when I considered the product from the vantage point of manufacturing technology and asked the question: What does a motor need? I also deepened my awareness of the connection between products and the environment, something I did not give extensive thought to before.

I also came away with an appreciation for the effectiveness of people with different specialties forming a team and working to solve problems while exchanging ideas and opinions. As a result of constant discussions with other team members and pursuing the best product and manufacturing process, I now realize that Nakatsugawa's automated lines are the realization of concurrent engineering. This experience is not easily gained, even when desired. I am grateful for this valuable experience and hope to spread what I have learned throughout the Company and help raise the global competitiveness of Nakatsugawa Works.

I would like to spread the DNA of motor development throughout the Company



Nobuaki Miyake

Production Technology
Development Assistance
Manufacturing Engineering
Center

When Project Leader Haruo Kinoshita came to the Manufacturing Engineering Center in Amagasaki, he expressed his conviction that we must build an exceptional production line on par with overseas production to keep Japanese manufacturing alive. I empathized with his conviction and remember feeling that we must succeed.

The Nakatsugawa Works and the Manufacturing Engineering Center have made motors for 20 years. Our predecessors focused on ease of winding and proposed a structure with a split core, which made it possible to raise motor performance and automate its production. This led to the birth of Mitsubishi Electric's Poki-Poki motor. This DNA was passed on to the younger team members on this project, and after discussions that included engineers from other production sites, a one-of-a-kind motor and production line were created.

This basic integration of design and manufacturing is essential not only to producing exceptional products but also to protecting the environment. The Manufacturing Engineering Center intends to stay true to this DNA and work with all motor team members to make Mitsubishi Electric the world's No.1 motor manufacturer.

Innovative Products and Production

Working with the Community for the Environment

Environmental JIT activities by all employees

The Nakatsugawa Works' Iida Factory, which began operations in 1974 as a ventilator factory, established a production floor for home photovoltaic systems in 1998. Together with the Nakatsugawa Works, the plant has made many products that benefit the environment. The Iida Factory reduces its environmental impact through such initiatives as Environmental JIT (just in time), which involves saving energy resources (electric power, gas and fuel oil), protecting river ecosystems by purifying wastewater and recycling coolant water, and promoting zero emissions by reducing waste volume and recycling.

The Iida Factory converts all the resources it uses, not just electricity and gas, but also iron, copper, aluminum and plastics, to carbon dioxide emissions so that each and every employee maintains a strong awareness of the environment during the course of their day-to-day work. For example, saving one ton of iron is equivalent to reducing carbon dioxide by 1.5 tons. Efforts are made to raise awareness of the fact that all improvement activities not only reduce costs but also are directly linked to environmental benefits. This serves to encourage all employees to participate in improvement activities (efforts to eliminate waste of all kinds).

Example of Environmental JIT

Delivery truck trips from parts supplier reduced by improving packing and raising loading efficiency



Working with government and citizens as a community environmental leader

Iida, located in Japan's Central Alps, is involved in initiatives based on its own Environmental Plan in an effort to bring sustainability to the region. A leading initiative is using more photovoltaic power systems. Since fiscal 1997, Iida has carried out measures to encourage greater use of these systems, offering financial intermediation and interest payment subsidies to citizens who install them. Iida has been selected as an "Environmental Cultural City" for its efforts to become a low-carbon city that produces energy from the sun and forest. The city's efforts are expected to significantly expand Mitsubishi Electric's photovoltaic power system business.

Mitsubishi Electric participates in the Research Group for Regional Environmental ISO launched in Iida in 2000. This group has developed into an organization that is critical to the region's environmental and cultural progress. Its members are 29 local businesses, including the Iida Factory. As the deputy representative of the research group, factory employees give lectures at environmental forums held by local administrative bodies and participate in local environmental activities conducted by the private and public sectors and private citizens.

Apple trees symbolic of a factory open to the community

The Iida Factory has 78 apple trees near its entrance that symbolize its environmental activities with the community. The trees were planted 35 years ago when the factory was established and express its basic stance of being open to the community, as the trees contribute to the environment by providing green space and replacing other types of fences.

Many employees have painstakingly cared for the trees. In the fall, they produce 35,000 apples, a local specialty of Iida. Every red apple is stenciled with the Mitsubishi logo, and these apples are one of the factory's celebrated products. They are given as souvenirs to people who tour the factory and are donated to local senior citizen centers and care facilities. In December, children from local care facilities are invited for an apple-picking event. The children express their appreciation in letters, often commenting on the great-tasting apples.



The Iida Factory has a row of apple trees instead of a traditional fence. The apples have the Mitsubishi Electric logo. There was a special version in 2008 to commemorate 40 years of producing duct ventilators.



A poster received from children who participated in the apple-picking event. The factory receives letters from children expressing their thoughts about the day.





Yoshiyasu Shirokane
Plant Manager
Nakatsukawa Works,
Iida Factory

Valuing all resources and letting nothing go to waste

These days, business must be discussed along with the environment. However, if environmental contributions are separated as a special activity, then progress becomes difficult. What is important is not letting anything go to waste. When every person is dedicated to avoiding waste—whether of energy resources like electricity and gas, materials like iron and copper, or things used at the office like paper—this will lead to everyday environmental activities. Based on this idea, the Nakatsugawa Works promotes its environmental activities as a "war against waste" with full employee participation. Reducing costs and expenses are essential, but it is also important that we use natural resources wisely.

Companies must also conduct activities with their communities. Environmental activities do not make much of an impact when conducted by a single company. I give lectures on the regional activities being promoted by Iida, and in my talks with people with a variety of local perspectives I have learned many things. I hope to deepen ties to the community and promote environmental contributions at the regional level based on a spirit of letting nothing go to waste.

Environmental Topics



One of the three initiatives for preventing global warming laid out in Mitsubishi Electric's Environmental Vision 2021 program, announced in October of 2007, is the goal of promoting photovoltaic (PV) systems and increasing their efficiency. Here we introduce the features of Mitsubishi Electric's photovoltaic power generation systems and the various ways we are working to achieve these goals.

Mitsubishi Electric is the only maker that can develop and manufacture photovoltaic systems entirely in-house.



Photovoltaic (PV) power generation systems are made up of two basic devices: a PV module that converts solar energy into electrical energy, and a PV inverter that converts the generated electricity into a form that can be used in the home.

Generally, most manufacturers involved in photovoltaic power generation only make the PV module themselves. They usually either assemble systems by using PV inverters from other companies or sell systems while marketing PV inverters purchased from other companies under their own brand. Mitsubishi Electric develops and produces every system component in-house, including PV modules and PV inverters. One of the main features of our photovoltaic power generation business is that we are able to provide total systems made entirely out of Mitsubishi Electric products.

We are able to develop everything in-house thanks to our extensive experience, long track record and outstanding technologies in the area of power electronics (equipment and facilities for receiving and distributing electricity). In fact, creating high-performance photovoltaic systems depends not only on cutting-edge semiconductor technology for the PV cells but also on power electronics technology for making the system function well. Our strength in power electronics shows up everywhere in Mitsubishi Electric photovoltaic systems.



Nakatsugawa Works Iida Factory is home to our photovoltaic power generation systems business

- ▶ Aug 27, 2008:
Mitsubishi Electric Announces Shipment of Small-size Photovoltaic Module for Non-electrified Areas.  (65KB)
- ▶ Aug 27, 2008:
Mitsubishi Electric to Build New Photovoltaic Cell Plant in Aim to Expand Annual Photovoltaic Production Capacity to 600MW by Fiscal 2012.  (30KB)

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Increasing Efficiency

Mitsubishi Electric PV inverters deliver an industry-leading power conversion rated load efficiency of 97.5%¹



A major difference between Mitsubishi Electric's photovoltaic (PV) systems and systems made by other companies is the PV inverter. Electricity produced from solar energy by photovoltaic cells must be converted from direct current to alternating current, the type of electricity used by electrical appliances. Converting electricity from D.C. to A.C. is the role of the PV inverter. However, energy is inevitably lost when this conversion takes place. The extent to which this

loss can be minimized rests entirely on the performance (power conversion efficiency) of the PV inverter.

If the power conversion efficiency of the PV inverter changes, the amount of power that can actually be used also changes, even if the PV module is producing the same amount of power. For example, if the conversion efficiency of the PV inverter is 90% (10% loss), then 10% of the PV cells on the roof are essentially being wasted. Whether or not valuable PV cells are wasted in this way depends entirely on the PV inverter.

Mitsubishi Electric has developed a high-performance PV inverter that leverages power electronics technology, one of our traditional strengths. A 4 kW household PV inverter released in October 2007 applies new proprietary technology to achieve a conversion efficiency of 97.5%, a two percentage point improvement over our previous model, which held the former industry high of 95.5%.

Our 100 kW large-capacity industrial PV inverter has also attained a conversion efficiency of 97.5% as of February 2009. In addition, the unit can now be installed in tighter spaces thanks to its industry-class compact size, a feature that was made possible through unique innovations to eliminate the transformer. Mitsubishi Electric's 100 kW PV inverter is slated to be ready for practical application in fiscal 2011 (year ending March 31, 2011), and we plan to continue developing even larger capacity models going forward.

Note

1: 4 kW household PV inverter and 100 kW large-capacity industrial PV inverter have both achieved an industry-high 97.5% conversion efficiency.

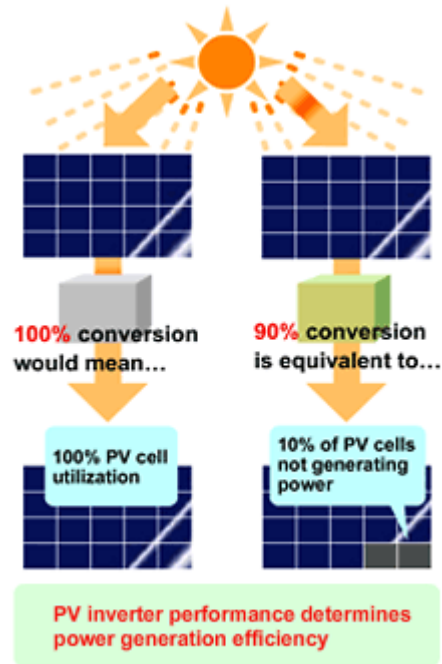
[4 kW Household PV Inverter]

Rated load efficiency is stipulated by JIS C8961. Actual measurement of 97.5% was by Mitsubishi Electric on the PV-PN40G model. (Mitsubishi Electric's previous model, the PV-PN33G, was 95.5%.)

As of October 4, 2007. Industry high among mass produced PV inverters for PV systems for Japanese household use.

[100 kW Large-Capacity Industrial PV Inverter]

As of February 18, 2009. Conversion efficiency with a load factor of 75% among 100 kW-480V PV inverters. Mitsubishi Electric survey.

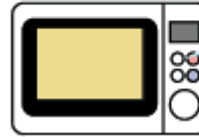


The Significance of 2%

To grasp what is so special about raising conversion efficiency by a mere 2%, from 95.5% to 97.5%, it's necessary to begin looking at it in terms of loss, which was reduced from 4.5% to 2.5%. This is close to half. And actually, when we accomplished this feat it was met with a good deal of surprise and admiration.

Increasing efficiency by 2% is equivalent to reducing loss by nearly half

The amount of loss recovered on a 4 kW photovoltaic system is equivalent to enough



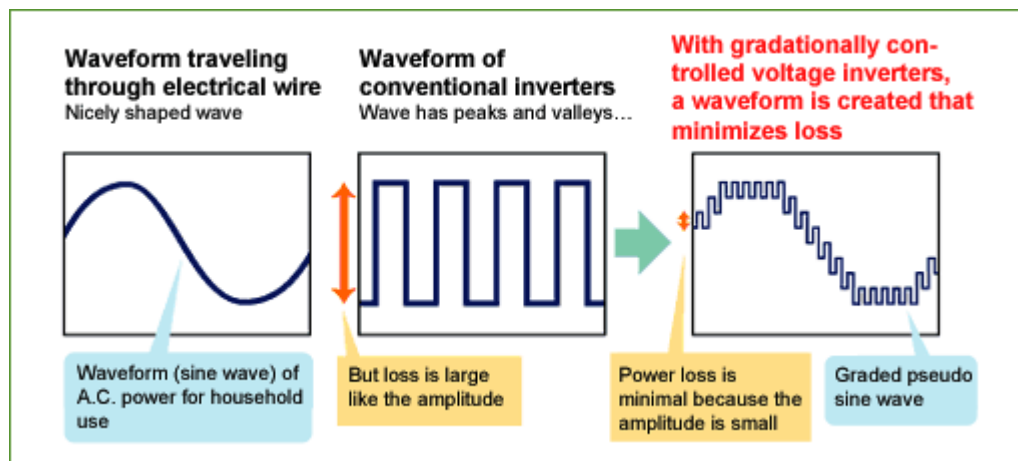
electricity to cook for **80 hours** with a microwave oven that consumes 1 kW.

Control technology comprising three separate inverters is the key to higher efficiency

Power loss occurs in a number of areas, but the part where power loss is especially large is the inverter. There is a close relationship between electricity loss and the waveform output by the inverter. Normally, the larger the wave's amplitude is, and the slower it changes, the larger the loss.

Conventional PV inverters were controlled with one inverter. The wave amplitude was large, so loss was also substantial. With the new technology, however, three inverters with differing voltages are skillfully combined to make the amplitude output by the inverter extremely small. Moreover, the on/off speed was increased several times over to come close to a form offering minimal loss. This technology, which we developed ourselves, is called gradationally controlled voltage inverter technology and it is the secret behind our achieving an industry-leading power conversion efficiency of 97.5%.

For more information, please see the Guide to Environmental Technologies



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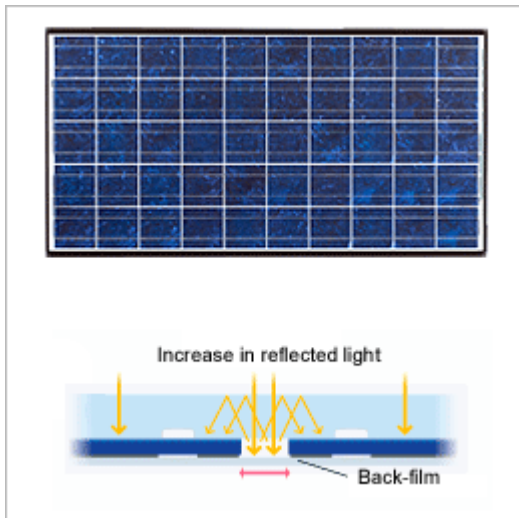
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Increasing Efficiency

Mitsubishi Electric Photovoltaic (PV) Modules Offer a Maximum Output of 185 Watts



Mitsubishi Electric is at the leading edge of photovoltaic module development worldwide. Our current product for the home generates 185 watts of power per module. This is the top level of output provided by a polycrystalline silicon module made in Japan.

Two innovations have made this high output possible. The first is the module's large size. We increased the number of PV cells, which feature industry-class conversion efficiency, and increased their size from 150 to 156 millimeters. The other innovation involves the design of the cell. The space between each cell was widened so that the cells could absorb more of the light reflected off the backing film between the cells.

Photovoltaic system performance equals PV inverter performance times PV module performance

No matter how much the PV inverter minimizes loss when converting from direct current to alternating current, if the performance of the PV module that makes the electricity in the first place is not up to par, the amount of power that is obtained is diminished. At the same time, no matter how much power is generated, if significant loss occurs when converting to A.C., the result is less power that can actually be used. To put it another way, the higher the performance of both is, the higher the performance of the photovoltaic system overall. Mitsubishi Electric's PV modules and PV inverters both deliver industry-leading performance, so our photovoltaic systems permit use of ample amounts of electricity made from the sun in daily life.



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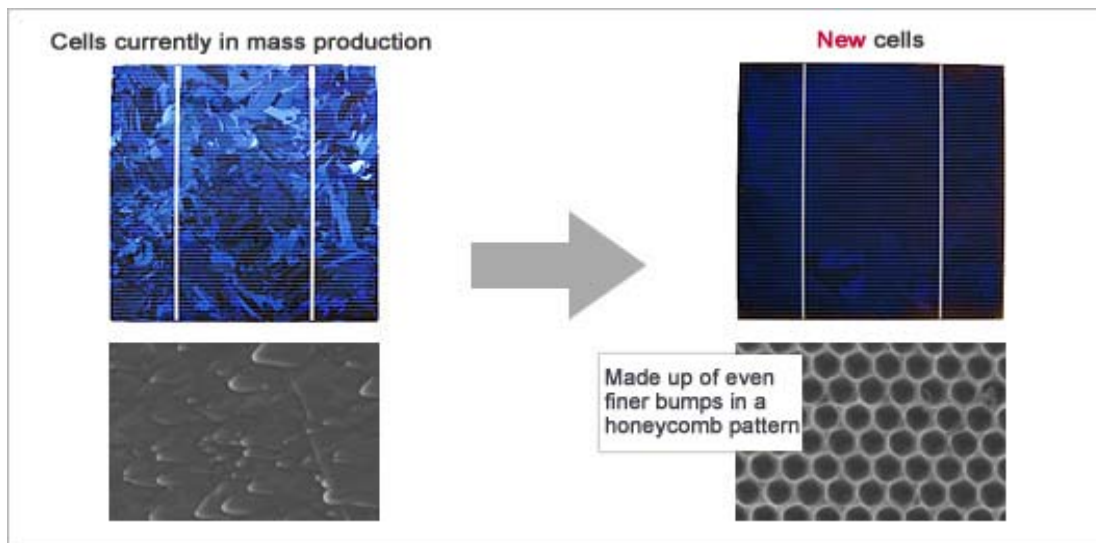
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Increasing Efficiency

New PV Cell Conversion Efficiency of 18.9% Represents the World's Highest for the Second Year Running¹

The amount of power generated by a photovoltaic module depends on the output of its PV cells, so raising the conversion efficiency of the cells leads directly to more power generated. To raise the conversion efficiency of PV cells there is a need to capture as much sunlight as possible by limiting the amount of sunlight that reflects off the surface of the cell.

Mitsubishi Electric achieved a conversion efficiency of 18.6%², the best in the world, in March 2008 when using 15-centimeter polycrystalline silicon PV cells with an ultra-fine honeycomb surface that limits reflection to a substantial degree.

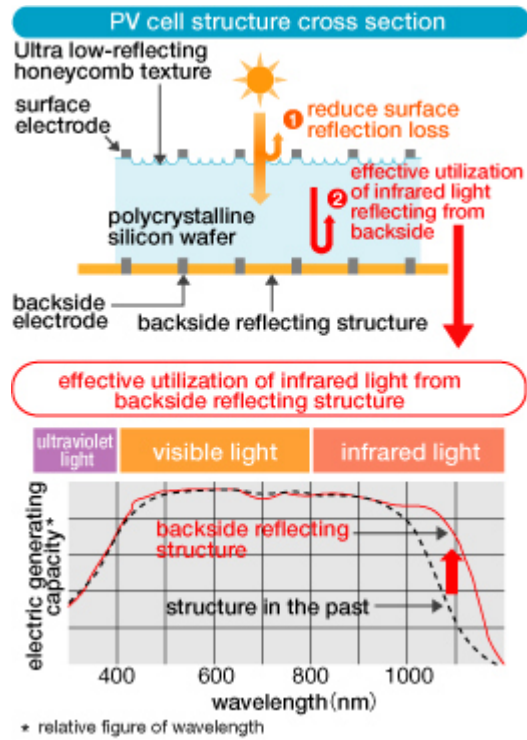


In February 2009 a conversion efficiency of 18.9% was achieved through a combination of innovations in how the cell surface absorbs sunlight and technologies for effectively utilizing infrared light. This number represents the best conversion efficiency in the world for the second year running. Among the wavelengths that make up sunlight, infrared light is less prone to absorption by crystalline silicon, so its contribution to power generation is roughly half that of other wavelengths. Moreover, if infrared light makes it through to the electrodes on the backs of the cells, it is lost as thermal energy. To address these issues, Mitsubishi Electric did something that had never been done before: created a reflecting structure for the backside of the cells in order to utilize as much sunlight as possible. Infrared light that reaches the backside is reflected back into the cell, which makes it possible to utilize this light for power generation.

We are currently developing technology for mass production of these high-efficiency cells and plan to gradually incorporate them into cells for PV modules starting in fiscal 2011 (year ending March 31, 2011).

Note:

- 1 As evaluated by Mitsubishi Electric
- 2 As evaluated by the National Institute of Advanced Science and Technology (AIST), a public certification body for conversion efficiency

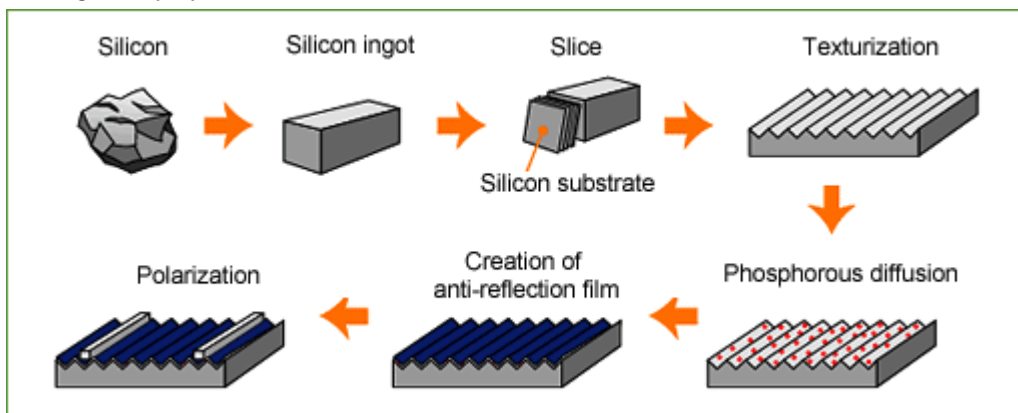


Value of Polycrystalline Silicon Photovoltaic Cells

There are two varieties of crystalline silicon PV cells: monocrystalline and polycrystalline. Monocrystals generate more electricity than polycrystals, but they are used in a range of semiconductors and so are relatively expensive. In contrast, polycrystals can only be used in PV cells and are relatively inexpensive. Mitsubishi Electric believes that one of the keys to further popularizing photovoltaic power generation will be to take inexpensive polycrystals and raise their generating efficiency to the level of monocrystals through technological innovation, and then provide systems to the market with exceptional cost performance.

Polycrystals are actually quite difficult to use effectively. But the converse is that if technology for creating high efficiency systems with polycrystals can be established, polycrystalline systems would be a match for monocrystalline systems. Even if the price of monocrystalline silicon were to go down and it became easier to use, there would be no concern, because the technology used for polycrystals would be at a high level.

Making a Polycrystalline Photovoltaic Cell



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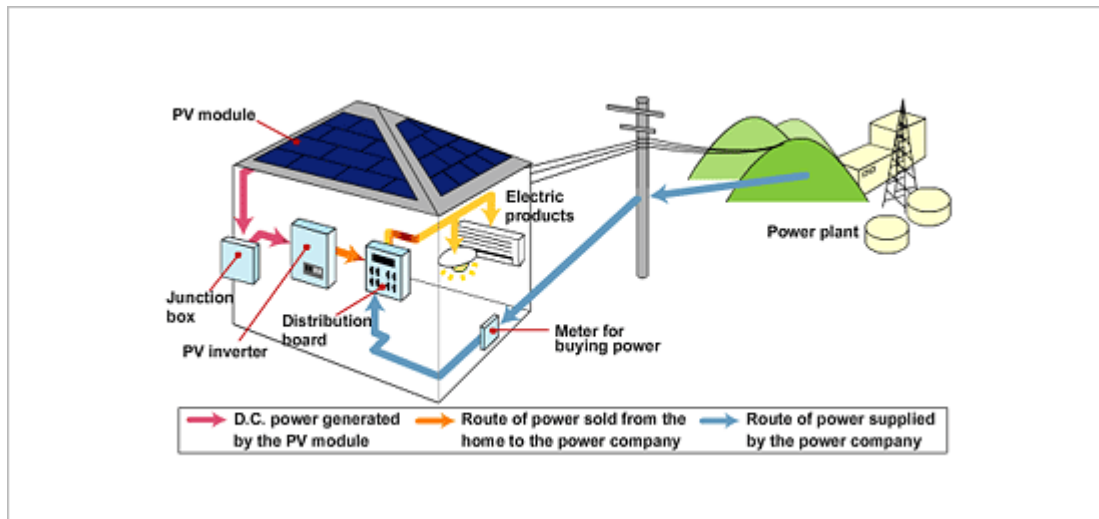
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PV Popularization

Research on Preventing Disturbances to Power Grid Quality When Selling Power

Power produced by photovoltaic power generation systems is sent on a priority basis to electrical devices through the distribution board. If any power is left over, it is returned to the power grid owned by the utility companies and sold to them (reverse power flow). The ability to sell power is one of the benefits of installing a photovoltaic system. However, power grids have not been designed for reverse power flow; they are more like one-way streets. In order to reverse the flow, the power must be sent at a voltage that is slightly higher than the grid and there exists the possibility that the grid could be negatively impacted by distorted waveforms and other phenomena specific to photovoltaic power.

With small systems for the home (3kW), this is not particularly a problem, but if the medium- and large-scale systems used by buildings and factories become more widespread, the impact of reverse power flow on the grid emerges as a problem that cannot be ignored. It is from this standpoint that Mitsubishi Electric is conducting research and testing, in partnership with the government and other companies in the industry, aimed at developing systems that minimize disturbance to the grid's power quality.



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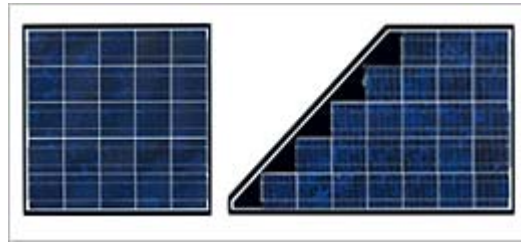
PV Popularization

Expanding the Range of Installations to Areas with Heavy Snowfall or Salty Air

Mitsubishi Electric is committed to further popularizing photovoltaic power generation systems. We are therefore also devoted to research and development aimed at improving module performance and minimizing installation restrictions. In 2007, we improved the load-bearing capacity of our PV modules via a newly developed protection bar, which eases the installation restriction on snow accumulation from less than one meter to less than 1.5 meters. This has made it possible to install the systems in nearly half the 4.36 million households in Japan located in regions with heavy snowfall - something that had been prohibitively difficult before. In addition, a three-layer backing film with exceptional weather-resistance, humidity-resistance and sealing performance has been adopted for use on the underside of the modules, which makes it possible to use the systems in areas where salty air is a concern, like along the coast.



As we expand the scope of potential installations, we are also working to diversify module shapes. Mitsubishi Electric offers a lineup that includes rectangular modules with a 1:2 width-to-length ratio, square modules and trapezoidal modules. This diversity of shapes allows our photovoltaic systems to be installed on a broad range of Japanese houses with various roof shapes, including homes with gabled, hipped or flat roofs.



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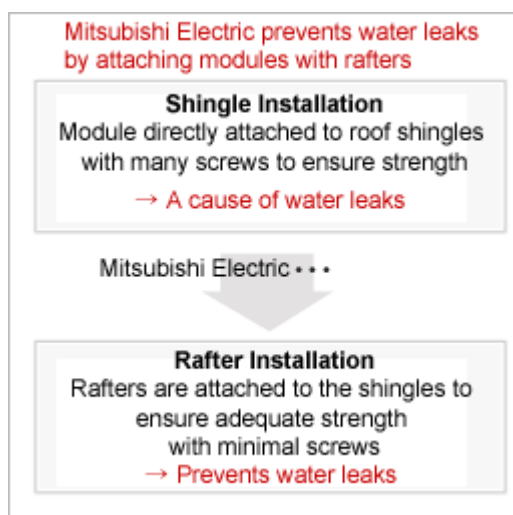
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Entire Range of Products, Sales, Installation, and Support: Pursuing the Highest Possible Quality to Earn the Trust of Customers

Photovoltaic systems are not cheap, which means that customers expect a system to effectively generate electricity, be trouble free and come with robust post-installation support. In other words, customers want a system that includes the product, installation and service in one package. In order to further promote photovoltaic systems, we are pursuing not only better product quality but also the absolute best quality in sales, installation and support.

For sales and installation in Japan, we hold presentations and research sessions for dealers and installers around the country, provide appropriate information to help customers properly understand the systems, and direct installations to make sure they are highly reliable. For installations in particular, we attach modules to the roof with rafters in order to prevent leaks, and only certified installers who have passed our training course are contracted for system installation. We also provide installers with free online software we developed ourselves to help custom design the optimal system based on each customer's installation requirements and specific needs. We provide a 10-year warranty on Mitsubishi Electric

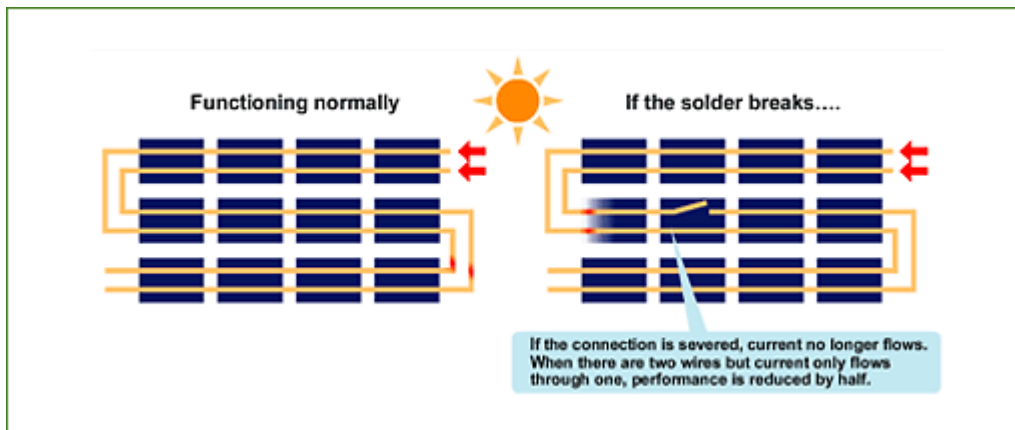
photovoltaic systems designed and installed using this system. There are some 1,200 registered MPS companies nationwide, a network that we continue to expand.



In addition, Mitsubishi Electric has opened the industry's only photovoltaic system technology help center for dealers and installers in Japan. Through this center we provide precise answers to all sorts of inquiries. In the area of post-installation support as well, we have a dedicated toll-free line for questions and concerns, and at least one service center in every prefecture. These centers enable us to provide thoroughgoing service, starting with regular inspections.

Soldering Technology Substantially Increases Reliability of Photovoltaic Modules

Photovoltaic modules are used on rooftops over a long period of time, for 20 years or more. If a module malfunctions, the time and cost for repairs and new parts can be significant. This is why Mitsubishi Electric works extremely hard to create a highly reliable product that will not break down over the long term. Soldering technology is one of the keys to improving reliability. PV modules are made up of around 40 to 50 photovoltaic cells that are linked together in a series with fine copper wire. If a connection breaks, those cells will cease to function. In fact, soldering problems are the most common cause of malfunctions in photovoltaic systems. Mitsubishi Electric has developed its own original automated soldering machine to help resolve this problem. Nakatsugawa Works, which manufactures the photovoltaic modules, leverages its unique production know-how, cultivated over many years in motor manufacturing, and uses highly reliable soldering to produce modules that can be used with peace of mind over many years.



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PV Popularization

Expanding Production Scale to Meet Rapidly Growing Demand Will Boost Annual capacity to 600 MW in Fiscal 2012

Against a backdrop of increasing environmental awareness and skyrocketing oil prices, demand is rapidly growing worldwide for photovoltaic power generation systems. Mitsubishi Electric expects the global market to expand to 5,800 MW by 2012 (compared to 3,100 MW in 2008), with further demand growth anticipated thereafter.

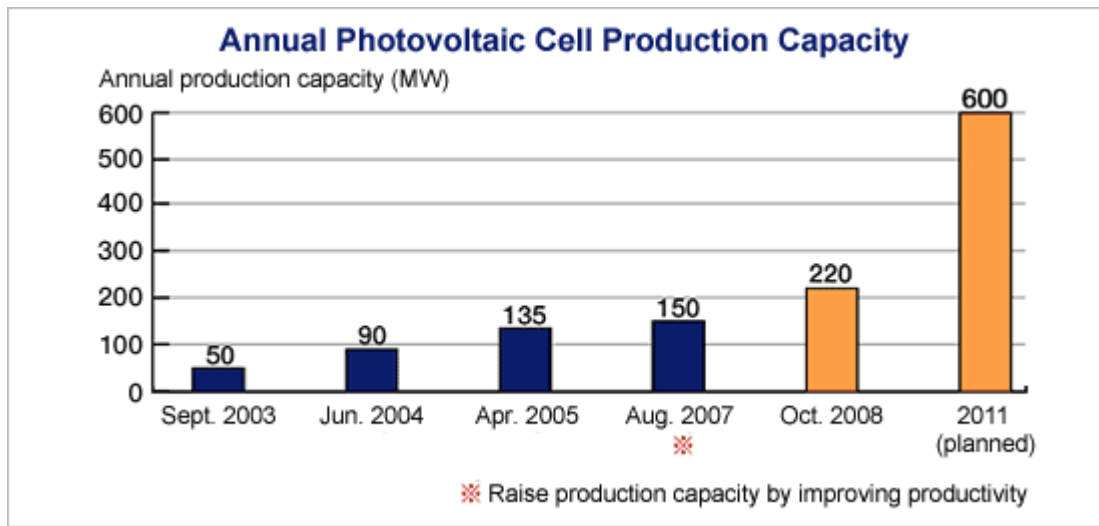
Mitsubishi Electric's annual production capacity for PV cells stands at 220 MW as of April 2009, so in order to meet this voracious demand, we are committing approximately ¥5 billion in capital investment through fiscal 2012 to augment PV cell production lines at Nakatsugawa Works' Iida Factory (Iida, Nagano Prefecture) and PV module production lines at the Kyoto Works (Nagaokakyo, Kyoto Prefecture). Our aim is to create a production system with 600 MW of capacity. As the first stage in this augmentation project, a second PV cell plant will be completed at the Iida Factory by December 2009.





Nakatsugawa Works Iida factory (PV cell plant #2)

In an effort to help prevent global warming, Mitsubishi Electric intends to continue boosting production capacity and raising the efficiency of its PV systems while working to promote them. We have a goal of reducing carbon dioxide by the equivalent of 350,000 tons* in 2015 through our photovoltaic power business.

* Amount of carbon dioxide reduced calculated based on the amount of power produced in one year by PV systems shipped in fiscal 2016.



- ▶ Aug 27, 2008:
Mitsubishi Electric Announces Shipment of Small-size Photovoltaic Module for Non-electrified Areas.  (65KB)
- ▶ Aug 27, 2008:
Mitsubishi Electric to Build New Photovoltaic Cell Plant in Aim to Expand Annual Photovoltaic Production Capacity to 600MW by Fiscal 2012.  (30KB)

Photovoltaic Power Generation

Increasing Efficiency

- ▶ PV Inverters ▶ PV Modules ▶ PV Cells

PV Popularization

- ▶ Ensuring Power Quality ▶ Expanding the Range of Installations ▶ The Pursuit of Quality
- ▶ Expanding Production Scale

Perspectives

- ▶ [Perspective of an Engineering Manager](#) ▶ [Perspective of a Sales Manager](#)
- ▶ Perspective of a Customer

Perspectives

Perspective of an Engineering Manager



Mitsubishi Electric is one of the few companies in the world that has total mastery of electricity's ins and outs, pathways and key components, and is one of the few companies that possesses the total package of photovoltaic system technologies, from PV cells to PV inverters and power systems. Our photovoltaic systems aren't too well known because they get such little exposure in commercials and the like, but they always earn rave reviews from customers that use them. It may seem a little strange for me to say this, but Mitsubishi Electric is a sincere, honest company. When making a product that meets a certain rated standard, some companies tend to think that it is good enough to just meet the prescribed standard. Mitsubishi Electric, on the other hand, has a culture that thinks it is never enough to just meet the standard. Whether in development or in manufacturing, we create our own "Mitsubishi Electric standard" and implement it. During our over 10 years of experience with PV modules and PV inverters, we have revised our own testing and production ratings over and over again and have tackled development under stringent standards. Whether or not we achieve exceptional levels of quality depends on the level of our own company standards.

Our goals are to widely publicize how solar power benefits the environment and to further popularize photovoltaic systems.

Shinichi Nomura
General Manager,
Photovoltaic System Marketing Section
Nakatsugawa Works



Demand for photovoltaic systems is growing around the world, but this demand differs somewhat from country to country and region to region. In European countries that subsidize photovoltaic power, especially Germany, many people are interested in taking advantage of the economic benefits offered by photovoltaic systems. In Asia, on the other hand, there is growing demand for such systems as a means of providing electric power to regions not yet on the power grid. The Japanese government revived its subsidy program in 2009, and in 2010 is expected to introduce a new program for buying back power. Such programs are helping to drive installation of PV systems from an economic standpoint. However, I think the biggest contribution these systems make are to the environment. In terms of carbon dioxide reduction, an installed system reduces CO₂ emissions by 330 kg per kilowatt. The reduction provided by just one system may not be very large, but if all homes in Japan had photovoltaic power systems, the Ministry of the Environment's target of reducing emissions one kilogram per person per day would be achievable. Our goal is to further popularize photovoltaic systems by continuing to provide information on their high quality, and widely publicize their benefits in helping to prevent global warming.

Photovoltaic Power Generation

Increasing Efficiency

- ▶ PV Inverters ▶ PV Modules ▶ PV Cells

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- ▶ Expanding Production Scale

Perspectives

- ▶ Perspective of an Engineering Manager ▶ Perspective of a Sales Manager
- ▶ **Perspective of a Customer**

Perspectives

Perspective of a Customer



As a semiconductor manufacturer, our company consumes a comparatively large amount of energy during the production process, and uses PFC (perfluoro compound) gases that have a high global warming potential. As a result of this, from the very beginning we have been aggressively enacting environmental measures. Industry goals for the reduction of PFC emissions were achieved four years ahead of schedule and we are now aiming to push them even lower.



As these environmental activities offer a solid platform from which to demonstrate symbolically to those inside and outside of our company the steps being taken, we have collaborated on a project being promoted by Japan's Environment Ministry and Kochi Prefecture, the LLP Yosakoi Mega Solar project. This is a joint usage megawatt photovoltaic model project being undertaken within the prefecture. As part of this, we installed a Mitsubishi Electric 100kW photovoltaic generation system at our Kochi Plant.

We chose the Mitsubishi Electric photovoltaic generation system over those of other manufacturers due to various factors, such as generation efficiency, installation cost, reliability and service. Even though it was difficult from a cost perspective, PV panels were installed and timber was laid around the area to prevent pebbles from being kicked up by the wind. The proposal was appropriate for the site, and also resulted in more beautiful scenery. We are also very grateful that our requests regarding PR electronic display panels were taken into consideration as much as possible.



Since it began operating in March 2008, employees have been seeing the photovoltaic panels and power generation display monitor on a daily basis, and this clearly seems to have boosted their awareness about saving energy and the environment. Moreover, the story surrounding the installation of the main system has become a topic in the area, having been covered by a local news program and four local newspapers. This has led to environmental PR that has made great contributions to our

business.

I am sure that Mitsubishi Electric will continue to offer the best in terms of management and maintenance. I expect that continuing advances in the research of photovoltaic systems will lead to greater efficiency and lower cost, making it more cost efficient, and I hope the technology becomes more mainstream in society.

Environmental Topics

Rebuilding and Developing Automotive Equipment



Automotive Equipment Initiatives in the United States

As a leading global automotive equipment manufacturer, Mitsubishi Electric has an obligation to reduce the environmental impact of automobiles.

This special feature focuses on two new Mitsubishi Electric initiatives in the United States, which is one of the most automobile-oriented countries in the world.

Rebuild Operations: Recycling in Action



Our Rebuild Operations in California.

[Click for details](#)

Providing Cutting-Edge Alternators



The forefront of alternator development and production is in the United States.

[Click for details](#)

Initiatives to Reduce Waste

Nearing the achievement of zero emissions, our U.S. facility turns waste into a saleable materials.

[Click for details](#)

Rebuilding and Developing Automotive Equipment

Rebuild Operations: Recycling in Action

Contributing to the Creation of a Recycling-based Society

Mitsubishi Electric Automotive America - Orange County (MEAA-OC) in California rebuilds starters and alternators.

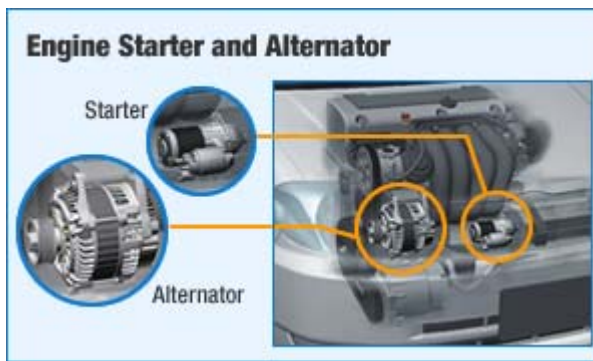
The starter, the first part of the engine to turn over, is the small motor that starts the engine.

The alternator is the power generator. The battery cannot supply a sufficient amount of power to all of the electrical components in an automobile, so the alternator is indispensable.



MEAA -OC in California

The alternator and the starter may fail if they are exposed to excessive severe environmental conditions or if they are subjected to excessive severe operating conditions. However, when it does, often only one part within the alternator has a problem, such as corroded electrodes or sliding parts worn from exposure to water. The alternator can be made to work like new simply by replacing just the parts that are broken or worn—this is the idea behind rebuilt components.



Mitsubishi Electric manufactures and sells automotive equipment at four U.S. locations. The first location was established in 1979 in California, where rebuild operations have been conducted for 30 years. The number of rebuilt products has increased and are now available for a wide range of vehicles, from standard and compact to large and heavy-duty. To improve our products, information from recovered core* products is regularly provided to the development center in Japan.

The rebuild business reduces resource input and helps create a recycling-based society.

Mitsubishi Electric's alternators and starters recovered from automakers are used to create genuine rebuilt parts. Trusted by automakers, we will continue to expand our rebuild operations.

*Core: Used alternators and starters that have broken down and need to be replaced.

	Wt. Per Unit (kg)			Monthly Core Build Qty.	Annual Resource Saved (tons)		
	Aluminum	Steel	Copper		Aluminum	Steel	Copper
Starter	0.50	2.25	0.57	1,822	10.93	49.17	12.39
Alternator	0.94	2.96	0.90	1,484	16.68	52.77	16.11
Annual Grand Totals (tons) =					27.6	101.9	28.5

Rebuilding Alternators

Alternators recovered from automakers are rebuilt as follows:



Enthusiastic MEAA Orange County Employees



Tadashi Katashima
General Manager
MEAA-OC

Five years ago, I was assigned to the MEAA-OC (OC) factory. At present, the factory's rebuild operations are growing steadily. Productivity has greatly improved, with stable supply capacity and quality. Our highly motivated local employees, who show great pride in their work, are supporting these activities.

For example, at our regular morning meetings, factory managers offer ground-breaking ideas to improve productivity and quality. This proactive attitude is evident in recycling, energy-saving and other activities designed to reduce our environmental impact.

At one time, California suffered from much air pollution, and beginning with the landmark Clean Air Act of 1970 (also known as the Muskie Act), various exhaust countermeasures have been implemented. Now, following the environmental countermeasures of the Obama Administration, California leads the nation in environment-related regulatory and aid policies, enabling OC and its employees to more fully develop their environmental awareness and engage in related activities.

I consider it my mission to make the most of my employees' motivation and awareness. By listening to everyone's opinions and ideas, and with the employees' help in expanding our rebuild operations, I will raise the level of satisfaction among our workers. I would like to continue our win-win relationship.



The upbeat California staff at MEAA show their power

Providing Cutting-Edge Alternators through Japan-U.S. Cooperation

Automotive Equipment R&D: Preventing Global Warming through Improved Environmental Performance

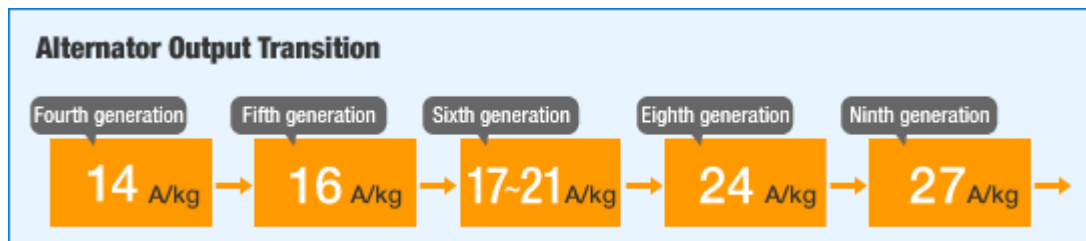
With advances in motors, the emphasis on high-efficiency alternators is growing. The Himeji Works is at the center of development activities to ensure optimal designs with the power supply necessary for each vehicle.

The Himeji Works began developing alternators in the 1960s in pursuit of high efficiency and high power output.

In addition to the sixth-generation and eighth-generation alternators currently in use, ninth-generation models were developed in 2006 (see below).

Ninth-generation models employ improved coil density through use of the pokipoki* motor with optimized generator size, output and efficiency. This high output, combined with quiet operation, is an example of a product that accurately meets the needs of the times.

*Pokipoki motor: motor densification achieved by wrapping coils around the extended core



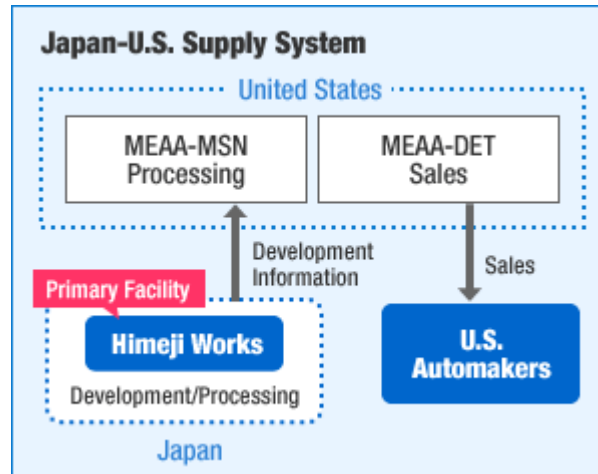
Expanding Eco Products through Japan-U.S. Cooperation

Alternators and starters for the U.S. market are developed at the Himeji Works and manufactured at Mitsubishi Electric Automotive America—Mason (MEAA -MSN) in Ohio.

Despite being slow to respond to environmental needs, U.S. automakers are now shifting to the development of smaller, fuel-efficient, hybrid and electric vehicles under the Obama Administration's "Green New Deal." Mitsubishi Electric's automotive equipment business has expanded distribution of its high-efficiency, high-output alternators, which reduce fuel consumption. The Company has also increased the distribution of its small, lightweight starters. We are working with automakers to develop a full range of services, from development, production and supply, to spare parts and rebuilds. MEAA (-DET¹, -MSN, -MVL²) is expanding America-wide sales of automotive equipment that contributes to lower environmental burden, while MEAA-OC carries out rebuild operations that reduce resource use.



MEAA-MSN(Ohio)



Mitsubishi Electric will continue to supply both OEM products and recycled parts to help reduce the environmental impact of the operation of automobiles in the USA.

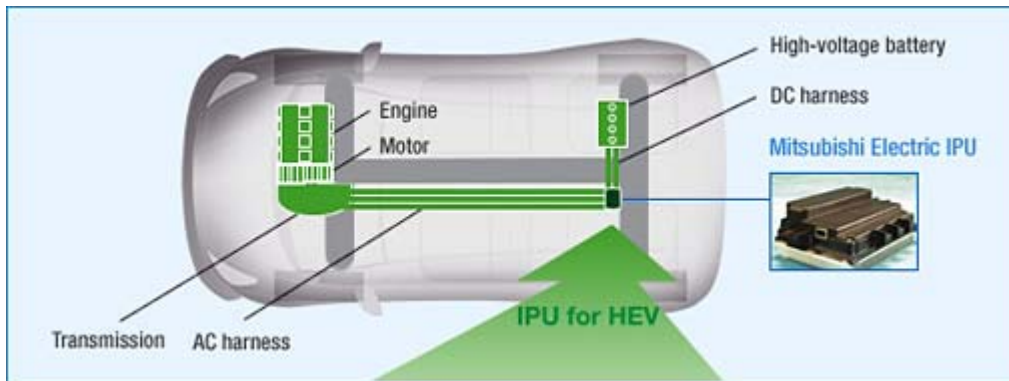
- 1 MEAA-DET: Mitsubishi Electric Automotive America—Detroit, in Detroit, Michigan
- 2 MEAA-MVL: Mitsubishi Electric Automotive America— Maysville, in Maysville, Kentucky

Mitsubishi Electric's Contribution to the Use of Hybrid Vehicles

Hybrid electric vehicles (HEV) are becoming a realistic environmental option. These vehicles use Mitsubishi Electric's inverters, which convert battery power from DC to AC. These inverters also regulate optimal engine RPMs to contribute to energy savings. The HEV, which has an electric motor to reduce gasoline usage, also has a large-capacity gasoline-powered motor and battery. The necessity for an adjustable range and the demand for smaller, more efficient components are increasing rapidly.

Automakers use Mitsubishi Electric's Intelligent Power Unit* (IPU), a DC/AC inverter unit between the battery and the motor that switches battery power from DC to AC. Recently, this unit has been employed in the Insight, made by Honda Motor Co., Ltd. Mitsubishi Electric plans on developing this product for automakers around the world, continuing to use its vehicle components and semiconductor technologies to meet the needs of automakers and contribute to vehicle-related environmental considerations.

* Mitsubishi Electric's IPUs are referred to by Honda Motor Co., Ltd., as Intelligent Inverter Units (IIUs).



EGR Valve: Contributing to cleaner exhaust and reduced CO2 emissions

Most vehicles run on either diesel or gasoline engines. In diesel vehicles, the emission of nitrous oxides (NOx), a cause of acid rain, is particularly problematic. NOx is rapidly produced when the engine combustion temperature exceeds roughly 1,700 degrees Celsius (approximately 3,100 degrees Fahrenheit), so lower temperatures must be maintained. The EGR valve reduces an engine's combustion temperature and helps reduce the formation of NOx by governing the amount of exhaust that is returned to the combustion chamber.

In gasoline-powered vehicles, the EGR valve helps prevent the energy loss (pumping loss) that occurs as the pistons move up and down, improving fuel efficiency.

Mitsubishi Electric provides a DC motor-based EGR valve with superior output and responsiveness for diesel vehicles, and a compact and inexpensive stepper motor-based EGR valve for gasoline-powered vehicles, helping address the major issues of air pollution and global warming.



DC motor-based model

Stepper motor-based model

From the Forefront of Alternator Development and Manufacturing



Yutaka Ohashi
Group Vice President,
General Manager
Himeji Works

When considering how we can contribute to society, we think about the development and supply of products that can efficiently draw output energy from the engine, and can use that energy efficiently. This approach satisfies automakers, and by extension the end purchaser.

In recent years, hybrid electric vehicles(HEV) are gaining a lot of attention, providing an opportunity to showcase Mitsubishi Electric's strength in power electronics technology. Our ability to optimize our semiconductor device, circuit, structural design and other capabilities to suit automobiles will become increasingly important. We will continue to develop our technical capabilities and contribute to the creation of a 21st century automotive society that benefits consumers as well as the environment.



Shingo Tanimoto
Senior Manager
Rotating Electric Products Dept. A
Himeji Works

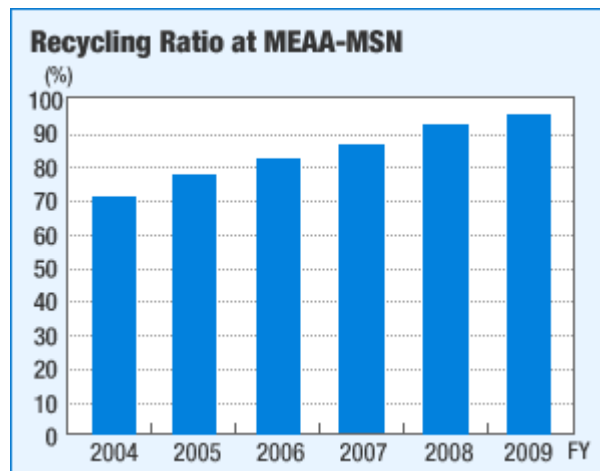
The Himeji Works has been developing alternators since the 1960s. Our consistent efforts to meet customer needs on all counts have enhanced our technological prowess and become the source of our dependable and highly competitive electrical components. As we pursue higher efficiencies going forward, we will aim to apply our expertise in fundamental technology development and manufacturing technology to achieve new breakthroughs.

Initiatives to Reduce Waste

Just One Step Away from Zero Emissions

MEAA-MSN* manufactures alternators and starters. Many of the parts it receives from Japan, as well as those procured locally, are all cushioned and packaged in cardboard boxes. The company also uses coils and other metal parts in its manufacturing processes. For the past 10 years, MEAA-MSN has been working to reduce the amount of cardboard, expanded polystyrene, metal shavings and other materials that ended up as landfill waste.

In the past, such waste was simply considered trash that companies paid to dispose of, but in addition to costing money, this method did not facilitate the reduction of landfill waste. MEAA-MSN began focusing on converting waste into something that could be sold—resources and products rather than trash. The company created a system whereby recyclers picked up these materials, and they introduced a number of ingenious processes along the way. Through these methods, the company promoted the complete recycling of everything from used work gloves to documents and memoranda. As a result of these efforts, in 2010 MEAA-MSN expects to achieve "zero emissions, zero waste" status.



*MEAA-MSN: Mitsubishi Electric Automotive America — Mason, in Mason, Ohio

Case study of Initiatives at MEAA-MSN



Recycling box



EPS densification



Metal scrap separation



Cardboard baler

Fostering Environmental Awareness: "Ecology = Economy"



Scott Stephenson
Corporate Manager of
Environmental, Safety and Quality
Systems, MEAA-MSN

Including environmental ISO activities, for more than 10 years I have been working to reduce MEAA-MSN's environmental impact. During this period, the biggest issue that MEAA-MSN faced was reducing final landfill waste. We introduced a number of creative recycling initiatives, but found that the most important factor in putting them into practice was raising the environmental awareness of local staff. Our Environment, Health & Safety and Hygiene Department holds staff environmental training sessions once a year, themed on generating revenue by reducing the environmental impact of our everyday operations. In other words, in our training we adopted the bottom-line approach that "ecology equals economy" as we worked to instill the importance of recycling. Staff awareness changed as a result. Now the question "Can't this be recycled, too?" has become much more frequent.

I believe that this question describes in simple words the concept behind the priority themes of Environmental Vision 2021. At present, MEAA-MSN and MEAA-MVL* hold quarterly management reviews and other activities that are designed to reduce our environmental impact companywide. Going

forward, we will work to encourage associates to share the concepts of the environmental vision as we take the next step along the path to our goal of zero emissions.

* MEAA-MVL: Mitsubishi Electric Automotive America — Maysville, in Maysville, Kentucky



Environmental Calendar

This calendar features environmentally themed pictures drawn by the children of MEAA-MSN employees.



Plastic Tubes into a Calculator

An employee came up with this idea of turning scrap into a calculator, which is used at local elementary schools. This is considered reuse activity



Scrap Wood into Bird Houses

Birdhouses made of scrap wood from incoming packaging. The first houses are being built for purple martins. The next step will be bat houses. This is also considered reuse activity.

Environmental Topics

Recycling of Waste Plastics



Technology for Large-scale High-purity Plastic Recycling

The home appliances industry is currently engaged in efforts to recover waste plastic from used home appliances and recycle the plastic in other products. Such initiatives seek to reduce the amount of new resources required by new products. Mitsubishi Electric aims to constantly be at the forefront of waste plastic recycling for its plastic recovery technologies, recovery volume and recycling quality. This section outlines some of our successes in this area.

Large-Scale, High-Purity Plastic Recycling

An overview of our work to establish closed-loop recycling with 100% recycled materials by utilizing precise separating technology developed exclusively by Mitsubishi Electric for mixed, shredded plastics.

[More](#)

Technology for Separating Plastics

An overview of our process for separating mixed plastic at high levels of purity.

[More](#)

Technology for Improving Plastic Quality

A discussion of technologies for improving the quality of recycled materials so that they are in no way inferior to new materials.

[More](#)

Using Recycled Plastic in Products

Examples of products made completely with materials recycled from used home appliances and commentary by the engineers involved.

[More](#)

Large-Scale, High-Purity Plastic Recycling

Aiming for 100% Closed-loop Recycling

When plastic that has been recovered from used home appliances is recycled, it is typically recycled into knick-knacks, imitation wood and other such products, a process called downgrading. However, this also means that resources must be continually consumed. What is really needed is closed-loop recycling—recovering plastics from old products and recycling it in new products.

Hyper Cycle Technology for Closed-loop Recycling

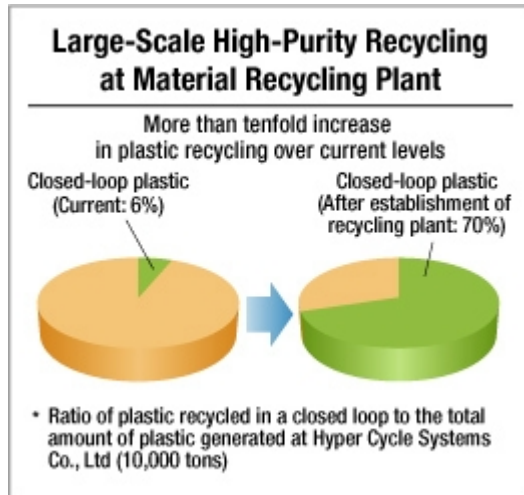


Conventional plastic recycling is usually limited to plastic parts made of a single material that is easy to separate out. Moreover, separating and recovery are conducted manually, so only around 10% of the plastic can be retrieved from the recycled product; the remainder is incinerated or landfilled.

In order to make it possible to create products out of 100% recycled materials instead of new materials, Mitsubishi Electric took on the challenge of automatically separating, recovering and recycling recyclable materials taken from shredded mixed plastic, a material that had traditionally proven difficult to recycle.

Japan's very first large-scale, high-purity plastic recycling system

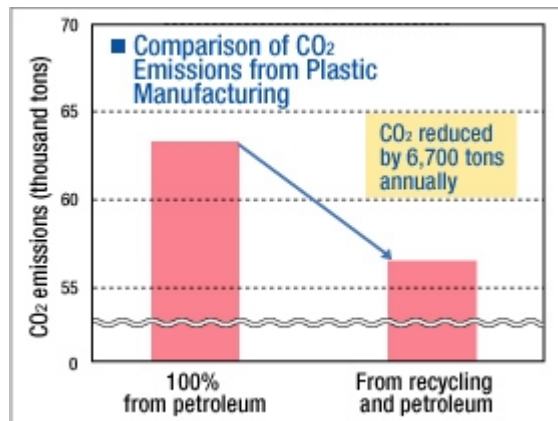
The main types of plastic used in home appliances are polypropylene (PP), polystyrene (PS) and acrylonitrile-butadiene-styrene (ABS). Mitsubishi Electric has succeeded in accurately separating mixtures of these plastics at purity levels exceeding 99%. This high degree of purity is made possible by proprietary technologies for separating different plastics by specific gravity and by electrostatic properties. PP, which is lighter than water, can be separated out using technology for separating by specific gravity, whereas ABS and PS, which are heavier than water and cannot be isolated in this way, are separated using differences in their electrostatic properties. (See the next page for details on these separating technologies.)



Previously, we recycled approximately 600 tons of plastic in Mitsubishi Electric home appliances, out of a total of approximately 10,000 tons generated by our home appliance recycling plant, Hyper Cycle Systems Co., Ltd, a ratio of just 6%. Now, thanks to successfully developing high-purity separating technologies, we recover approximately 6,400 tons of the three major plastics for recycling in our home appliances in a closed-loop system. This represents Japan's very first large-scale high-purity plastic recycling system.

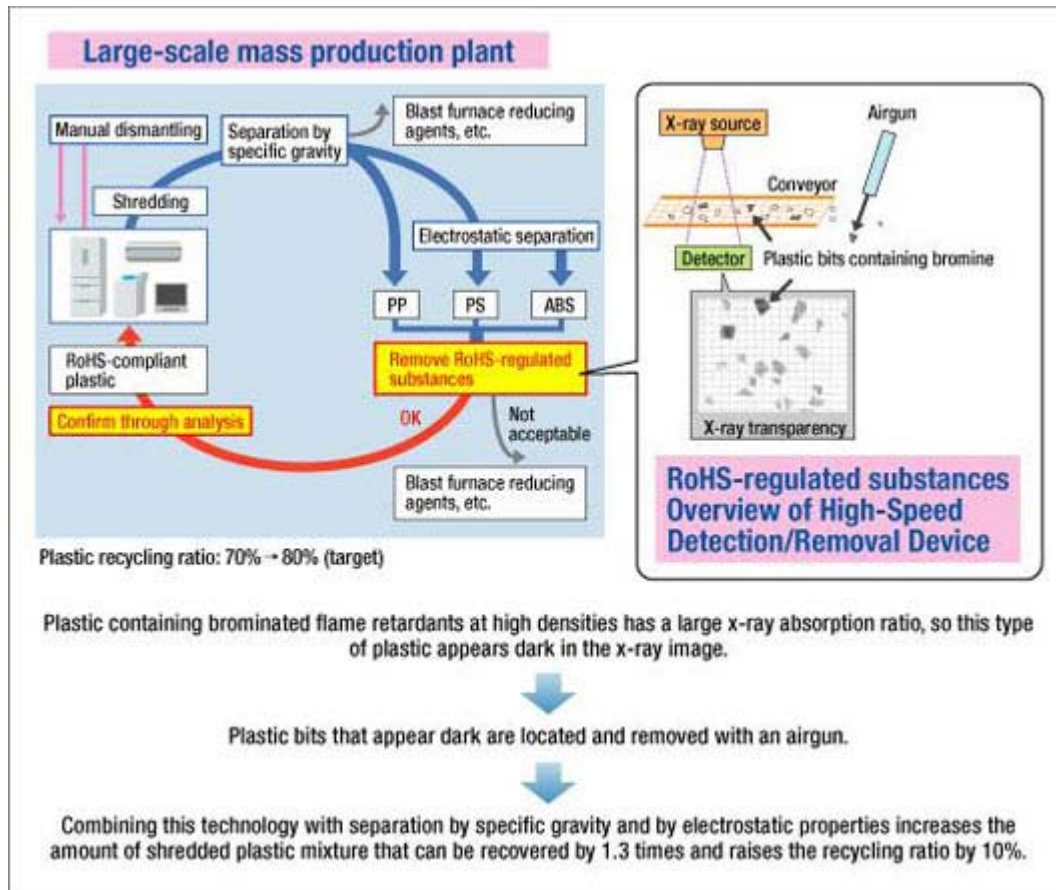
Reducing CO₂ emissions by 6,700 tons annually

Promoting the "3Rs" (reducing, reusing and recycling) for home appliances is one of the pillars of Mitsubishi Electric's Environmental Vision 2021. Our large-scale high-purity plastic recycling system recycles the three major plastics in a closed loop from shredded mixed plastic. The system reduces use of these three major plastics by our home appliances business by around 18%. This translates into less new plastic produced, which in turn reduces carbon dioxide by 6,700 tons annually (Mitsubishi Electric estimate). The kind of closed-loop recycling pioneered by Mitsubishi Electric will be a driving force behind eliminating waste and preventing global warming.



Successfully Developed Technology for Rapidly Removing a RoHS Regulated Substance from Shredded Mixed Plastic

Plastic mixtures being separated for recycling sometimes contain flame-retardant plastics with very small amounts of high-density bromine. However, compliance with the EU's RoHS Directive is a critical part of recycled plastics in home appliances. Currently, flame-retardant plastic is removed by utilizing its high specific gravity and setting a low specific gravity to separate out compliant varieties. With this method, however, it is exceedingly difficult to increase the amount of plastic recovered. But, in February 2009, Mitsubishi Electric succeeded in developing a new technology for rapidly and automatically detecting and removing brominated flame retardants from PP, PS and ABS. In 2010 we plan to apply this technology to mass production lines at our home appliance recycling plant.



* RoHS Directive: An EU directive on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment. Restricts use of six types of hazardous substances: lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ether. Cadmium content must be less than 0.01 wt% (content percentage on same substance basis); the other substances must have a content percentage of less than 0.1 wt%.

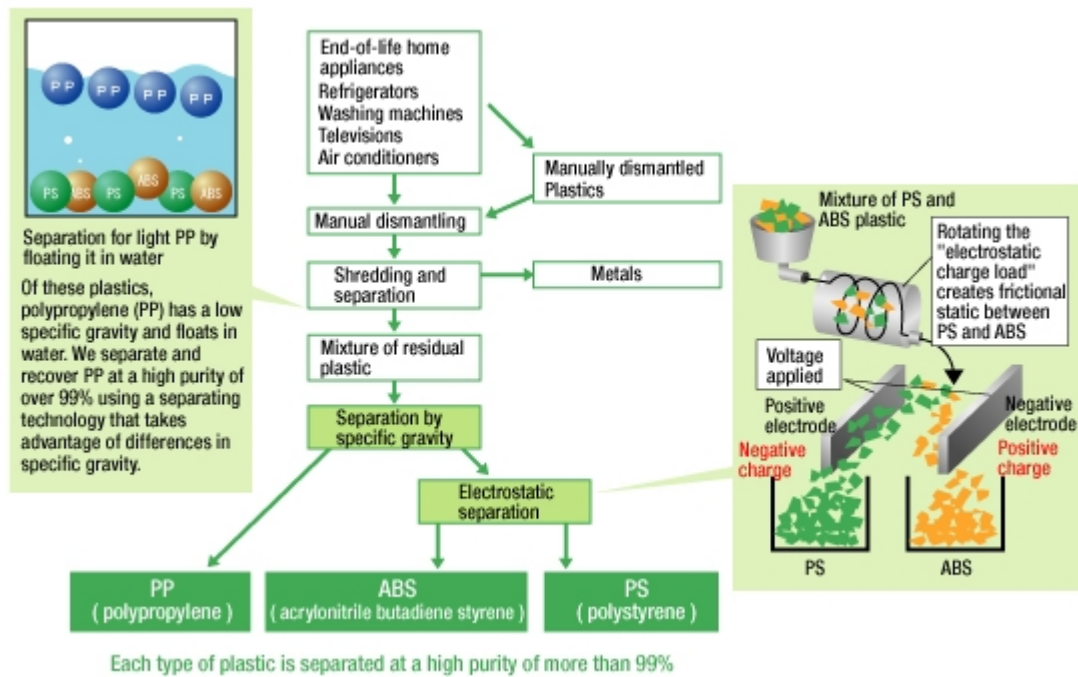
Recycling of Waste Plastics

Technology for Separating Plastics

Separating Plastics at High Levels of Purity and High Recovery Rates

To make closed-loop recycling a reality, it is first necessary to separate out usable plastics from the used home appliances that have been collected. Mixed, shredded plastic used to be exceedingly difficult to separate, but Mitsubishi Electric has developed a proprietary method for separating plastics based on their respective characteristics. This method enables plastics to be separated at high levels of purity and high recovery rates.

Process for Separating Mixed Plastic at High Levels of Purity

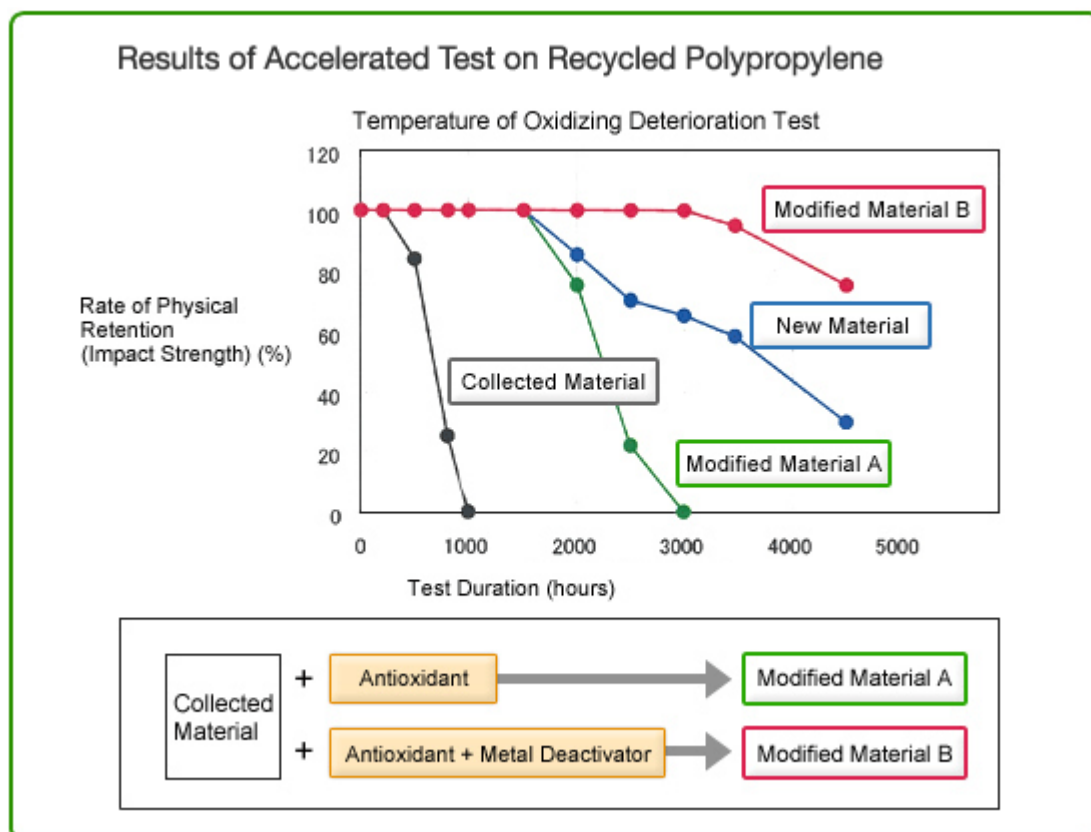


Technology for Improving Plastic Quality

Making Recycled Plastic Even Better Than New Materials

In order to be used in home appliance products, recycled plastic materials must be of high quality. High purity is one of the keys to ensuring quality. We have almost entirely resolved this issue through our separating technologies. However, the quality of plastic materials can deteriorate over time due to oxidation and other causes. For this reason, recycled plastics were not capable of being used in home appliances, which require long-term durability, and were generally only used in downgraded products.

To resolve this problem, Mitsubishi Electric quantified the remaining lifespan of collected plastic and designed a new quality improvement formula with the optimal formulation of additives to prevent the deterioration of recycled materials. We succeeded in creating recycled materials with quality that is by no means inferior to new materials. We also made it possible to give recycled materials durability that exceeds new materials and added properties like fire resistance. Through this proprietary quality improvement technology, we not only eliminated concern over the quality of recycled products but also opened up major new frontiers for recycled materials.



Note: Accelerated testing is a testing method in which a product is placed under extreme conditions that simulate actual usage and intentionally degraded in order to verify its lifespan.

Recycling of Waste Plastics

Using Recycled Plastic in Products

Where Recycled Plastic is Used

Refrigerator drain pans



Lower covers on dishwashers



**Plastic recycling has much potential.
We will continue to innovate and polish our technologies.**

We introduced our plastic recycling initiatives at the Eco-Products exhibition held in December 2008, and they caused quite a stir. We had many questions, but the most common was about price. In recent years recycled products have started taking root in day-to-day life, but many people tend to think of eco-products as somewhat expensive. Mitsubishi Electric has worked very hard to keep costs as low as possible in order to promote widespread use, and as a result our recycled plastic costs about the same as new materials, or even a little less. Everyone I talked to about this was pleasantly surprised.



Katsumi Fujisaki
Recycling Systems Group



Plastic Recycling Booth at Eco-Products
garnered much attention

The next most common question was about how the plastic is actually separated. I explained how we separate the plastic using water and static electricity while illustrating the process with a simple experiment. Water and static electricity are so common and well known that many people were very impressed. Children who visited our booth were especially interested in the experiment. It is often noted that fewer young people are studying science, so I hope that this experiment also helped in some small way to turn some kids on to science.

Plastic recycling technology holds much potential. We have developed that potential day after day and increased what we can do little by little. In introducing some of these technologies at the exhibition, we had the opportunity to meet many people and directly get a sense for people's high level of interest. We will continue to innovate and polish our technologies and do our part to create a future with a healthy, flourishing natural environment.

Environmental Topics

Towards Zero Emissions



The Environmental Vision 2021 program is a demonstration of the Mitsubishi Electric Group's commitment to achieving zero emissions status and promoting the 3Rs (reduce, reuse, recycle) in order to help bring about a recycling-based society. Completely eliminating waste that goes directly to landfills requires that waste be efficiently reused and recycled. Based on proposals made by local area environmental managers, Mitsubishi Electric has initiated a recycling system involving the coordinated efforts of multiple local production areas in June 2007. This type of system is actually quite rare in this industry, so it has garnered the wider attention of the industry as a leading example of progressive cross-regional waste recycling.

▶ Birth of a Recycling System

A group of environmental managers that met while attending a training course have successfully developed a completely unprecedented recycling system. Learn about the system and how it was developed.

[More](#)

▶ Recycling Examples

Learn about the coordinated efforts of local production areas involved in recycling cushioning materials, polystyrene foam and waste cooking oil and provides details on our recycling logistics.

[More](#)

▶ Future Development

Key environmental personnel discuss their thoughts on recycling and their future ambitions.

[More](#)

Birth of a Recycling System

Collaboration Begins with Environmental Training

In 2004 Mitsubishi Electric was faced with the retirement of a considerable number of experts who had long been involved in environmental management. So we initiated a training program for key environmental personnel with the aim of training a group of employees to play a leading role in our environmental management activities. This training program proved to be the genesis of recycling activities that cut across our local production areas.

Until the training program, key environmental personnel at our various manufacturing works had little opportunity to get to know one another. Through their conversations while attending the training course they learned that they shared many of the same challenges. This led a group of key personnel who worked close to one another in the Kansai region of Japan to form the Environmental Managers Committee with the aim of facilitating communication on environmental matters. The first committee meeting was held in April 2005. The participants discussed their various activities and shared their own expertise with one another. Talk centered on the problem of waste disposal. What began with how to make the management of waste disposal contractors more efficient ended up shifting to the fundamental problem of how to reduce waste.

The Kansai Waste Recycling Working Group

At the time, the company's manufacturing works already had established processing methods for dealing with various types of waste and it was thought that there was little room for improvement. The committee, however, soon discovered that waste categories and amounts differed at each site and that things classified as waste at one site were being bought as supplies at another. As these discoveries were made they came to appreciate the importance of working together. So in April 2005 the Kansai Waste Recycling Working Group was established under the committee. The working group was Mitsubishi Electric's first project team dedicated to recycling that encompassed multiple production sites.

From Reuse of Cushioning Materials to Recycling of Waste Products

The working group felt that reusing cushioning materials would be feasible right away. A considerable volume of cushioning materials used to package parts is generated as waste every month at the company's Kobe area sites, where large products like plant equipment for social and public institutions are manufactured. Itami Works, which makes electric components for automobiles, requires a large volume of cushioning materials to ship its products. In June 2006 we began supplying cushioning materials from Kobe to Itami, and the company took its first step toward coordinated recycling.



The project to reuse cushioning materials was eventually expanded into a recycling program for waste plastic sheeting and polystyrene foam that involves coordination among the Kita-Itami, Himeji and Ako Works. This has been further developed into a system by which waste from the various production sites is consolidated at one site, compacted and provided to an outside contractor that turns it into recycled plastic products. In addition, using waste cooking oil from employee cafeterias to manufacture bio-diesel and then using it to fuel forklifts was another idea that we successfully made a reality.

A Recycling Logistics System that Eliminates Waste

A key question we sought to answer was, where should we bring waste and where should it be processed in order to improve efficiency? After an overall picture of waste reduction and recycling emerged, we next considered how to reduce carbon dioxide emissions in transportation. After considering various proposals, the Kobe, Itami and Kita-Itami Works inked a chartered delivery contract with one of the Kobe Works waste haulers and designed a transport route that would keep trucks fully loaded when moving between Kobe, Itami and Kita-Itami. For trips to the Ako and Himeji Works, which don't require anything from Kobe to be delivered to them, we made a request to the transport company that makes deliveries to customers in Himeji and Ako to stop by Ako and Himeji Works and load the truck with waste plastic sheeting and waste polystyrene foam for the return trip to Kobe.

Through this process, in June 2007, we completed a recycling system that promotes effective resource utilization via an environmentally conscious logistics system involving the coordinated efforts of our five manufacturing works in the Kansai region. The system was very well received outside the company as well, so much so that it was honored with the Chairman's Prize by the 2008 3R Promotion Persons of Merit Awards. We are also proactively providing information on the initiative in order to widely publicize it. These efforts have included exhibiting at the 2008 Environmental Fair in Ako and presenting recycling examples in the Kansai region to visitors as a part of the "City Factory Quiz Bus Tour" put on by the city of Kobe.

Our recycling logistics system has garnered attention for pioneering new possibilities in recycling. In November 2008, we launched a working group for the Kyushu region to move towards further expanding the scope of the system.



Recycling Examples



Recycling Cushioning Materials

Cushioning materials that are no longer needed at Kobe and Kita-Itami are collected at Itami Works and reused as packaging material for product shipments. A specially chartered delivery truck is used to deliver the materials from Kobe to Itami. On its return trip, the truck is loaded with waste plastic sheets and waste polystyrene foam produced by Itami. When the route passes through Kita-Itami, the truck is loaded with cushioning materials, waste plastic sheets and waste polystyrene foam at Kita-Itami, the cushioning materials are dropped off at Itami, and the truck returns to Kobe Works after being loaded with Itami's waste plastic sheets and waste polystyrene foam. The system has reduced cushioning material purchases by Itami Works by around half, saving both costs and resources.



Genichiro Sasaki

Environmental Promotion Section, Production System Department, Semiconductor and Device Management Division
Semiconductor and Device Group

At Kita-Itami Works, in the past we had only thought of waste in terms of semiconductor waste, but thanks to this experience I have realized the importance of everyone aligning their thinking, and not just thinking in terms of the narrow world of semiconductors. This recycling system has captured the wider attention of the semiconductor industry. We reported on the system in February 2008 at an international conference of the Japan Electronics and Information Technology Industries Association, and it was quite well received as a novel approach to resource recycling.

Recycling Polystyrene Foam and Polyethylene Sheets

Waste polystyrene foam and waste polyethylene sheets are processed at a recycling center that has been established on the premises of Kobe Works. The waste plastic sheets and waste polystyrene foam produced by five of our manufacturing works, including Kobe Works, is collected together and processed all at once via compaction. The waste plastic sheets and waste polystyrene foam are collected from the Itami and Kita-Itami area on return trips from delivering cushioning materials. They are collected from the Himeji and Ako Works on return trips from making deliveries to customers. After the waste polystyrene foam and sheets have been compacted, the material is sent to a recycling contractor and turned into recycled plastic products.



Yasuo Kugimoto
Environmental Management Group
Production Management Department
Himeji Works

In actuality it is more economical to thermally process polystyrene foam than it is to recycle it. In the past at Himeji we had it thermally processed by a vendor, but since this recycling method impacts the environment, we thought that it would be better to utilize material recycling even though it costs more. By consolidating recycling at Kobe, we've created an even more efficient, economical system. We plan to continue to expand by drawing on initiatives taking place at our various sites.



Kenichi Yoshioka
Ako Production Management Section
Production Systems Department
Transmission & Distribution Systems Center

At the Ako Works, we formerly had an outside company thermally process polystyrene foam as a part of our ISO 14001 initiatives. However, I felt that integrated recycling at Kobe Works would be more effective in terms of reducing environmental impact.

At the Satoumi Symposium held recently in Ako, there was a presentation on participating in a project to have elementary school students grow eel grass and help make the local marine habitat suitable as a home for porpoises. I think this activity speaks to the fact that we as a company are engaging in these recycling initiatives out of respect for the earth's limited resources.

Recycling Waste Cooking Oil

Equipment for producing bio-diesel was installed at Kobe Works' recycling center in June 2007. Waste cooking oil, which is produced in large volumes everyday by employee cafeterias, is collected and turned into bio-diesel using the equipment. The bio-diesel is then used to fuel forklifts and other vehicles at Kobe Works. Currently, all of the applicable work vehicles at Kobe Works run on bio-diesel, which helps to reduce the plant's environmental impact. We are also considering collecting waste cooking oil from local residents and cafeterias at other sites in order to further the environmental benefit of this program.



Yuji Ouchi

Environmental Promotion Group
Production Systems Department
Energy & Systems Center

Himeji and Kita-Itami Works handle smaller sized products, so they use electric forklifts to haul things around onsite. At Kobe Works, however, the products are larger, so they require vehicles with diesel-powered engines. We have cafeterias almost everywhere and they all produce waste cooking oil, so by adjusting output of waste cooking oil based on whether or not diesel is needed, we have improved the situation both in terms of waste and fuel.

Future Development

Building a Recycling System Helps Foster Environmental Awareness Looking Forward to the Challenge of New Initiatives



Yuji Ouchi
Environmental Promotion Group
Production Systems Department
Energy & Systems Center

With everyone thinking as a team about waste we were able to view the company as a whole from various perspectives. We realized that logistics is extremely important in building a recycling system, and we learned that judgments have to be made on whether it is better to haul something far away to recycle it or dispose of it at a nearby location instead.

I secretly hoped that this new initiative would raise the environmental awareness of equipment designers and manufacturing managers by providing feedback for their primary jobs. I felt that knowing how much waste we produce and directly experiencing the importance of recycling would inspire more designs and manufacturing processes that do not produce waste. As soon as the project got underway, environmental awareness increased dramatically at Kobe area sites. Mitsubishi Electric acquired its first Type III Eco Mark (part of Eco Leaf labeling, a program for evaluating a product's environmental performance). Other manufacturing divisions are currently developing similar systems. Moreover, in the Kyushu region, work has begun on building a recycling

governance system that encompasses our affiliates. I'm always happy to hear this kind of news. I look forward to taking on the challenge of new initiatives and continuing to help foster an environmental mindset within the company.

Scaling Up Activities and Developing the Entire Company's Potential

I think it is important that we think about the cost of waste when manufacturing products. We need to calculate the cost of waste that is generated and think about what can be improved to eliminate things that aren't necessary. If we do this, waste volume will go down while productivity goes up. Whether waste is sold or recycled, ultimately, it consists of things that aren't needed. Thinking about how to stop generating things that aren't needed is itself environmental management.

The working group's next goal is to scale up. We want to increase the types of waste handled by the system and increase the range of people involved. We also want to expand geographically to other regions. The system we built centers on the Kobe Works, but one can also imagine a system centering on the Ako Works that coordinates with Himeji Works and Fukuyama Works or one centering on the Kita-Itami Works that coordinates with Itami Works and Kyoto Works. Our goal is to have all domestic manufacturing works coordinate with one another so that each site is participating in various systems. We hope to develop the potential of the entire company, including the head office.



Tetsuji Nishino
Manager, Environment & Infrastructure
Maintenance Section
Production Systems Department
Itami Works

Environmental Topics



Mitsubishi Electric Outdoor Classrooms— Development and Merits

Experiencing nature is paramount in fostering environmental awareness. To help people experience the wonder of nature, Mitsubishi Electric carries out a hands-on outdoor classroom program led by employees and conducted in nature classrooms across Japan. In the three years since this program commenced, the enthusiasm over our outdoor classrooms has steadily increased. The development and merits of this program are featured below.

▶ Outdoor Classroom Objectives

This program is designed to bring participants together with their colleagues and families to spend time in a natural setting while working toward a common goal in classrooms that are created by employees themselves. Find out more about the concept behind the Mitsubishi Electric Outdoor Classrooms program.

[More](#)

▶ A Handmade Virtuous Circle

The hands-on creation of classrooms by employee leaders represents an integral aspect of the Mitsubishi Electric approach. Through trial and innovation, the classrooms have become increasingly appealing. Find out more about the growing number of employee leaders and the evolution of the program.

[More](#)

▶ Reports from the Field

Mitsubishi Electric aims to provide an enjoyable and rich experience to program participants. Learn more about how program leader ingenuity is driving the further development of the outdoor classrooms.

[More](#)

▶ Mountains, Seaside and Parks: Outdoor Classroom Case Studies

Learn more about unique outdoor classroom activities to date.

[More](#)

▶ Nature Conservation Leader Perspectives

Novice and veteran leaders discuss their innovative approaches and share what they have learned so far. Read more about their experiences and future aspirations.

[More](#)

Fostering Environmental Awareness

Outdoor Classroom Objectives

The everyday lives of employees and their families can be transformed by experiencing nature together

Mitsubishi Electric Outdoor Classrooms represent an effort to inculcate an environmental awareness within the broader context of the company's Environmental Vision 2021. The classrooms themselves are natural settings such as woodlands and waterways, parks and seacoasts where employees and their families can experience nature together. The ultimate objective of each outdoor classroom is to cultivate behaviors that positively impact the environment while fostering an awareness of our symbiotic relationship with nature.

We believe that providing employees and their families with a chance to share experiences outside their daily work or home lives can change the way they think about the environment, which in turn will positively impact their actions in the workplace and at home. For example, by encouraging program participants to consider how the disposal of a certain product might be harmful to the ecosystem, or whether there might be alternative methods of production that utilize resources more effectively, both knowledge and understanding are enhanced. With this enhanced knowledge and understanding, we hope that each family member will approach daily activities such as electricity use from a more environmental perspective.

In recent years, respect for biodiversity has become an increasingly prominent environmental issue. Becoming acquainted with various forms of wildlife in our outdoor classrooms cultivates empathy with nature. This is the basis for respecting biodiversity.

(See Concept 1 in below diagram)

Steadily Increasing the Number of Employees Who Become Leaders and Create Classrooms

Another integral aspect of Mitsubishi Electric Outdoor Classrooms is the role of employees as teachers (nature conservation leaders), who are responsible for planning and managing the program. Twice a year, in spring and fall, leader candidates from all over Japan attend a two-day training seminar where they learn how to become nature conservation leaders. The seminar involves practical training and fieldwork fully utilizing all five senses in a mountain setting, and the cultivation of the knowledge and skills required to lead in the classroom, including how to communicate with children, emergency first-aid procedures and other critical subjects. Upon completion of the seminar, the new leaders return to their respective workplaces and apply their training toward the creation of their own outdoor classrooms.

In this way, by increasing the number of leaders who actively communicate the importance of environmental issues, we are able to inculcate environmental awareness among our employees and their families in Japan and throughout the world, spreading the message outward in an ever-widening circle. Despite this seemingly diminutive gesture by a single enterprise, we nevertheless believe that we can contribute to raising environmental awareness throughout society.

(See Concept 2 in below diagram)



Our Perspective on Biodiversity

We recognize that our business activities involve the use of a variety of raw materials, and our chemical substance emissions and waste place a burden on biodiversity. We believe it is the responsibility of humans—merely one constituent of nature's vastly diverse offerings—to understand, sustain and respect our natural environment. To our minds, this is the true meaning of "environmental awareness." Accordingly, we take an active role in fostering environmental awareness, both as a corporate entity and from the standpoint of the individuals that make up the company, as we strive to protect biodiversity. Coming into contact with living things through environmental preservation activities is a starting point of fostering environmental awareness.

Based on the belief that the environment is an asset we share with future generations, we consider environmentally conscious management a topmost priority. To the extent that their activities interact with society and the natural environment, we believe companies are duty-bound to be proactive in maintaining harmony with their surroundings. We take these responsibilities to heart through our ongoing initiatives to preserve biodiversity.

Fostering Environmental Awareness

A Handmade Virtuous Circle

Leaders Create Outdoor Classrooms through Ingenuity Based on Their Personal Experiences

Based on the experience gained at training seminars, outdoor classroom leaders give free range to their creativity in planning nature classrooms. The duration, type of participants and targeted nature field of the classroom are all left freely up to the leader, with no predetermined constraints. Plans for the precise impressions they wish to give to participants, what they wish to communicate amid their selected natural settings and other parameters are prepared individually by each leader.

The rationale behind this approach stems from utilizing the ingenuity of leaders by making optimal use of the impressions and discoveries that they themselves gained through actual experience. This is the essence of Mitsubishi Electric Outdoor Classrooms. Of course, outdoor classrooms created by amateurs are not always guaranteed to progress according to plans. However, we believe that there are also opportunities for learning that arise precisely because they are not veterans. During outdoor classrooms, there are unexpected instances where participants show enthusiasm for some aspect of the session not foreseen by the leader, and the entire group begins focusing on that facet. This, too, is an important aspect of learning. Through such opportunities, the leaders themselves are able to develop even greater environmental awareness.



Classroom-based leader training seminars cover how to communicate with children, emergency first-aid procedures for onsite accidents and program creation.



Knowledge-based leader training seminars involve observing fauna and flora with interest and respect.



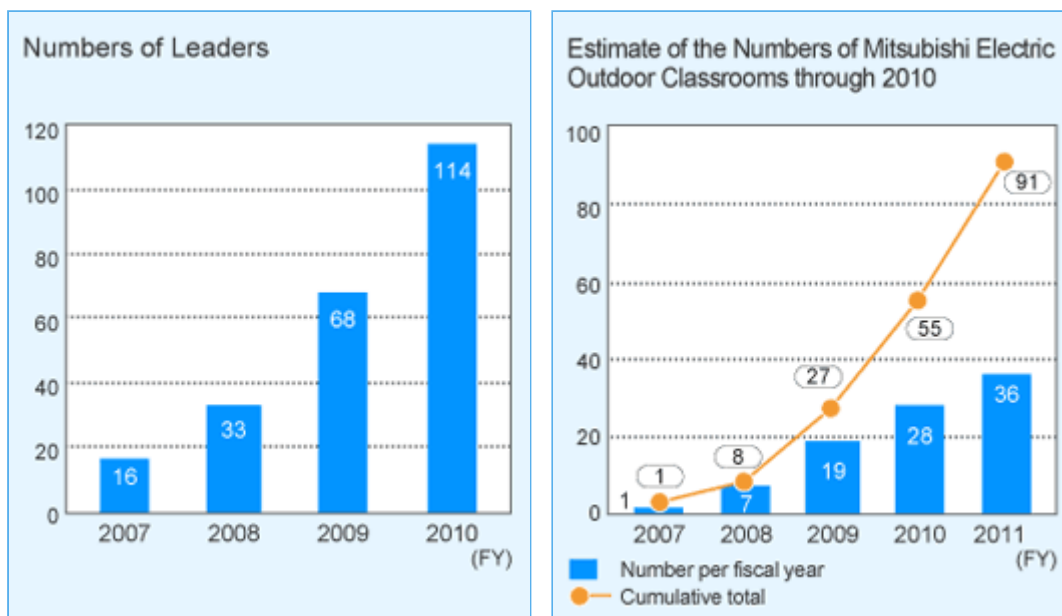
Practical training incorporating all five senses is also indispensable.

The Succession of New Leaders Results in the Development of Many New Outdoor Classrooms

Following the inauguration of the Mitsubishi Electric Outdoor Classroom program in October 2006, the number of leaders expanded from 34 to 68 in a year and half. The number of employees participating in the program on their own initiative is increasing, demonstrating the potential for further growth in the future.

During the past year, the variations in classroom plans have also become more replete. There has been enthusiasm for greater specialist knowledge that could lead to even more interesting discoveries and repeat attendance to gain an even deeper understanding. In response, plans have been formulated in cooperation with the Japan Outdoor Lifestyle Promotion Association, the Wild Bird Society of Japan, local experts and other external specialist sources, in addition to plans that interweave nature observation with handicraft workshops and programs that combine environmental themes with aspects of dietary education. By reflecting on previous activities, some classrooms have enhanced the program by providing improved goods. The classrooms continue to develop as the number of leaders grows. In addition, we now see some cases inspired by outdoor classrooms held in other areas.

These developments represent a welcome phenomenon that were not anticipated at the outset of the program. This virtuous cycle is a unique feature of Mitsubishi Electric Outdoor Classrooms. We wait with anticipation for further changes the future will bring.



Environmental Report: Environmental Education & Awareness →

Environmental Report: Fostering Environmental Awareness →

Reports from the Field

Report 1: Taking Part in Rice Planting and Observing Waterside Wildlife in Motegi (May 16, 2009)

Motegimachi, in the southeast of Tochigi Prefecture and home to scenic rice paddies, was the stage for our rice planting experience. This was the second rice planting workshop, and it began on the bus en route to Motegimachi. The purpose of the exercise is planting rice, which is inextricably linked with food. At the suggestion of the leader, a little workshop was held with a discussion about rice paddies, under the theme of dietary life. The leader conducted an ongoing quiz, with such questions as "How many grains of rice in a rice bowl?" while explaining various facts about the crop, its yield and the role of rice paddies. Any related subjects can be freely incorporated into outdoor classrooms: this, too, contributes to making them interesting. (By the way, the answer is 3,300 grains of rice in a 75g rice bowl!)

Once we finally began the actual rice planting, we realized the difficulty of getting the rice stalks to stand up straight. The children had the same difficulty, but they were taught the art of planting stalks straight by their fathers, who were setting a fine example themselves. Spending time in this way is an important experience for both parents and children.

Having gotten used to planting, the conversation naturally shifted to the harvest in the fall. As we progressed with sowing of the individual stalks, we wished for a bountiful crop. Completing a sweep of the paddy made us painfully aware of how demanding it is to work in that crouching position. Although you can buy rice in a shop, you can't buy a challenging experience like this. One of the messages of the outdoor classroom was intended to be gratitude—to farmers and for food.



And now, some discussion about rice paddies.



In the paddies together...Walking is difficult.



Looking good...



No, no. Don't pull up the ones you've already planted.



Croak! Croak!



Here's the frog I caught.



Standing up straight and gazing out over the rice paddies, enthusiastically searching for wildlife.



I'll be back to see you again.



In silence: Almost finished planting.



Finished! A heartfelt day's work.

The smaller children were intrigued by the living creatures in the paddies. Under the guidance of the leader, they caught frogs, tadpoles and diving beetles for more thorough observation. The leader had brought along magnifying glasses, which proved to be extremely popular. These had been overlooked at the previous event, which was one case of reflecting on former activities and learning from them.

On the way home some of the participants mentioned that it had been an enjoyable day and they would like to come back again. Another theme of the outdoor classroom was experiencing the cycle of nature: we are planning a return trip for the fall to see the harvest. By then, perhaps new leaders will have emerged from among the participants at this outing.

The venue was Aburayama Nature Sanctuary, which is a forest plentiful with wildlife amid wetlands formed from spring water. Our guests for the lecture were a group of cute and lively children who attend a preschool near the Kyushu Branch.

Looking back on last year's outdoor classroom, there was something to learn and apply to this year's classroom: principally to take things on a case by case basis; and that children simply cannot be hurried. If there are too many predetermined observation points to be taken in, we tend to hasten through, leaving the children unsatisfied, which was an important lesson learned last year. Children are fascinated by so many things, and they respond differently, some wanting to forge ahead, others to take their time and look at their leisure. It is important to maintain a flexible frame of mind, allowing the children to become absorbed in something of interest that they stumble upon, and conversely to skip over any points that do not grab their attention.

Plunging into the forest with their magnifying glasses in one hand, the children soon found plenty of interest—particularly small insects and other little discoveries. In addition, we shared in studying things that they had heard of but never seen in their everyday lives, such as ant-lions, and in playing with bamboo-leaf boats and carrying out other activities. Another new experience during this event was making things from natural materials with their own hands.



Starting a lively day by getting to know each other.



At the start of the orientation, even the leader looked a bit nervous.



Look at the ragged edge where the slugs have been eating...



The rocks in the water hide great things.



Look for doodlebugs!



Hand-made bamboo-leaf boats. And they're off...!



Rotten tree stumps—highlight of the nature walk!



There are lots of different river crabs.



Items that proved to be very popular.



Memories of an enjoyable day—playing bingo!

Touching the mossy tree stumps was a definite highlight of the day. The rotten parts of the trees break down and return to the Earth, and fallen seeds sprout and grow once more into trees. These were valuable points gleaned from the day's activities. Mitsubishi Electric, working in the manufacturing sector, is necessarily involved in the recycling of resources. It is our fervent hope that Mitsubishi Electric Outdoor Classrooms make it easy to communicate the patterns and cycles of nature, which provides valuable assistance in the growth and development of children. This was a strong focal point for the event.

Previously, leaders had all been drawn from general affairs departments, but from this fiscal year there will be new leaders from the personnel, accounting and sales departments. With this enhanced project team, we should be able to offer activities to various local residents that only Mitsubishi Electric is in a position to deliver.

Message from the Secretariat

When the activities began in 2006, we were really just finding our way. Our starting point was fraught with uncertainties: whether the site would accept the project as an approach to environmental measures, whether enough people would be interested in attending and whether we could get our intended message across. I remember that we, as novices, were unsure about the feasibility of the philosophy of the Japan Outdoor Lifestyle Promotion Association—the organization that we externally contracted for leader training seminars— "to find the impact that humanity has on the environment and cultivate people who will act."

Looking back after three years, the staff who participated in leader training seminars translated this philosophy into practice by finding distinctive themes in a variety of areas to communicate the transience of the cycles of nature and life, and our symbiotic relationship with nature. General employees then emerged to support the lectures, influenced by the devotion and energy of the leaders. Knowing how interesting lectures can be when properly conducted, leaders ingeniously cultivate enjoyment for other participants as well as for themselves.

One of the most inspiring things about holding outdoor classrooms has been to hear from the kindergarten teachers of the children who participated, now in their third year of elementary school, that along with their parents they are separating garbage and thinking about conserving resources. This trend can be traced back to their participation in Mitsubishi Electric Outdoor Classrooms. Although the event itself may have occupied only a couple of hours, the activities undoubtedly play a part in cultivating people who consider the environment.

Mitsubishi Electric Outdoor Classroom activities bring a smile to the face of so many people, not only participants and organizers. Over the next three years, we plan to extend the program at a rate of five sites per year. We shall continue with these endeavors within reason and look forward to the understanding and support of many people who can share this enjoyment through nature across a wider area.



Yoshio Isogai
Corporate Environmental Sustainability
Group, Strategic Planning

Looking for water stick insects with the children for the first time in 20 or 30 years reminded me of Japan's abundant nature.



[Environmental Report: Environmental Education & Awareness](#)

[Environmental Report: Fostering Environmental Awareness](#)

Mountains, Seaside and Parks: Outdoor Classroom Case Studies

In October 2006, we held the first Mitsubishi Electric Outdoor Classroom in the locality of the Mitsubishi Electric head office. These activities have spread nationwide, with the total number of events reaching 39 as of July 31, 2009, to the benefit of a total of 1,400 participants. Some examples from this unique program are outlined below.

26th Mitsubishi Electric Outdoor Classroom: Rediscovering Acorns! (Chugoku Branch)

November 29, 2008

Location: Peace Boulevard, Naka-ku, Hiroshima

The Chugoku Branch planned a Mitsubishi Electric Outdoor Classroom as a subsidiary event to its ongoing Flowerbed Promotion Activities (known locally as Kapora) for employees and their children. The only materials required were the fallen acorns around the flowerbeds. The gathered acorns were named according to their different roles: "insect food" for those that were already eaten by worms, "leaf shoots" for those that had begun to sprout, and "kids toys" for the ones that were intact. Each acorn was examined thoroughly by the children, who listened intently to explanations of the role of acorns in the wild. Further, we made acorn cookies, which everyone tried while offering additional thoughts on the subject of food. Younger employees from the branch also participated in the event as candidates for wildlife conservation leaders, raising their awareness of the program and its contents.



Studying acorns retrieved from beneath the fallen leaves and wondering where the roots will sprout from.

(Answer: The roots are always from the pointed end.)



Baking acorn cookies...surprisingly good to eat!

23rd Mitsubishi Electric Outdoor Classroom: Learning about Nature through Games (Sagami Site)

November 22, 2008

Location: Kanazawa Shizen Park, Yokohama

"A quiz rally in the forest!" "Let's look at things through a magnifying glass." "Found an acorn!" "Let's pick up leaves." These were some of the comments that were heard when the Sagami site held a Mitsubishi Electric Outdoor Classroom, which featured an elaborate game format. For example, "Let's pick up leaves" meant clearing the fallen leaves until we could see the soil and then learning about such things as the role in nature of millipedes, wood louses and other insects that live beneath the fallen leaves and how the leaves are broken down and restored to the soil by mushrooms and other fungi. The participants ranged from nursery and kindergarten through elementary school pupils. The consensus of the elementary school students was that the lecture gave them the opportunity to make new discoveries through hands-on experience as opposed to from learning in the classroom.



Raking over leaves and finding an unexpectedly good smell—even a casual stroll can lead to a wealth of opportunities for observing nature.



Learning from a textbook then experiencing through nature brings knowledge to life.

23rd Mitsubishi Electric Outdoor Classroom: Making Dolls from Twigs after Nature Observation Workshop (Nagoya Site)

November 22, 2008

Location: Togokusan Prefectural Forest, Moriyama-ku, Nagoya

We planned a Nature Observation Workshop for Parents and Children to enjoy with the aim of experiencing natural beauty and the importance of conservation, and at the same time working up a refreshing sweat in a rich natural environment. A total of 33 employees and their family members participated in the event. A forestry instructor from the Aichi Moriyama Shizen no Kai (Aichi Natural Woods and Mountains Nature Group) came along to help out by telling us plant names and characteristics, turning the event into a full-blown nature workshop. The children took renewed interest in the familiar trees and wild flowers, forging ahead to forage nuts from the trees and gather up fallen leaves. Later, we had a go at making twig dolls with guidance from the Aichi Moriyama Shizen no Kai. The children proudly took the completed dolls home to show their parents after struggling with the unfamiliar tools.



An exhilarating walk along autumn forest paths, with rich variation among the mixed trees and a fascinating world to examine through a magnifying glass constantly attracting children's interests.




The forestry instructor's explanations stimulate thinking about nature, and children and adults alike take the opportunity for spiritual growth.

31st Mitsubishi Electric Outdoor Classroom: Bringing Parents and Children Together for a Day by the Sea (East R&D Laboratory, Ofuna)

May 23, 2009

Location: Katase-Enoshima coast

We planned this outdoor classroom at the Katase-Enoshima coast with the idea of promoting a deeper understanding of aquatic life in the surrounding seas through hands-on experience. This outdoor classroom was held as part of an annual seining event sponsored by the local fishing cooperative. Held this year for the second time, the outdoor classroom drew 235 participants, including employees and their families. As in the previous year, we invited guides from the nearby Enoshima Aquarium to explain the characteristics of various aquatic life caught in the net that day, as well as other fish selected beforehand. Following these explanations, a short cooking class was held as the fish caught that day were prepared for eating. After the meal, participants experimented with recycling the oil used in frying the tempura into soap.

▶ With the cooperation of the Enoshima Aquarium 



At the fisherman's call, participants heave on the rope connected to the fishing net. The catch contains an unexpected variety of fish and shellfish.



Curious children becoming acquainted with many new varieties of fish: "What's that? And that one? Why is that fish shaped that way?"

Fostering Environmental Awareness

Nature Conservation Leader Perspectives

The role of the wildlife conservation leader is to make each and every participant feel how precious, interesting and surprising nature is and help them make to new discoveries. There are both novice and highly experienced wildlife conservation leaders in attendance. Some examples of ingenuity in planning and experience gained from Mitsubishi Electric Outdoor Classrooms are given below, along with aspirations for the future.

Aiming to provide a forum for family communications

Jun Takahashi

Mitsubishi Electric Trade Union, Head Office Branch

The Creatures of the Sea Observation Workshop held in May 2009, was my first opportunity to act as a classroom leader. What I was most conscious of at the planning stage was the large number of young children who would participate. Concerns were expressed that: "of course they will learn about the environment. What we need to do is to create an effective forum for enjoyable communications between parents and children." Accordingly, protection of safety was made a major premise. I drew up provisions covering all the foreseeable eventualities to guard against accidents and injuries and to avoid any children going astray, calling for the cooperation of parents to ensure an event free from incidents.



Before starting, I was unsure as to whether my commentary could hold the interest of the children, but on actually starting to speak I realized that you do not actually need to talk about very much. Simply expressing the minimum to get your point across allows the children to think for themselves and to notice how interesting and important the living creatures are. Learning to guide the kids in this way was an important lesson for me.

Aspiring for Lessons that Can be Enjoyed Again and Again by Children and Adults Alike

Manae Furukawa, Kyushu Branch

A participant at a leader training seminar said how much fun it looked and how much they wanted to give it a try that it got me interested in becoming an outdoor classroom leader as well. I myself am a parent, so empathize with the philosophy of the Mitsubishi Electric Outdoor Classrooms. At first, just talking was the best I could do, but as I gained experience with successive events, I progressed smoothly as I began to enjoy myself more and felt that this was infectious for the children, too.



The Kyushu Branch's Mitsubishi Electric Outdoor Classroom has always been held at the Aburayama Nature Sanctuary. The abundant nature of this locale cannot be exhausted in one or two events, so interweaving explanations for the children attending for the first time with general knowledge that will appeal to their parents to ensure that both parents and children can enjoy lectures time and time again is a skill in itself. Even when handling insects, the children fluctuated between being timid and being boisterous at first. But through the Mitsubishi Electric Outdoor Classroom, we teach them to touch insects gently. Through these methods of teaching, I would like to become a leader who can communicate respect for life to children.

The Knowledge Required to Deliver Lectures Changed My Own Perspectives

Shinichi Sato, Sagami Plant

As an outdoor classroom leader, I try to take in a vast quantity of information. As a result of the influence of television and school lessons, children today are far more knowledgeable about nature than adults expect. Accordingly, they do not necessarily react to what is said to them as expected. And if the conversation moves off at a tangent, we will have to respond flexibly. It means we can never have enough material.



Perhaps because my antennae are always trying to collect information, these days I naturally pay attention to flowers and trees in my daily life. If you take a new look around, nature is never far from everyday life. Just taking a walk in the neighborhood brings you into contact with a surprising amount of vegetation.

In addition to wanting to be popular with students, one of the attractions of the job is that by boosting knowledge and experience I can become the sort of person who notices things that I used to overlook.

Noboru Sakamaki, Nakatsugawa Works

The significance of Mitsubishi Electric Outdoor Classrooms lies in children experiencing nature as it really is and noticing how precious and alluring nature is. This is even the case in Nakatsugawa City, surrounded by pure streams and deep forests.



For children accustomed to the sight of forests and rivers, perfunctory talk is likely to be met with an expression of boredom. Experiences via the sense of taste have the power to change that expression. Tasting a nut gathered from the forest can instantly light up a child's eyes and get a thrilled "delicious!" from his or her mouth. I feel that any Mitsubishi Electric Outdoor Classroom will go successfully if experience using the sense of taste is called into play, bringing a response akin to the surprise of discovering something new.

In addition, the leader's job is to prepare thoroughly to teach because there are so many things that children do not know about on top of taste. Occasionally you will see children putting into practice something they have just been taught. The younger of two brothers who had participated in the Creatures of the Mudflats Observation Workshop, on touching a fish with his bare hands, was warned by the elder that "human hands are hot, so they can give fish burns!" It brought me great joy and I felt the classroom I held was worth something.