

# Consideration for the Environment in Our Products



We believe that one of the pillars of our Mission Statement is to contribute to the environment through our products. By making efforts in design and procurement and implement thorough compliance with laws and regulations, we will continue to promote consideration for the environment in our products in the entire Kawasaki Group.

## Main Efforts of the Kawasaki Group

### Efforts in Design and Procurement

#### Product Assessment

For newly developed and designed products, as well as for particularly important products, we implement product assessment for resources conservation, energy saving, and recycling with the goal of reducing the environmental impacts of products during their lifecycles.

Main product assessment items

1. Product weight reduction
2. Product energy saving
3. Longer product life
4. Product safety and environmental conservation effectiveness
5. Measures for product disposal and recycling
6. Environmental impacts when problems or other extraordinary circumstances occur
7. Provision of information for use and maintenance
8. Compliance with regulations

#### Green Procurement

We are promoting “green procurement” in order to reduce environmental impacts during product lifecycles even at the procurement stage.

The Consumer Products & Machinery Company applies green procurement guidelines to business partners in Japan and abroad, and we request them to identify and manage environmental substances of concern that are contained in procured parts and materials. We also ask these partners to establish their own environmental management systems. For environmental substances of concern, in 2008, we achieved the elimination and reduction targets voluntarily set by the Japan Automobile Manufacturers Association, Inc. (JAMA) for lead, mercury, hexavalent chromium and cadmium. These targets conform to the EU ELV Directive<sup>1</sup>. Moreover, in order to comply with the REACH Regulation<sup>2</sup> and other overseas laws and regulations, we began collecting data on environmental substances of concern designated by GADSL<sup>3</sup>, including substances from our overseas production bases.

<sup>1</sup> ELV Directive: End of Life Vehicles Directive  
<sup>2</sup> REACH Regulation: Regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals  
<sup>3</sup> GADSL: Global Automotive Declarable Substance List

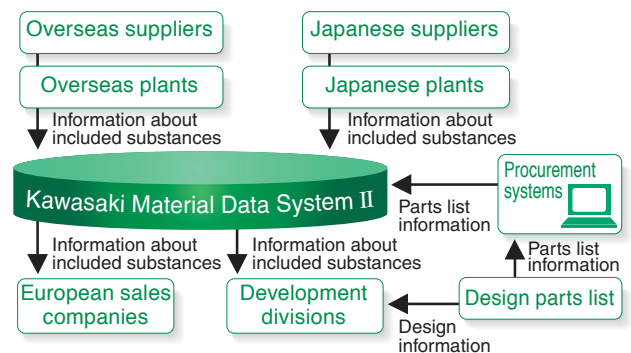
### Responding to the ELV Directive, the RoHS Directive<sup>4</sup> and the REACH Regulation

Since 2000, the ELV Directive, the RoHS Directive and the REACH Regulation have strengthened laws and regulations related to chemical substances in the EU. The RoHS Directive covers electrical and electronic equipment, so some of the products made by our Robot Division and Kawasaki Precision Machinery Ltd. have met the directive. The ELV Directive covers automobiles, but excludes motorcycles. The Consumer Products & Machinery Company, however, is participating in the voluntary efforts of JAMA, and Kawasaki Precision Machinery Ltd. is also applying the directive to some of its products.

The REACH Regulation came into force in June 2007, and it applies to all chemical substances manufactured in or imported into the EU. Businesses that manufacture or import chemical substances in quantities of one ton or more are required to register and report those substances. In addition, there are regulations related to evaluation, authorisation, restriction and communication of information, so it is necessary to have a system to determine information about the chemical substances included in our products throughout our entire supply chain.

The Consumer Products & Machinery Company has created the KMDS II<sup>5</sup> system to collect data about environmental substances of concern that we handle.

#### Response to REACH in the Consumer Products & Machinery Company



<sup>4</sup> RoHS Directive: Directive on Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment  
<sup>5</sup> KMDS II: Kawasaki Material Data System II

## Cleaning Exhaust Gas

In FY2008, continuing from the previous year, we sought to make the exhaust gas of the motorcycles that we sell in Japan cleaner. We began the sales of our ZRX1200 DAEG, which is a large motorcycle model. This model complies with the Japanese motorcycle emission regulations that became much stricter in FY2007. By adopting computerized fuel injection systems, we have made precise control possible throughout the entire rotational range and realized extremely smooth engine characteristics in the rotational range of ordinary use, while obtaining maximum performance at medium and high speeds. In addition to purified exhaust gas this motorcycle has also cleared noise regulations.

Moreover, through the installation of fuel injection systems and other new technologies, we are able to clean exhaust gas, and we are even able to sell motorcycles in Europe that have cleared the motorcycle emission regulations, which became much stricter there in 2006 (EURO-III).



ZRX1200 DAEG

## Promotion of 3R

We have been steadily operating an autonomous motorcycle recycling system in cooperation with three other motorcycle manufacturers and 12 importers in Japan. This effort has had no structural trouble related to receiving motorcycles for disposal.

Using this system, which began in October 2004, we have achieved a recycling rate of 87.8% in its 5th fiscal year (April 1, 2008 – March 31, 2009).

Furthermore, for our new models of motorcycles, we are endeavoring to consider Design for Environment, including reducing materials and recycling, from the development phase. We conduct preliminary evaluations of our efforts related to reducing, recycling and reusing

(3R) at the beginning of each of the design, prototyping and mass production stages. In particular, through the use of materials that are easy to recycle, we are seeking to increase recyclability. Calculating the potential recycling rate based on the “Guidelines for the definition of the potential recycling rates of new vehicles and its calculation method (1998 JAMA),” we have achieved a rate of over 90% for every model, with the majority of models scoring over 95%.

## Elimination and Reduction of Environmental Substances of Concern

For new motorcycles sold in Japan, we have already been achieving the voluntary reduction targets established by JAMA since FY2007. In addition, we have also achieved the voluntary reduction targets for older motorcycle models that we have continued selling.

### Japan Automobile Manufacturers Association “Reduction targets for environmental substances of concern” for new vehicles

Substance	Reduction target
Lead <sup>1</sup>	Use 60 g or less in and after January 2006 (for 210 kg weight vehicle)
Mercury	Use prohibited in and after October 2004 (Exception for the use of minute quantities in parts that are necessary for traffic safety <sup>2</sup> )
Hexavalent chromium	Use prohibited in and after January 2008
Cadmium	Use prohibited in and after January 2007

<sup>1</sup> Used batteries are already recycled and excluded from the target values

<sup>2</sup> Combination lamps, discharge headlamps, etc.

For general purpose engines, JET SKI® Watercraft, there are no Japanese regulations like the JAMA voluntary reduction targets, but we are making elimination and reduction efforts that follow those applied for motorcycles, and we had achieved voluntary reduction targets for lead, mercury and cadmium by FY2007. Hexavalent chromium had been contained in a very small amount of parts, but through the use of substitutes we completed its elimination in FY2008.

# Environmentally Conscious Products

**Plan** We believe that reducing the environmental impacts of products that support the foundations of society and industry, including transportation-related products, industrial plant and equipment, is one of our missions for society. We will continue our efforts to improve environmental performance in the future, through products.

## Transportation-Related Products

In the aircraft industry, we are working with leading corporations in Europe and America in the joint development and manufacturing of fuselages and jet engines, and our technologies are receiving high praise worldwide.

In the rolling stock field, we manufacture a wide range of products, including shinkansen bullet trains, express trains, commuter trains, subway trains, freight trains and locomotives. In response to the demand for increased energy efficiency during operation, we are striving to reduce the weight of train cars and decrease their air resistance as well as improve motor efficiency through technological cooperation with customers and the application of our own technologies. Moreover, we are also advancing new technologies, including our next-generation light rail vehicle SWIMO and our Battery Power System (BPS) for Railways.

In our shipbuilding business, starting with LNG carriers and LPG carriers, we are developing and building a variety of products, including container ships, bulk carriers and crude oil tankers. We are also manufacturing propulsion systems, including diesel engines and steam turbine plants for LNG carriers. In response to the demand for increased fuel efficiency, we are working to develop technologies for optimizing hull forms and increasing the efficiency of propulsion systems.

### Preparing for the Mass Production of the Trent 1000, the Most Advanced Passenger Aircraft Engine

High fuel efficiency

Low noise

We have participated in the development of the Rolls-Royce plc (UK) Trent 1000 from the basic design stage. We are responsible for the design, manufacturing and assembly of the intermediate pressure compressor (IPC) module, which is one of the most important parts for the engine. It has been decided to use this engine for the Boeing 787 Dreamliner, which is being made lighter using the most innovative composite materials. We are also participating in the development and manufacture of fuselages for this aircraft. Through the use of the high fuel efficiency Trent 1000 and lighter-weight fuselages, the Dreamliner will be able to improve fuel efficiency by 20% compared to the previous model.



Trent 1000 transparent illustration



Boeing 787 Dreamliner

### Putting Our Next-Generation Light Rail Vehicle SWIMO and Battery Power System (BPS) for Railways into Use

Energy Saving

Resource conservation (overhead lines unnecessary)

We have developed the battery-driven low-floor light rail vehicle SWIMO, which uses the large-scale nickel-metal hydride battery GIGACELL that we also developed in-house. During braking, the driving motor is used as a power generator, and the electricity that is generated (regenerated electricity) is stored in the GIGACELL. With energy saving greatly increased, we are able to realize operation using the power stored in the GIGACELL in areas without overhead lines to run distances of more than 10 km. We have also developed a BPS for Railways that utilizes the GIGACELL, which features great capacity and ability to charge and discharge rapidly to improve energy efficiency.



SWIMO



BPS for Railways

### Delivery of the LNG BARKA 155,000 m<sup>3</sup> LNG Carrier

High fuel efficiency

Resource conservation (low evaporation loss)

We delivered the LNG BARKA, which is our first 155,000 m<sup>3</sup> LNG carrier. While maintaining the hull dimensions of a 147,000 m<sup>3</sup> carrier, which is a size that is able to enter the major LNG terminals around the world, this carrier has a capacity that is 8,000 m<sup>3</sup> greater. We have greatly reduced the amount of fuel consumption per unit of cargo. For the LNG tanks, we have adopted the “advanced insulation panels (Kawasaki Panel System),” which suppresses the LNG evaporation rate to about 0.15% per day.



155,000 m<sup>3</sup> LNG carrier

Kawasaki Shipbuilding Corporation

### Increased Fuel Efficiency with Electronically Controlled Diesel Engines

High fuel efficiency

With our electronically controlled diesel engine, we have achieved the practical use of a system that is the first in the world to realize operation with one turbocharger disengaged. This system is designed to increase thermal efficiency and improve fuel efficiency by cutting off one turbocharger during partial load operation of an engine. By using this system, we can reduce CO<sub>2</sub> emissions.



Electronically controlled diesel engine

## Industrial Plant and Equipment

We are developing and manufacturing a variety of products that support the foundations of industry, including, large-scale plants for cement, chemicals and nonferrous metals, steam turbines, aerodynamic machinery and other prime movers, as well as industrial robots, hydraulic equipment, and even shield machines and other civil engineering machinery.

For plants, in addition to increasing the performance of rotary kilns, we are developing various other technologies, including fluidized-bed cement kilns that can realize greatly improved energy saving.

We are also working to reduce environmental impacts from prime movers, including increasing the efficiency of all types of steam turbines and aerodynamic machinery, by using our advanced fluid dynamics technologies and mechanical device technologies.

In the field of industrial robots, we are responding to a variety of needs, including for assembly, handling, welding, painting and sealing, and we are providing automation systems that contribute to increasing efficiency as well as energy saving.

We are developing various hydraulic equipment products for industrial machinery, particularly emphasizing construction machinery. In order to respond to market demands for energy saving and low noise, along with improving our hydraulic equipment, we are also working on developing technologies for entire systems.

Compared to methods that excavate from the surface, the excavation of tunnels using shield machines is a very efficient way to work, and it also has few impacts on the environment. We are seeking to further reduce environmental impacts by reusing internal parts of shield machines and enabling excavation of any cross-section shape.

### Kawasaki MAG-Turbo, an Aeration Blower That Increases Energy Saving in Sewage Treatment Plants

Energy Saving

Low noise and low vibration

In sewage treatment plants, aeration blowers are the greatest consumers of energy. We developed the high-efficiency Kawasaki MAG-Turbo in order to resolve this problem. By allowing high-speed revolution while maintaining mechanical noncontact using magnetic bearings, we have created a blower that is high-efficiency, is good for energy saving and produces very little noise and vibration. With the Kawasaki MAG-Turbo, we have also realized a compact package that incorporates the control system. Its outstanding features have been evaluated highly, and we had received orders for 38 units by the end of FY2008.



Kawasaki MAG-Turbo

### New Spot Joining Technology—Friction Spot Joining (FSJ) Robots

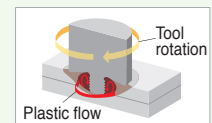
Energy Saving

Resource conservation (equipment reduction)

Instead of resistance spot welding or rivet joining, the FSJ robots that we have developed conduct a completely new type of spot joining on light metal alloys, including aluminum alloys and magnesium alloys. While a joining tool is rotated, the tool is forced into the overlapping metal plates, and the frictional heat softens and mixes metals to join them together. Compared to resistance spot welding, the amount of electricity consumed is less than 1/20, making high-capacity power reception systems unnecessary and thus reducing equipment costs.



FSJ robots



Joining overview

### Development of Energy-Saving Inverter Systems for Industrial Machines

Energy Saving

Low noise

We have developed the KESV Series of energy-saving inverter systems for hydraulic pumps. By detecting the pressure holding status of the hydraulic system and automatically controlling the rotation speed of the hydraulic pump, the power consumed while holding pressure is greatly reduced. In one example of an actual application, we achieved a reduction of up to 50% in power consumption while holding pressure. We have prepared a series for 1.5 – 22 kW electric motors, and many have also been employed in facilities for machining our products.



Energy-saving inverter system

Kawasaki Precision Machinery Ltd.

### Reducing Impacts on the Surface and Underground Environments — Our Shield Machine That Uses the APORO-Cutter Method

Reduced impacts on the surface and underground environments

Kawasaki and Kajima Corporation have jointly developed a new APORO-Cutter (all potential rotary cutter) shield machine that can excavate cross-sections of any shape. This machine allows the tunnel cross-section to be as small as necessary, decreasing the amount of excavated soil and realizing reduced impacts on the surface and underground environments.



APORO-Cutter shield machine

# Environmental Solution Products

**Plan** We are developing environmental solution products that are useful for directly improving and conserving the environment, and providing these products to society. We will seek to contribute to the sustainable development of society by improving their performance and developing new technologies.

## Energy-Related Products

We have numerous high-performance products, including gas turbines, steam turbines and various types of boilers, and we are providing a range of energy systems that incorporate these products to locations around the world.

We have a long record of achievements with high-efficiency power generation systems, including combined cycle power plants (CCPP), which are plants that combine gas turbine power generation with steam turbine power generation using the heat from the gas turbine, and gas turbine cogeneration systems that use the heat from gas turbine power generation to make steam and hot water. Moreover, we have developed Green Gas Engine power generation systems, which have the world's highest power generation efficiency, in 2006. With these products, we have a lineup that can meet the demands for heat and electricity use ratios of various users.

In addition, among technologies that use renewable energy, we have woody biomass power generation systems that use wood chips and thinned wood as fuel, photovoltaic systems, small-scale hydraulic power generation systems and bioethanol production technologies.

Furthermore, we are also actively striving to advance technologies that efficiently use waste heat recovered from various plants, including those that make cement, chemicals, iron and nonferrous metals.

### Completed Production of 100th M7 Gas Turbine

Use of high-efficiency energy

NOx reduction

Since delivering our first M7 gas turbine, which is especially for cogeneration, in 1994, we have completed production of more than 100 of these units in total. This is a first for this class of gas turbine in Japan. We have added the 7,000 kW M7A-03 to our lineup. This model has the highest level of efficiency in the world. In FY2008, we received our first order for a power generation system that includes the M7A-03D from Germany. By replacing an existing coal-burning boiler power generation system with this product, CO<sub>2</sub> emissions can be expected to be reduced by about 30% (30,000 tons per year).



Interior of M7 gas turbine

### Completion of Verification Test of Green Gas Engine Power Generation Systems

Use of high-efficiency energy

NOx reduction

At our test plant for Green Gas Engine power generation systems, we completed one year of verification test (4,000 cumulative hours). The KG-18, which is the largest model in the series (18 cylinders, 7,800 kW), achieved the world's highest power generation efficiency at 48.5% and a low NOx level of 160 ppm (O<sub>2</sub>=0% conversion). As a result, denitration equipment has become unnecessary in most regions in Japan. Utilization in cogeneration systems is also possible, and the overall heat efficiency in this case exceeds 85%.



Green Gas Engine power generation system

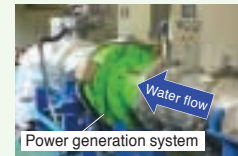
### Development of Compact Small-Scale Hydraulic Power Generation Systems

Renewable energy

Use of previously unused energy

Low noise and low vibration

We have developed compact, small-scale hydraulic power generation systems (ring waterwheels) and succeeded in realizing a product lineup. Small-scale hydraulic power generation enables the utilization of previously unused hydraulic power energy for small-scale power generation. Through the incorporation of water-lubricated bearings, we have achieved an oil-free, low-noise and low-vibration design. Our lineup includes units ranging in capacity from 20 kW to 500 kW.



Power generation system (40 kW) installed in a pipe

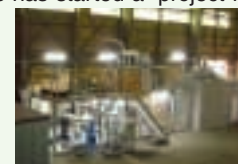
Kawasaki Plant Systems, Ltd.

### Bioethanol Production Technology That Uses Rice Straw

Renewable energy

Use of previously unused energy

The Ministry of Agriculture, Forestry and Fisheries has started a "project for the establishment of technologies for the effective use of soft cellulose," and we were selected to be a project leader along with the Akita Agriculture Public Corporation. We are seeking to establish bioethanol production technologies that use rice straw and rice husks. In the rice straw saccharification process, we plan to use a "hot water-type" bioethanol production technology. This new technology, which we jointly developed with NEDO, does not use sulfuric acid.



Pilot plant during joint development with NEDO (at Okinawa Kyuyo Seito)

Kawasaki Plant Systems, Ltd.

We have various types of technologies related to waste heat recovery boilers, which are the core of these energy-efficient technologies, and we are realizing high reliability in their application.

Waste Heat Recovery Power Generation in cement plant that uses this waste heat recovery boiler is very effective in reducing CO<sub>2</sub> emissions and is receiving great attention in China and Southeast Asia.

## Waste Treatment and Recycling-Related Products

We began developing waste treatment technologies early on, and we have various types of refuse treatment technologies, including incineration systems and gasification and melting systems, for urban refuse. In addition to delivering these types of systems all over Japan, we are also providing various types of industrial waste incineration systems (for power generation).

We are developing and supplying recycling systems, including refuse-derived fuel (RDF) production systems, bulky waste crushing and recycling systems, and PET bottle recycling systems. Moreover, we were the first in Japan to realize an activated carbonization system for sewage. In these ways, we are striving to recycle wastes and reduce final waste disposal amounts.

## Environmental Pollution Prevention-Related Products

To improve the atmosphere, we make flue gas De-SO<sub>x</sub> systems to treat the combustion exhaust gas from boilers, and we have delivered a great number of these systems in Japan and abroad since the 1970s.

For the improvement of water quality, we are developing and providing new systems that contribute to increasing the performance of sewage and sludge treatment systems.

### Contributing to the Reduction of CO<sub>2</sub> Emissions with Waste Heat Recovery Power Generation (WHRPG) in Cement Plant

Effective use of waste heat

WHRPG in cement plant recovers heat from exhaust gas in a cement plant by waste heat recovery boilers and generates electric power using steam turbines. This electric power can cover about 30% of the electricity consumed by the entire cement plant, and we have gained a reputation for high reliability even in the difficult conditions of a cement plant waste heat recovery boiler. Since delivering our first WHRPG in cement plant in 1980, we have a record of delivering over 100 units (including some under construction) in Japan and abroad. Through this, we are contributing to the reduction of CO<sub>2</sub> emissions.



WHRPG in cement plant

Kawasaki Plant Systems, Ltd.

### Delivery of a Cutting-Edge Refuse Treatment System

Use of high-efficiency energy

Waste recycling

We have delivered a cutting-edge refuse treatment system to the Clean Association of TOKYO 23. The concepts of this system are to increase the efficiency of waste power generation and to pursue technologies for the effective use of residuals. The system is comprised of a fluidized-bed gasification and melting furnace and a plasma ash melting furnace that we have developed in-house. The system has cleared dioxin emission standards, exhaust gas regulations, wastewater regulations, ash leaching regulations and other strict standards.



Refuse treatment system (Clean Association of TOKYO 23)

Kawasaki Plant Systems, Ltd.

### Delivery of the First Activated Carbonization System for Sewage in Japan

Waste recycling

Energy saving

We have delivered the first activated carbonization system for sewage in Japan to the Tainai City Nakajo Cleanup Center in Niigata Prefecture. This system dries, carbonizes and reactivates sewage sludge, and produces activated carbon products that can be used as substitutes for commercially-available activated carbon. By enabling the effective use of sludge without incinerating it, this system contributes to both the recycling of waste and energy saving.



Main unit of the carbonization furnace

Kawasaki Plant Systems, Ltd.

### Flue Gas De-SO<sub>x</sub> Systems Utilized in Japan and Abroad

Improving the atmosphere

Flue Gas De-SO<sub>x</sub> systems remove sulfur oxides from the exhaust gas emitted by power generation boilers and various types of industrial boilers for the purpose of preventing air pollution. We have accumulated over 30 years of research and improvements to complete the development of technologies that offer high performance, outstanding energy saving and reliability.



Flue gas De-SO<sub>x</sub> system (Saudi Arabia)

Kawasaki Plant Systems, Ltd.