

Environmental Solution Products

Energy-Related Products

We have numerous high-performance products, including gas turbines, gas engines and various types of boilers, and we are providing a range of energy systems that incorporate these products to locations around the world. We are also working on renewable energy technologies (woody biomass power generation, photovoltaic power generation, small-scale hydraulic power generation, etc.) and clean energy technologies (hydrogen and LNG facilities, etc.).

As to gas turbines, we have an article entitled “Developed the L30A new-model gas turbine for power generation” in the CSR report 2011 booklet version (P.13).



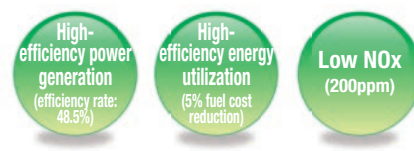
L30A gas turbine

1 First Order for Kawasaki Green Gas Engine, with World’s Highest Electrical Efficiency

In March 2011, KHI received an order from a major Japanese chemical maker for a cogeneration system using the 7,800kW Kawasaki Green Gas Engine. With electrical efficiency of 48.5%—the world’s highest—and NOx emissions below 200ppm (O₂ = 0%), the revolutionary Kawasaki Green Gas Engine presents excellent cost-efficiency and environmentally friendly qualities. Specifically, compared with other gas engines in the same output class, the Kawasaki Green Gas Engine cuts fuel costs by more than 5% and its low NOx level obviates the need for NOx removal equipment under normal circumstances. In addition to being compact and lightweight, the Kawasaki Green Gas Engine features an electric spark ignition system, which precludes the use of liquid fuel, so it

can maintain high electrical efficiency over a wide operating range from 30% to 100%.

KHI constructed the Kobe Power Center, a 5,000kW in-house power plant driven by the Kawasaki Green Gas Engine, at its Kobe Works to acquire greater know-how on in-house power generation solutions through practical operation of its own system.



Kawasaki Green Gas Engine at Kobe Power Center

2 Waste Heat Recovery Power Generation (WHRPG) in Cement Plant

KHI’s waste heat recovery power generation (WHRPG) in cement plant works by recovering heat from exhaust gas released in the cement production process. This system is drawing attention from around the world as a clean power-generating technology that does not emit CO₂. The system can generate enough power to cover about 30% of the total electricity needs of a cement plant.

KHI has expertise in waste heat boilers, which can tolerate high-temperature gas above 1,000°C and exhaust gas containing large amounts of dust, and its waste heat boilers for cement plants, with very challenging requirements, are known for their high reliability. Since delivering its first WHRPG in cement plant in 1980, we have built more than 160 systems for cement plants in Japan and overseas. Some of

these projects are still under construction. Many orders for these systems have been received, mainly from China and other parts of Asia, including South Korea, but also from Europe, including Germany and Turkey.

Aggregate power generation by systems in use is around 1,900MW, which has contributed to a reduction of more than 13 million tons of CO₂ emissions per year.



WHRPG in cement plant in Pakistan

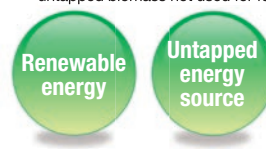
3 Successful Production of Bioethanol from Rice Straw

Working with Akita Agriculture Public Corporation, KHI participated in an initiative launched by Japan’s Ministry of Agriculture, Forestry and Fisheries to establish bioenergy technology utilizing soft cellulose^{*1}. We were responsible for the production of bioethanol and road tests using the fuel, while Akita Agriculture Public Corporation was responsible for raw material gathering and transportation. In October 2010, verification tests using rice straw to produce bioethanol suitable for automotive fuel were successful. The demonstration plant, in Katagami, Akita Prefecture, can produce as much as 200 liters per day. KHI designed and built the entire plant, from pretreatment facilities to saccharification, fermentation, distillation and dehydration processing facilities. The plant utilizes proprietary breakthrough bioethanol production technology using heated water to

saccharify rice straw. This technology cuts the cost of production since it does not use sulfuric acid or enzymes, which the conventional saccharification process requires.

The demonstration will continue through the fiscal 2013, with the goal to reduce the cost of production to a level favorable to commercialization.

^{*1} An open project by the Ministry of Agriculture, Forestry and Fisheries to establish technology for producing biofuel from soft cellulose, such as rice straw, an untapped biomass not used for food use.



Bioethanol demonstration plant

Waste Treatment and Environmental Pollution Prevention Products

We began developing waste treatment technologies early on, and we currently have various such technologies for treating urban refuse, including stoker-type furnaces, fluidized bed gasification and melting furnaces and direct gasification and melting furnaces. We have delivered leading-edge waste treatment systems all over Japan.

To prevent pollution, we have worked with a number of technologies to protect and improve air and water quality. We have addressed boiler and other combustion gases since the 1970s by developing flue-gas desulfurization systems, and have delivered a number of these in Japan and abroad, where they are improving air quality.

4 KHI Awarded Municipal Contract for Combined Waste Incineration/Biogas Generation Complex

In June 2010, KHI received an order from the city of Hofu, Yamaguchi Prefecture, for a combined waste incineration/biogas generation complex—the first of its kind in Japan. The complex will include a sorting facility, where organic waste appropriate for biogas generation is separated from combustible waste, and a biogas generation facility, where the separated waste is converted into biogas using a dry thermophilic methane fermentation process. Any remaining waste and methane fermentation residue will be incinerated at a high temperature under a low air ratio in a parallel flow incinerator with mechanical stoker for efficient energy production. The combination of sophisticated waste-processing technologies boosts the efficiency of energy recovery

for the entire complex and delivers superior performance, with maximum generating capacity of 3,600kW and generating efficiency of 23.5% under normal waste-processing operations. Electricity generated on-site is sufficient to power the entire complex with surplus available for sale to local power companies. This contributes to reduced CO₂ emissions.

Note: This complex received an award in the 10 Best New Products category at the 53rd awards event in January 2011, sponsored by *Nikkan Kogyo Shimbun*.



Combined waste incineration/biogas generation complex

5 Flue-gas Desulfurization Systems Utilized in Japan and Abroad

Flue-gas Desulfurization 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 experienced about 40 years of research and improvements to complete the development of technologies that offer high performance, outstanding energy-saving and reliability. Kawasaki has delivered 42 flue-gas desulfurization plants to various industries and electric power companies in Japan and 59 plants abroad, including China, Southeast Asia and Europe. We also license technologies abroad. In recent years, we are promoting R&D for developing

countries and the standardization of design, and we are making efforts to put a competitive price in addition to energy and resource saving through such measures as developing compact absorption towers.



Flue gas Desulfurization System (Saudi Arabia)

Effect of CO₂ Emissions Reduction through Products (For major products delivered in fiscal 2011)

Field	Effect of CO ₂ Emissions Reduction	Major Products	Technologies, Remarks
Energy-related products	313,000t-CO ₂ /year	• Gas turbine cogeneration system	1, 2
		• Gas engine power generation system	1
		• Binary turbine power generation system	3
		• Waste heat recovery power generation in cement plant	3
		• High-efficiency boiler system	2
		• Absorption Chiller/Heater	2
Transportation-related products	38,000t-CO ₂ /year	• Next-generation mid-sized Boeing 787 (reduced weight)	4, shared production
		• LNG carriers, LPG carriers, bulk carriers (improved propulsion capabilities)	4
Industrial equipment and other products	64,000t-CO ₂ /year	• Sewage aeration blowers (Kawasaki MAG Turbo series)	5
		• Electro-hydraulic hybrid system (Kawasaki Eco Servo)	5
		• Cement kiln-using plant turning waste into fuel	3
Total	415,000t-CO ₂ /year	—	—

Technologies: 1. High-efficiency power generation; 2. High-efficiency energy use; 3. Waste heat/exhaust energy use; 4. Reduced fuel costs; and 5. Energy-saving equipment and other systems

CO₂ emissions reduction effect calculation reference points:

- (1) Emission factors for electricity, heat, fuel and other types of energy were set to comply with the manual for the Law Concerning the Promotion of Measures to Cope with Global Warming.
- (2) CO₂ emissions reduction effect through improved efficiency is based on a comparison with products before replacement or with standard products on the market.
- (3) All energy derived from the use of waste energy and energy produced from waste products is counted toward the CO₂ reduction effect.