

For a Prosperous Earth, Society, and People

Together with Clean Energies

Kawasaki's Natural Gas Technology

"Natural gas" is a clean energy with low CO₂ emissions. Kawasaki offers a variety of technologies in the field of supply and application of natural gas, ranging from production, transport, receiving, storage to efficient power generation systems.

Increasing Demand for Clean Energy "Natural Gas"

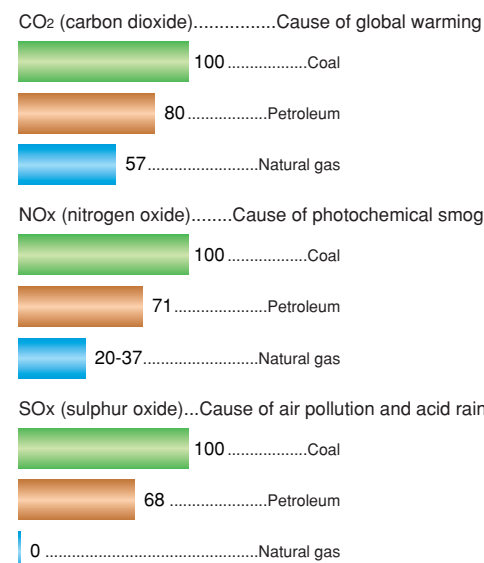
Natural gas is found in abundance in many parts of the world and has been expanded to use for stable energy source. Another feature of this resource is that it emits less CO₂ (carbon dioxide), NO_x (nitrogen oxide), and SO_x (sulfur oxide) when burned than other fossil fuels. The popularity of the cleanliness of natural gas is rising amid the globally growing importance of urgent measures to prevent global warming.

We are the first Japanese shipbuilder of LNG (liquefied natural gas) carriers; we manufacture gas compression module built in production plant, construct natural gas-receiving and storage terminals, and develop cogeneration systems that utilize natural gas efficiently. An effective use of those technologies related to natural gas allows us to help enrich lifestyles, develop industries, and reduce impact on the global environment.

Let's look at the routes of natural gas from producer to the user in Japan, specifically from production to transport, receiving and highly-efficient use, together with the technologies Kawasaki uses for this.

Cleanliness of Natural Gas

Comparison of CO₂, NO_x and SO_x emissions when burned (relative to coal as 100)



Source: Natural Gas Prospects to 2010 (1986), International Energy Agency; Report of the Corroborative Study of Assessment of the Impact of Thermal Power Plants on the Atmosphere (1990), The Institute of Applied Energy

3 LNG Transport



LNG carrier, Energy Advance, navigating with the load of 145,000 m³ of LNG

Liquefied natural gas is transported on LNG carriers equipped with cargo tanks for LNG. Safer and more efficient transportation of a huge volume of -162°C LNG requires various advanced technologies. As the first Japanese shipbuilder of LNG carrier in 1981, we are building many LNG carriers using our accumulated valuable expertise and experience.

A detailed description of the LNG carrier is shown on page 9.

The Route Taken by Natural Gas to Japan and Our Company's Technology

2 Liquefaction and Shipment of Natural Gas



LNG carrier moored to a pier at an LNG liquefaction terminal (photo by Tokyo Gas Co., Ltd.)

Sent to an onshore natural gas liquefaction terminal through a submarine pipeline, natural gas is cooled down to the cryogenic temperature of -162°C to become liquefied natural gas (LNG). Liquefaction of natural gas results in a volume reduction of about 1/600, thereby making highly efficient transport possible.

Kawasaki is examining the idea of conducting business in this field by utilizing our LNG tank technology, as well as its peripheral technologies.

4 Receiving and Storing LNG



LNG receiving terminal and LNG carrier approaching to the pier



Vaporizer that evaporates LNG by heat exchange with hot water

LNG, transported on an LNG carrier and having arrived at the receiving terminal, is temporarily stored in LNG tanks in the terminal. LNG tanks are required to be of strong and safe structure and resistant to temperatures as low as -162°C. Kawasaki was among the first to conduct R&D of onshore LNG tanks, and delivered our first underground LNG tanks in 1982 and our first above ground ones in 1983. The total number of LNG tanks we constructed in March 2007 is 26.

1 Production of Natural Gas



Gas compression module installed offshore

Natural gas produced at an oil/natural gas field is sent to an onshore liquefaction terminal through a submarine pipeline laid on the sea bed. Our involvement here is the supply of gas compression module to pressurize natural gas to the level necessary for transport. Kawasaki has supported the production of the world's natural gas for over a quarter century, and has supplied a total of 49 modules as of March 2007.

5 High-Efficiency Use of Natural Gas



Combined cycle power plant (25 MW) equipped with Kawasaki gas turbine L20A

Kawasaki has developed gas turbine cogeneration systems and combined cycle power generation systems of high efficiency with natural gas, and has delivered them to all over the world.

A detailed description of the highly efficient use of natural gas is shown on page 10.

For a Prosperous Earth, Society, and People

Aiming at Stable Supply of Natural Gas

Kawasaki's Technological Expertise Mobilized to Build LNG Carriers

Natural gas is a primary energy which accounts for about 14% of its kind in Japan, and provides about 25% of all generated power in the power generation field. Kawasaki supports Japan's energy demand with LNG carriers we have built using our advanced technology.

Pride of a Pioneer Kawasaki-made LNG Carrier

As of March 2007, we have built 20 LNG carriers, with tank capacities of up to 145,000 m³, since we built Japan's first LNG carrier in 1981.

Amid the globally rising demand for natural gas and increasing number of LNG carriers, we have been playing a leading role in construction of LNG carriers equipped with spherical independent tanks.



LNG carrier under construction

Spherical Aluminum Alloy Tank with Cryogenic Toughness and Excellent Insulation System

Cargo tanks are required to have the toughness for the extremely low temperature of LNG, and the structural strength for the weight of large volume of LNG and thermal insulation system that can minimize evaporization loss of LNG.

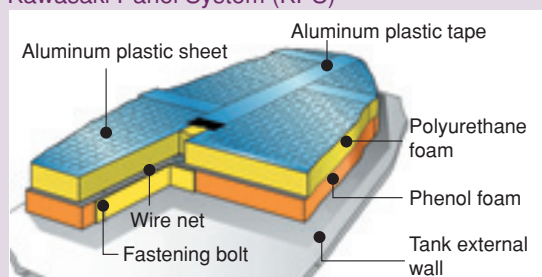


Aluminum alloy spherical tank

Adopting aluminum alloy having the toughness for extremely low temperatures as the tank material, and spherical shape which has the greatest structural strength, we construct LNG carriers. For the thermal insulation, our cargo tank boasts the world's highest class performance, with minimum boil-off rate of 0.1% per day thanks to the advanced insulation panels ("KPS; Kawasaki Panel System" shown in the under drawing) of our own development.

KPS, which is of a highly reliable double structure, achieves excellent insulation performance which enjoys a high reputation on a global scale.

Kawasaki Panel System (KPS)



Energy Carrying Ship that Contributes to Saving Its Own Energy

Ordinary LNG carriers use the steam turbine plant for propulsion in order to make effective use of natural gas evaporated in the tank during LNG transport (boil-off gas). The mechanism generates steam with a boiler capable of using boil-off gas as fuel, rotate the turbine with its high temperature and high pressure steam, and transmit the rolling capability to propellers as propulsive force.

To improve the fuel consumption of steam turbine propulsion plants for LNG carriers, we have developed "Kawasaki Advanced Reheat Turbine Plant" (Kawasaki URA Plant) based on the reheat cycle. In these plant the steam used in the turbine is reheated to improve its efficiency in the later stages, and the driving steam condition is improved (steam pressure and temperature are increased).

The Kawasaki URA Plant improves the efficiency by about 15%, so that LNG ships to carry energy contribute to saving of their own energy.

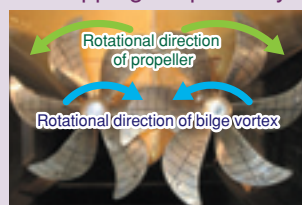


Steam turbine for LNG carrier

Development of High-Efficiency Propulsion Device for Larger LNG Carriers

Kawasaki developed the overlapping propeller system that uses bilge vortices* (patent registered) to obtain high propulsive performance.

Overlapping Propeller System for Large LNG Carriers



Providing two propellers reduces the propeller load and eventually increases propulsive efficiency. Locating each propeller at the center of the bilge vortex of the port and starboard side to utilize the rotational energy of the vortices can further improve propulsive efficiency.

*A set of inward-turning longitudinal vortices occurring on the right and left side of the ship in the stern when the ship moves forward

Toward High-Efficiency Use of Natural Gas

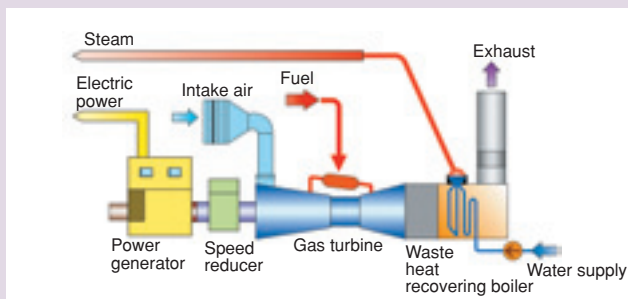
Kawasaki's Cogeneration System and Combined Cycle Power Generation System

Effective use of energy is strongly demanded for Japan which is a great importer of natural resources at the same time it is very important to prevent global warming. Kawasaki's contribution in this respect is application of its technology to highly efficient use of natural gas for the betterment of both society and the environment.

Reducing CO₂ in Two Ways—Effective Use of Natural Gas and High-Efficiency Power Generation System

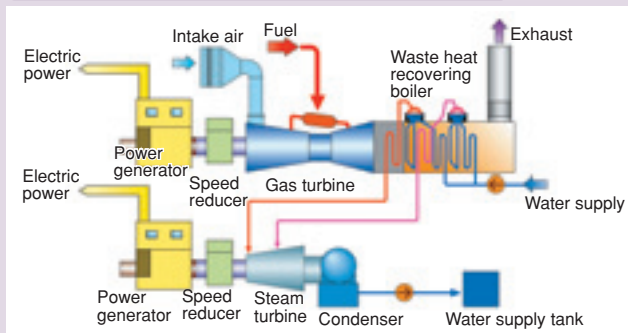
We provide cogeneration systems and combined cycle power generation systems to the market, both of which are fueled by clean natural gas, intended to encourage effective use of natural resources and prevention of global warming.

Cogeneration System



The cogeneration system burns fuel such as natural gas in the turbine or engine to generate electricity and uses waste heat generated from burning to generate steam or hot water.

Combined Cycle Power Generation System



This system is a high-efficiency power generator that generates electricity by burning natural gas with the gas turbine and use the waste heat to generate power with the steam turbine.

Decentralized Power Generation Evaluated Highly for Its Economic and Environmental Performance

The cogeneration system and the combined cycle power generation systems are intended to be installed as small- or medium-class distributed power generations, and can generate power at the right place where it is necessary. Therefore, almost no power transmission loss occurs, and waste heat is reusable. Because of these factors, their energy efficiency is very high; the total thermal efficiency is over 80% for the cogeneration system and the total power generation

efficiency is over 48% for the combined cycle power generation systems. In addition to the economical advantages of such high energy efficiency, these systems enjoy good reputations in terms of energy saving and CO₂ reduction; expectations are also high for both.

Kawasaki's Small and Medium-Class Gas Turbines Occupying Over 60% of the Domestic Share

Our cogeneration system and combined cycle power generation system enjoy worldwide trust for the high technological prowess incorporated into them. The heart of those systems, the gas turbine, is the particular focus of our attention; we have put special energy into its R&D for over 30 years since the first one was developed in 1974. As a result of this long-term experiences accumulation of know-how and good sales records, our systems occupy over 60% of the Japanese share of small- and medium-size types, and enjoy a good reputation in the world at large as well.



Cogeneration system

Kawasaki Also Developed the World's Highest-Performance Gas Engine More Contributions Through Resource Saving and Environmental Improvement

We developed a gas engine with an 8 MW class power output in August 2006, which achieved the world's highest-class power generation efficiency, or 48.5%. It also attained the world's highest-class low NO_x emission capability (160 ppm in O₂ = 0%).

We added the gas engine with power generation efficiency of 48.5% to a line-up of gas turbines ranging from 150 kW to 20 MW to meet the varying needs of users and, at the same time, contribute to resource saving and environmental improvement.



Newly developed gas engine

For a Prosperous Earth, Society, and People

Report on Social Activities from Overseas

Every member of the Kawasaki Group hopes to grow together with the local community as a member of society, through both exchange with and support of local communities as well as participation in communal activities. This page focuses on our activities supporting the local community and outlines the social activities of two U.S. companies very active in support of local societies.

Turning Customers' Support into Our Own Friendliness to Society and the Environment Kawasaki Motors Corp., U.S.A. (KMC)

US Sales Company Paved the Road for Overseas Development

Born in California in 1966, Kawasaki Motors Corp., U.S.A. (herein KMC) grew to be an established sales outlet for the Group selling a variety of products from motorcycles to ATV (all-terrain vehicles), the utility vehicle MULE, and the personal watercraft, with some 550 employees and over 1,500 dealers all over the country. KMC is also active in social activities supporting local communities and promoting environmental conservation.



KMC building

Acting as a Member of Industrial Associations

KMC is a member of various industrial associations related to the products handled, namely, motorcycle, ATV, and personal watercraft, and provides various support activities to the users as such. For example, as a member of the motorcycle association, KMC promote safe use of motorcycles through high-quality education to riders. As a member of the ATV association and the personal watercraft association, KMC is actively communicating with users to provide them with the sense of safety and responsibility.

What We Can Do for Society

KMC is actively involved in the support of social welfare. Their support related to motorcycles is the March of Dimes RIDE, for which KMC is a national sponsor. In FY2006, over 40,000 riders and over 250 riders clubs took part in the charity event, held in various parts of the U.S.A. The profits

from the event were used to support activities to save the lives of premature babies and small children.



Kawasaki Booth in the venue of the March of Dimes RIDE



Riders participating in the March of Dimes RIDE

Activities Supporting Local Societies

As a member of the local chamber of commerce and industry, KMC assists in the growth of the local economy. The vacant spaces in the head office and branch offices are open for off-road riders as a training ground, and the distribution center facilities are also offered for training of drug-sniffing and police dogs.

Environmentally Conscious Activities

KMC, on the basis of our FY2006 environmental conservation activities, was selected as an award nominee of an environmental program sponsored by the state of California to reward companies for excellent achievements in energy saving. KMC attained the reduction of a remarkable 500 tons of refuse that would have been sent to landfill sites. In document control, some 500,000 pieces of paper have been cumulatively saved by in-house computerization.

Efforts to reduce environmental impact is also an established part of sales activities. When ATVs and utility vehicle MULEs are delivered, recyclable metal returnable pallets are used, which have replaced the wooden pallets otherwise used in carrying out 100,000 vehicles a year.

KMC is determined to reinforce their efforts towards environmental conservation, and supporting the betterment of the global environment, while continuing their support on the local level as well.

Pride in Work and Social Contribution

Kawasaki Motors Manufacturing Corp., U.S.A. (KMM)

First Japanese Carmaker in the U.S.A.

Kawasaki built factories in the U.S.A. as the first Japanese carmaker in 1974. The facilities are located in Lincoln, Nebraska, and Maryville, Missouri under the management of Kawasaki Motors Manufacturing Corp., U.S.A. (herein KMM).

Today, over 2,000 workers for the two factories in total have strong senses of responsibility for the quality of their work, and take great pride in what they do.

As for local support, KMM helps develop the local economy, invites companies to its own soil, and propels local prosperity as a member of the local chamber of commerce and industry. Promotion of education and multi-cultural understanding is also one of the arenas they support.



KMM factory in Lincoln



KMM factory in Maryville

Support to Education

KMM provides grants to local universities and schools. The Kawasaki Reading Room was opened in the University of Nebraska in 1992, while responding to the request, to help students learn Japanese. The Room is used by students and local residents to learn about Japanese language and culture.

The Room stores plenty of books and other materials on Japanese language and culture. Today, the Room provides the local society with opportunities to learn a variety of things Japanese, including language, literature, history, religion, business, and politics, through Japanese language and

culture.

KMM conducts various other educational support activities mainly for local educational institutions, including a student exchange program to offer opportunities to study in Japan, a Japanese language learning support fund, scholarships, grants for school activities, and newspaper donation.



People learning in the Kawasaki Reading Room

Participation in Charity Activities

KMM holds and supports a variety of charity events. Their activity in this field is wide-ranging, including participation in welfare events sponsored by the city, contribution to funds, donation of money to funds, support of the physically challenged, participation in drug elimination campaigns, support of the highway patrol, and service as volunteer firefighters.

Business Operation That Is Kind to the Environment

KMM earned ISO 14001 certification in 2003 and started to fully use EMS (environmental management system). The energy savings achieved in FY2006, including the contributions of other energy-saving actions, total to \$250,000.

In recycling, KMM recycled 1,000 tons of cardboard and 13 tons of paper documents in FY2006. They intend to tackle recycling of wastewater in the future.

KMM has just begun environmental management, and is currently aiming to incorporate environmental actions into their daily production activities in a natural manner.