

# Environmentally Conscious Products

## Transportation-Related Products

In shipbuilding field, we develop and build a variety of products, such as LNG carriers and LPG 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.

In rolling stock field, we manufacture a wide range of products, such as Shinkansen bullet trains. In addition to enhancing energy efficiency of rolling stock, we are pursuing energy savings for overall railway systems by developing equipment such as a battery power system for railways.

In aerospace field, we contribute to the advancement of the world's aircraft by jointly developing and manufacturing with leading American and European enterprises.

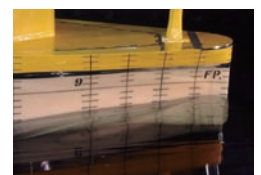
### 1 LPG Carrier Energy-Saving Technology: SEA-Arrow (Sharp Entrance Angle bow as an Arrow) Ship Design

LPG carriers are required to have box-shape tanks arranged forward of the bow for the purpose of efficient arrangement of LPG tanks, so, conventional bow shape generate high wave to form around the bow part during open-sea operation.

New developed bow shape, SEA-Arrow having no protrusion of bulb, keeping the effect of bulbous bow, thereby high propulsive performance is obtained by minimizing the bow waves. In addition, this design offers maximum fuel economy thanks to an ultra-long stroke, low-speed diesel engine for main propulsion and a Kawasaki rudder bulb with fins which reduces energy loss around the propeller.

KHI also gave thought to environmentally conscious features, such

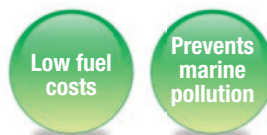
as double-hull construction for the fuel oil tanks, to prevent marine pollution. To date, we have delivered 15 SEA-Arrow LPG carriers, which have been very well received.



SEA-Arrow ship design model



LPG carrier



### 2 Megawatt Superconducting Motor for Ship Propulsion: Highest Domestic Output

KHI has been developing a superconducting motor that can deliver substantial energy saving with research organizations in both the public and private sectors under the support of the New Energy and Industrial Technology Development Organization (NEDO). Verification tests conducted by the Corporate Technology Division with a pilot unit demonstrated the highest output ever achieved with a superconducting motor in Japan and an efficiency rate of 98%.

Superconductivity is a phenomenon that occurs in certain materials: When cooled to ultralow temperatures, they exhibit absolutely no electrical resistance. If this inherent capability can be harnessed, it could significantly boost the efficiency of various devices and systems. KHI has been moving steadily forward on the development of superconducting motors for tomorrow's large-ship propulsion engines and for large

industrial drive systems. As an example, a vessel with a propulsion system utilizing superconducting motor technology would benefit from the high efficiency and the compactness, cutting fuel costs by about 20% compared with ships powered by conventional propulsion systems. Currently, KHI is developing a 3MW service model that will be the world's most efficient superconducting motor and boast the world's smallest footprint.



Superconducting motor pilot unit



### 3 New York Subway is Site for First Overseas Test of Battery Power System (BPS)

GIGACELL, a large-scale nickel-metal hydride battery developed exclusively by KHI enables rapid charging and discharging and quick control response. KHI utilized these features to develop a wayside energy storage system for railways called the Battery Power System (BPS) that contributes significantly to enhanced energy savings and reduced CO<sub>2</sub> emissions. This BPS stores energy—specifically, regenerative energy produced when a train's brakes are applied—for later use. It is this recycling of regenerative energy that optimizes energy saving.

Thus far, the system has caught the eye of the Osaka Municipal Transportation Bureau and, as of fiscal 2011, is being used at a substation on the Tanimachi Subway Line. Verification tests

performed jointly with Tokyu Corporation have demonstrated the potential for high energy savings and lower CO<sub>2</sub> emissions by using BPS. These results were further complemented by the success of a test overseas—our first outside Japan—on a BPS installed between two substations along a stretch of the New York City Transit's A Line.



Battery power system for railways (New York subway verification test)



## 4 KHI Ships Out First IPC Module for Trent XWB State-of-the-Art Passenger Aircraft Engine

The Trent XWB, the newest model in the Trent engine series from Rolls-Royce of the United Kingdom, has been tapped to power the A350XWB, a state-of-the-art passenger aircraft currently under development by Airbus S.A.S. in Europe. This engine improves fuel efficiency by about 15%, compared with existing engines, and dramatically reduces noise as well as CO<sub>2</sub> and NO<sub>x</sub> emissions.

KHI has been participating in the project to develop and produce this engine and has played a key role in joint design and development efforts with Rolls-Royce, but our primary responsibility has been the design, manufacture and assembly of the intermediate pressure compressor (IPC) module. One of eight main modules that comprise the engine, the IPC module increases the pressure of air drawn in through the fan and delivers this highly compressed

air to the combustion system.

KHI has supplied IPC components since March 2010 but this is the first time that we have completed the entire process, from parts manufacturing through to assembly, culminating in its first IPC module shipment in March 2011.



A350XWB® Airbus



Trent XWB intermediate pressure compressor module

## Industrial Plant and Equipment

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

The field of plant and industrial equipment constantly requires not only high performance but also lesser environmental impact, such as energy and resource conservation and more compact sizing. We continue to develop new products with advanced technologies to meet these needs.

## 5 KHI Delivers Cement Plant to Vietnam: Features High-Performance Dust Collection and Low-Noise, Low-Vibration Systems

In February 2011, KHI delivered a cement plant to But Son Cement Joint Stock Company, a subsidiary of Vietnam Cement Industry Corporation, a state-owned company controlled by the Ministry of Construction. This was an expansion project to add capacity at an existing cement plant. The plant is one of Vietnam's large-scale cement plants with production capacity of 4,000 tons/day and provides integrated production, from raw material receiving to grinding, burning and cement shipping.

KHI is responsible for the design and delivery of a full set of process equipment/machines used in the line from raw material receiving to cement shipping, as well as supervising on construction, erection, and commissioning. In the last few years, Vietnam has joined so many other nations around the world in establishing tougher environmental requirements, and cement producers are increasingly keen to procure energy-saving equipment for their

plants. The recently delivered cement plant features a high-efficiency dust collecting facility and low-noise, low-vibration systems that will contribute significantly to reduced environmental impact. In addition, We provided operating instructions so that no energy or heat would be wasted during operation.

To date, KHI has delivered around 90 cement plants to customers in Japan and overseas.



Cement plant in Vietnam

## 6 Launch of 400kW-Class Kawasaki MAG Turbo: Dramatically Boosting Energy Savings at Sewage Treatment Plants

Aeration blowers are used at sewage treatment plants to supply air to bioreactors where sanitary wastewater is cleaned by microorganisms. These aeration blowers consume 40% to 50% of the total electricity needs at a sewage treatment plant, prompting demand for greater efficiency and energy-saving features in such equipment.

KHI meets these market demands with the Kawasaki MAG Turbo, a single-stage blower with a high-speed motor and magnetic bearings. Recently, We expanded the lineup with the newly developed 400kW-class MAG-M35, the largest model to date.

The Kawasaki MAG Turbo features an integrated design, with the impeller attached directly to the rotor of an inverter-driven, high-speed motor, and magnetic bearings in the rotor shaft. This structure allows

high-speed rotation without mechanical contact for enhanced efficiency and substantial energy savings and also reduces noise and vibration.

KHI has received over 60 orders for the Kawasaki MAG Turbo since the blower series debuted, and with a selection of systems capable of handling air volume between 30m<sup>3</sup> and 300m<sup>3</sup> per minute, the series will meet the needs of a wide range of customers.



400kW-class Kawasaki MAG Turbo