

## Feature Meeting Problem-Solving Needs around the World

### Energy & Environment

Power Systems

Machinery & Steel  
Infrastructure Systems

# Supporting the World's Energy with Environmentally Friendly, High-Efficiency Thermal Power

Given the nuclear power plant accident caused by the Great East Japan Earthquake and plummeting gas prices, interest in thermal power generation is on the rise around the world.

MHI will contribute to the 3Es—energy security, environmental protection, and economic growth—through high-efficiency natural gas-fired gas turbine combined cycle (GTCC) and integrated gasification combined cycle (IGCC) power generation technologies that meet the needs of countries worldwide.



### Gas turbine combined cycle (GTCC) sets world standard for generation efficiency

MHI has supplied a large number of products for GTCC power plants, which is becoming a mainstream method of power generation globally. GTCC is a power generation technology that combines a gas turbine and steam turbine and is fueled by natural gas, which has a smaller environmental impact than other fossil fuels. Compared to conventional thermal generation systems, which tend to throw away half or more of the generated energy as waste heat, GTCC is a zero-waste system that generates electricity twice: once with a gas turbine and once more with a steam turbine using the exhaust heat from the gas turbine. Whereas systems that use only a gas turbine or steam turbine have a thermal efficiency of only about 40%, combining the two into something like MHI's state-of-the-art J-Series gas turbines results in a highly efficient



J-Series gas turbine

system with a thermal efficiency of at least 61%. Moreover, GTCC is also a very eco-friendly method of generation, as it reduces carbon dioxide (CO<sub>2</sub>) emissions by roughly 30% from generation using a gas turbine alone.

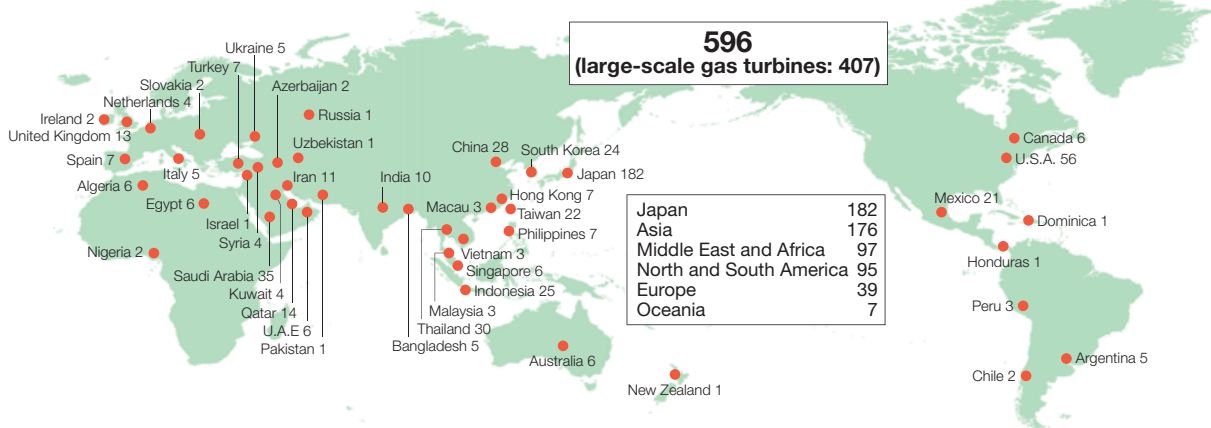
MHI is the only manufacturer in Japan that provides all the products and services that go into a GTCC system using its own technologies.

This includes the designing of major system components such as the gas turbine, steam turbine, waste heat recovery boiler and the engineering of the entire plant, as well as everything from component production to civil engineering and construction work, installation, commissioning, and after-sales servicing.

MHI also has an extensive track record of making deliveries overseas, having exported approximately 600 gas turbines and over 200 GTCC power plants to more than 40 countries worldwide.

We plan to expand our GTCC business primarily in Asian countries such as China, South Korea, Taiwan, Thailand, and Indonesia where rapid economic growth in recent years has led to soaring electricity demand, as well as in countries such as the U.S. where the introduction of shale gas is sparking further expansion in natural gas use.

**Cumulative number of gas turbine orders** (as of May 31, 2013)



**Meeting demand worldwide (major trends in past year)**

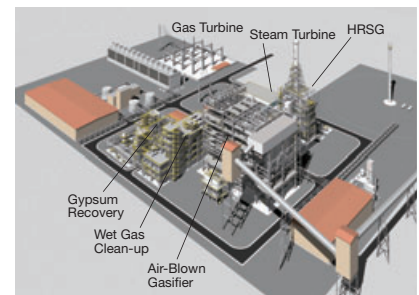
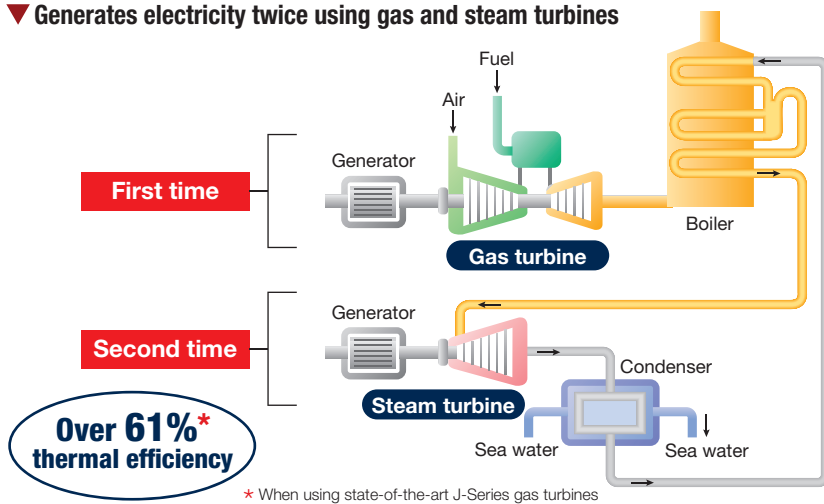
- May 2012:** Received order in the U.S. for basic design of IGCC facility with CO<sub>2</sub> capture and storage capability
- August 2012:** Received order in China for two 30 MW-class GTCC power plants for an iron and steel company
- December 2012:** Received order in India for the rehabilitation of a GTCC power plant with a 663.36 MW capacity
- December 2012:** Received order in Thailand for the construction of a 1,600 MW GTCC power plant
- June 2013:** Received order for a GTCC power generation system for Portland General Electric in the U.S. and also signed long-term service agreement
- June 2013:** An IGCC plant in the Nakoso area of Fukushima Prefecture that previously was used for demonstration testing began commercial operation as the 10th power plant of Joban Joint Power Co., Ltd.

**Contributing to reduced environmental impact through integrated gasification combined cycle (IGCC) power**

Integrated gasification combined cycle (IGCC) power is an efficient combined cycle power generation system that uses gasified coal, a resource with a large amount of untapped reserves, to generate electricity using a gas turbine, the exhaust heat from which is then used to run a steam turbine. Since IGCC is between 10% and 20% more efficient than conventional coal-fired thermal power and thus reduces CO<sub>2</sub> and other pollutant emissions, the technology is attracting attention as a key next-generation energy technology with high environmental compatibility. MHI has been researching and developing this technology since the 1980s and through a number of proprietary technology innovations became the world's first manufacturer to succeed in establishing an air-blown gasification technology. MHI will continue to promote the application of IGCC, as the effective use of coal using this technology is vital from an energy balance standpoint and also from the perspective of reducing environmental impact.

**GTCC roughly 20% more thermally efficient than conventional power plants**

**Generates electricity twice using gas and steam turbines**



◀ EGAT Diamond Service (Thailand)



▲ EGAT Wang Noi GTCC Plant, Thailand

**Voice Expectations of MHI**

**We would like MHI to continue being EGAT's "Best Friend Partner."**

MHI and EGAT have built a 45 year-long relationship through construction, operation and maintenance of Hydro, Thermal, and GTCC power plants which have been contributing to the stable provision of electricity in Thailand.

With such a long relationship, MHI and EGAT have set up a joint venture company as a power generation service provider to start contributing to the stable provision of electricity for ASEAN people's happiness.

We expect MHI to continuously provide environmentally-friendly products with high-level technology. Also, we would like MHI to keep providing Japanese-style warm, speedy, and careful support based on "CS First!" (Customer Satisfaction First!)—the mission of the MHI Service Division—and to continue being EGAT's "Best Friend Partner."



**Pithsanu Tongveerakul**  
Electricity Generating Authority of Thailand (EGAT) Deputy Governor  
-Business Development