

BUSINESS SEGMENT OVERVIEW

# POWER SYSTEMS DOMAIN

We aim to be the industry leader in the energy solutions and turbomachinery businesses.

- Thermal Power:** Generation systems offering the world's highest levels of thermal efficiency and output. A full range of output levels, from small and medium-sized to large. State-of-the-art environmental technologies (AQCS<sup>1</sup>, IGCC<sup>2</sup>). Abundant experience in EPC capabilities.
- Nuclear Power:** Highest levels in the world in safety technologies and product quality.
- Renewable Energy:** Extensive track record in orders for offshore wind turbines (second-largest share of the world market (MVOW<sup>3</sup>)).
- Turbomachinery (rotating machinery):** Turbomachinery synergies (Mutual use of technologies, human resources, and facilities) [Gas turbines, aero engines, aero-derivative gas turbines (PWPS<sup>4</sup>), compressors, pumps, MET turbochargers<sup>5</sup>, Organic Rankine cycle (ORC)]

<sup>1</sup>. AQCS: Air quality control system  
<sup>2</sup>. IGCC: Integrated coal gasification combined cycle  
<sup>3</sup>. MVOW: MHI Vestas Offshore Wind A/S (Joint venture with Vestas of Denmark)  
<sup>4</sup>. PWPS: PW Power Systems, Inc.  
<sup>5</sup>. Turbochargers for marine engines

- Thermal Power:** Profitability (delayed PMI)
- Nuclear Power:** Little experience in constructing new plants overseas
- Renewable Energy:** Limited lineup (offshore wind turbines, geothermal, organic Rankine cycle)
- Compressors:** Track record in the oil and gas market
- Aero Engines:** Market led by European and US engine manufacturers

**W**  
WEAKNESSES

- Thermal Power:** Need for high-efficiency, green power generation in line with increasingly stringent environmental regulations. Need for supply and demand adjustments in accordance with the expansion of renewable energy.
- Nuclear Power:** Introduction of new generation capacity, centered on emerging markets.
- Renewable Energy:** Growing demand for offshore wind turbines.
- Compressors:** Increasingly vigorous oil and gas markets.
- Aero Engines:** Sustained market growth.

- Thermal Power:** Increasingly stringent competition with overseas companies. Backlash against fossil fuel generation in advanced countries. Market domination by renewable energy.
- Nuclear Power:** Trend away from nuclear power generation in advanced countries.
- Renewable Energy:** Demand for rapid reduction in the unit cost of wind power generation (decline in government subsidy systems). Competitors expanding scale of business through M&A (pursuing economies of scale).
- Compressors:** Delayed recovery in the oil and gas market, increasingly severe competition.
- Aero Engines:** Aircraft component business changing due to technological innovation.

**T**  
THREATS

**O**  
OPPORTUNITIES

## Operating Environment

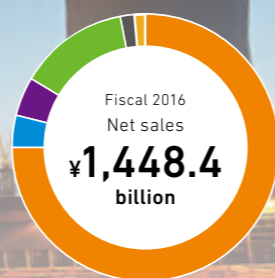
Over the medium to long term, in the power generation field demand related to renewable energy is likely to grow due to measures to counter global warming and increasingly stringent environmental regulations, while that for generation using fossil fuels is expected to taper off.

The main business in this domain—natural gas and coal-fired thermal power generation facilities and nuclear power generation facilities—will continue to represent major sources of power. Therefore, demand for maintenance services for our main business remains robust. On the other hand, we expect demand for newly constructed power plants to stagnate—particularly for coal-fired thermal generation. Competition for orders is likely to heat up as a result.

In wind power and other types of renewable energy, demand is forecast to continue growing. Going forward, needs in this area will include increased generation efficiency and lower unit generating costs. We also expect the need for supply and demand adjustment systems and electricity storage systems to grow, in order to stabilize sources of electric power.

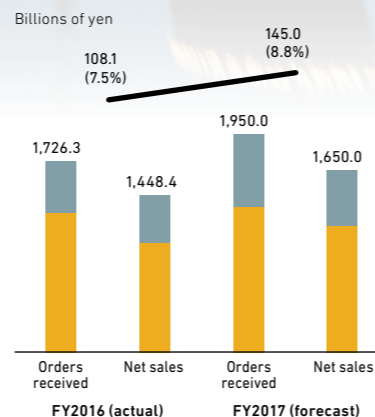
At the same time, future prospects in the oil and gas field are subject to the protracted curtailment of investment as the price of crude oil falls. Nevertheless, we anticipate a resurgence in demand for compressors as the market recovers. Given the globally robust aircraft market, we believe the market for aero engines will continue to deliver solid growth.

### Net Sales by Core Business



Legend for Net Sales by Core Business:  
 Thermal Power generation systems (Orange), Compressors (Blue), Aero Engines (Purple), Nuclear Power (Green), Renewable Energy (Yellow), Others (Grey)

### Operating Performance



Legend for Operating Performance:  
 MHPs\* (Yellow), Others (Blue), Operating income (operating margin) (Black line).  
 \* MHPs: Mitsubishi Hitachi Power Systems (thermal power generation systems)



## Directions for Fiscal 2017 and Focus Strategies for the Medium to Long Term

We expect the operating environment to remain challenging in fiscal 2017. Even so, we plan to meet our sales and profit targets, thanks to growth in the service business and steady progress on the construction of large-scale domestic thermal power plants for which we have already received orders. Also, as we move forward toward the new business plan that will commence in fiscal 2018, we will seek to bolster profitability by accelerating PMI at MHPs and augmenting competitiveness through turbomachinery synergies, building a solid financial and technological foundation.

Over the medium to long term, we expect the composition of power generation sources to change and become more diverse in response to needs to lower environmental impact and move toward a low-carbon society. Responding accordingly to customer demands in these respects, it will become increasingly important for us to develop more sophisticated generation technologies and provide optimal solutions for the efficient use of energy.

In thermal power generation facilities, we have taken the lead and are moving enthusiastically forward in the gas turbine combined cycle (GTCC) arena by accelerating the development of a 1,650°C-class next-generation gas turbine that realizes one of the world's highest levels of efficiency. In coal-fired generation, we are proceeding with the construction of integrated coal gasification combined cycle (IGCC) facilities that offer increased generation efficiency and reduced CO<sub>2</sub> emissions.

In nuclear power generation systems, we are concentrating on providing support for the restart of a pressurized water reactor (PWR) that conforms to Japan's new standards, which are some of

the world's highest. At the same time, we are stepping up collaboration with the AREVA Group of France, working in the nuclear fuel cycle process field and engaging in new overseas projects.

Offshore wind power generation facilities are a focal area in the renewable energy field. In this category, we are working with MVOW of Denmark. We plan to launch a cutting-edge 9.5MW turbine and expand the North American, Asian, and other markets. To respond to the increase in demand for supply and demand adjustment, which is caused by growth in renewable energy generation, we will provide systems that leverage our aero-derivative gas turbines—with their rapid startup capabilities—as well as demand for facilities to store electricity.

From the perspective of energy-efficient operation, we propose solutions that utilize Internet of Things (IoT) and artificial intelligence (AI) technologies. Specifically, we will begin offering the MHPs-TOMONI™ digital solution service for optimizing facility operation and maintenance, as well as the ENERGYCLOUD® Service, which realizes energy-efficient operations at factories and other facilities.

We will also seek to maximize synergies from consolidating our turbomachinery technologies, centered on gas turbines. In compressors, we intend to secure orders for petrochemical plants, which has typically been an area of strength for MHI. We will also seek to combine these offerings with gas turbines to provide new compressor trains, increasing their introduction into the upstream oil and gas market. In aero engines, we aim to expand the business of maintaining engines that are currently in operation, as well as developing next-generation engines.

## Business Directions at a Key Subsidiary: MHPs

Fiscal 2016 was characterized by a lackluster global market for thermal power plants, and orders and sales did not meet our targets as a result. In fiscal 2017, we will commence full-scale construction of new plants in Japan for which we have already received orders. Orders should thus rebound, but we do not expect the business environment to improve significantly for the foreseeable future. We will face this difficult business environment head on, striving to sustain our business expansion by adopting new strategies and shoring up our retrenchment strategies.

First of all, in new strategies we will operate the MHPs TOMONI™ service system for thermal power plants. This system, which we have already begun providing, employs IoT and AI technologies. Through the system, we will work to expand our service business in the areas of long-term plant maintenance and operational support. As orders for overseas projects increase, we will expand our bases in the core markets in Asia; North, Central, and South America;

the Middle East; and Eastern Europe. This move will strengthen our ability to accumulate information about potential business. We will also reinforce our ability to structure projects by obtaining support from export credit agencies, and leveraging yen loan systems. Going forward, we anticipate growth in the market for large-scale gas turbines of 300MW or more. We aim to take the lead over our competitors in the development of superior new models that should garner a top share of the market. We aim to launch the first of these 1,650°C-class next-generation gas turbines in fiscal 2019, 1.5 years ahead of schedule.

As to retrenchment strategies, we will work to restore profitability by accelerating PMI. In particular, we will streamline product lineups at each factory in the aim of augmenting production efficiency and using assets more effectively. Through these measures, we expect to cut fixed costs by between ¥10.0 billion and ¥15.0 billion. We will also strive to optimize our supply chain by utilizing overseas locations.

BUSINESS SEGMENT OVERVIEW: POWER SYSTEMS DOMAIN

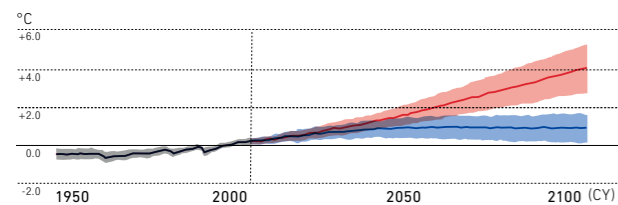
Addressing Social Issues

An Energy Portfolio that Contributes to the Realization of a Low-Carbon Society

Social Issues

Since the second half of the 20th century, global warming has been driving changes in the climate: atmospheric and ocean temperatures have been rising, increasing ocean levels and reducing the amount of polar ice. The Intergovernmental Panel on Climate Change (IPCC) surmises that rising concentrations of CO<sub>2</sub> and other greenhouse gases are highly likely to be a major cause. Worst-case scenarios predict that average global air temperatures will rise by around 4°C by the year 2100, presenting the serious risk of climate change across the entire world. Global efforts to counter this situation by realizing a low-carbon society, such as by adopting the Paris Accord, are growing. As electric power generation has a particularly large effect on CO<sub>2</sub> emissions, renewable energy use is forecast to grow substantially over the medium to long term.

Forecast of Global Changes in Average Global Surface Air Temperatures



Source: Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report Red shows the scenario if greenhouse gas emissions are not reduced. Blue indicates the scenario if all measures are implemented.

MHI Group's Solutions

MHI Group provides some of the world's most efficient thermal power plants. We also have an extensive menu of power generation offerings in the area of renewable energy, including offshore wind turbines and geothermal generation systems. Through combined systems that incorporate AQCS and SOFC\*, we can contribute to a reduction in greenhouse gases, meeting needs in regions around the world.

Looking first at our thermal power plants, which boast some of the highest efficiencies in the world, as one aspect of our activities as a world leader in high-efficiency gas turbine combined cycle (GTCC) systems, at our demonstration facility in the Takasago district (Hyogo Prefecture) we are promoting a cycle of development, design, manufacturing, demonstration (our proprietary tests on the burden of long-term operation), mass production, and reflection (simultaneously employing the results we have received into the next round of development, design, and manufacturing). Throughout, we pursue high levels of efficiency, reliability, and environmental friendliness.

MVOW is developing the offshore wind turbine business in Europe, where the use of renewable energy is expanding rapidly. Established in 2014 as a 50-50 joint venture between MHI and Vestas Wind Systems of Denmark, MVOW is steadily accumulating orders for the construction of large-scale wind farms off the coast of Denmark and the United Kingdom. MVOW has the world's

second-largest share of the world market for offshore wind power generation facilities (cumulative performance as of the end of 2016). The company's generation facilities boast world-leading output and are contributing substantially to lowering customers' generation costs.

In the field of geothermal generation, MHI Group has accumulated orders for more than 100 projects in 13 countries, including Mexico and Kenya. With combined capacity of more than 3 million kW, we hold a leading share of the world's installed geothermal power generation capacity. We believe geothermal is a promising generation method, as it emits no CO<sub>2</sub> and generates stable power that is unaffected by the weather.

Meanwhile, demand for coal-fired generation is high in coal-producing countries in Southeast Asia and other parts of the world. There, we propose integrated coal gasification combined cycle (IGCC) systems, which feature world-leading technologies. The IGCC process gasifies coal at high temperatures and pressures in air-blown gasifiers and utilizes a combined-cycle method that combines gas and steam turbines, thereby achieving substantially higher generation efficiency than with conventional coal-fired generation and reducing CO<sub>2</sub> emissions by around 15%. IGCC systems facilitate the use of low-grade coal, which is problematic with conventional thermal generation. This is expected to achieve the dual benefit of making effective use of resources and helping to protect the environment. Combining an IGCC system with our AQCS curtails the environmental impact of coal-fired generation, optimizing facilities for the regions where they will be used.

By commercializing SOFCs as a next-generation technology, from fiscal 2017 MHI Group will begin launching hybrid units combining SOFCs and micro gas turbines. SOFCs reform natural gas and LNG into hydrogen and carbon monoxide, reacting with the oxygen in the air to generate power directly. As the heat produced in this process can also be used effectively, energy efficiency is extremely high, leading to expectations for future use in distributed or concentrated power sources.

\* SOFC: Solid oxide fuel cell



© Image Courtesy of Grupo Dragón  
Geothermal generation facility (Mexico)

Initiatives in This Domain Related to Material ESG Issues

Material Issue 3: Response to Mega Trends

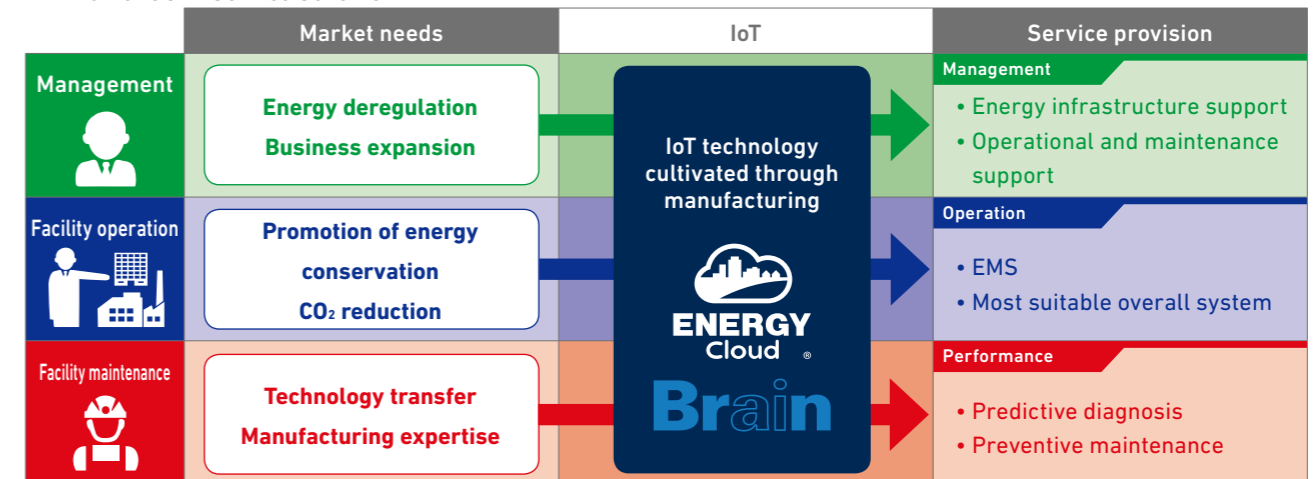
Solutions Combining IoT and AI Technologies, as Well as the Knowledge Cultivated Over Many Years

In this domain, we are leveraging leading-edge IoT and AI technologies to respond to diverse customer needs. For thermal power plant customers, in March 2017 MHPS began providing MHPS-TOMONI™, which optimizes operational and maintenance costs of thermal power generation facilities and enhances their environmental performance. Leveraging big data analysis and AI technology derived from the innovative technologies and specialized knowledge we have cultivated in thermal generation over decades, in-house O&M know-how, total plant knowledge, and customer partnerships, MHPS-TOMONI™ is a comprehensive family of digital solutions MHPS developed for the power industry.

Also, in April 2017 we began providing the ENERGY CLOUD® Service for customers that use large amounts of energy. ENERGY CLOUD® is a general term for the energy solution service based on MHI Group's industry-leading technological strength and

experience in power generation facilities and related businesses, as well as comprehensive analysis from the Group's own diversified plant operation expertise, configured with our unique ENERGY CLOUD® Brain AI technology. Data is measured through our newly developed facility operation monitoring system, and analysis is performed using this AI technology. The data and analysis enable energy demand to be forecast to a high level of accuracy—higher than 90%. By performing this forecasting and ascertaining facility operational status, the system helps improve energy procurement and production efficiency. ENERGY CLOUD® can also be configured into an energy management system (EMS) that uses a network connection and operates over multiple business sites. We have begun considering an overseas rollout in line with needs in various regions. We anticipate that this could become a ¥100.0 billion business.

ENERGY CLOUD® Service Scheme



R&D Case Study

Development of Elemental Technologies for 1,650°C-Class Next-Generation Gas Turbines

MHI has developed high-efficiency gas turbine combined cycle (GTCC) systems for many years. We are now working on the development of elemental technologies, including the gas turbines with a turbine inlet temperature in the 1,650°C class and a next-generation air cooling system, in the aim of achieving combined thermal efficiency of more than 64%, exceeding that of new machines offered by our competitors. Specifically, we are developing technologies to predict the risk of combustion instability

and flashback (backfire) associated with higher turbine inlet temperatures, as well as prediction technology for turbine blade heat transfer coefficient distribution to minimize the rise in cooling air temperature, leading to increased generation efficiency. In the aim of gaining the top share of the market for gas turbines larger than 300MW, the main market for these technologies, we are accelerating development with a view to market launch in fiscal 2019.