Business Segment Overview

Energy & Environment

Viewing changes in society as opportunities to expand our scale of business, we are building up our financial and technological base and preparing to progress toward our next business plan.

Michisuke Nayama
Domain CEO, Energy & Environment

S Strengths

- Accommodate almost all methods of power generation
- Thermal: Possess high-efficiency, high-output, and energy-saving high-performance models
  Broad-ranging product lineup, encompassing small, medium-sized, and large
- Nuclear: Highest levels in the world in safety technologies and product quality
- Chemical plants: Engineering prowess accumulated in diverse plant businesses, etc.
- Renewable energy: MHI Vestas Offshore Wind A/S (MVOW), the second-largest company in the offshore wind power market

W Weaknesses

- Thermal: Servicing business accounts for a low percentage of sales relative to major global competitors, as our base of installed plants is lower
- Nuclear: Little experience in constructing new plants overseas
- Chemical plants: No proprietary licenses
- Renewable energy: A narrower range of products than competitors including Siemens, which provides substations and other items

O Opportunities

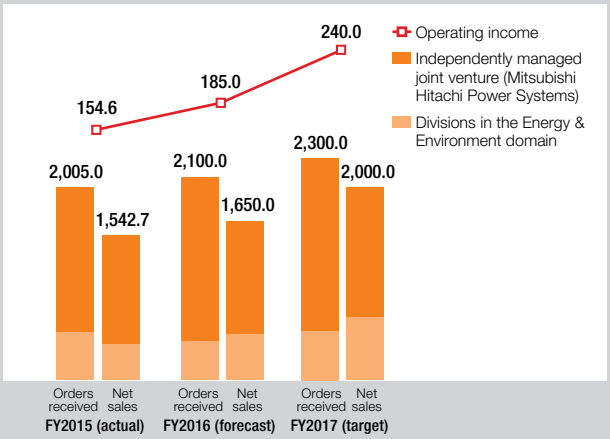
- Thermal: Expanding demand due to low and stable natural gas prices
- Nuclear: Increase in new construction projects and capacity upgrades, centered on emerging markets
- Chemical plants: Growing demand for investment to add high value to gas in gas-producing countries
- Renewable energy: Growing demand for renewable energy, such as offshore wind power, due to rising concern about global warming

T Threats

- Large-scale M&A activity by major global competitors with an overwhelming presence
- Thermal: Slowdown in emerging markets in line with falling resource prices
  Aggressive measures by major overseas competitors to utilize IoT
- Nuclear: Decrease in number of plants being brought back on line in Japan, so lower demand for after-sales services
- Chemical plants: Geopolitical risk in gas-producing countries
- Renewable energy: Market susceptible to policy-driven subsidy trends

Targets of the 2015 Medium-Term Business Plan

Billions of yen



Operating Environment

While the global energy situation is experiencing falling crude oil prices, advanced countries, in particular, are increasing their introduction of renewable energy. Decisions reached in November at the 2015 United Nations Climate Change Conference (COP21) are expected to substantially increase the ratio of non-fossil fuels in the global energy mix. Calls are growing to reduce greenhouse gas emissions through anti-warming measures that include the introduction of high-efficiency thermal power generation systems and nuclear and wind power plants that do not emit CO_2 during generation as well as the use of carbon capture and storage (CCS) systems.

One of MHI's strengths lies in the construction of high-efficiency coal-fired power plants that feature low CO_2 emissions and gas turbine combined-cycle (GTCC) power plants. Demand remains robust for these systems, notably in emerging markets. Nevertheless, the operating environment remains challenging in this field, with MHI facing intensified competition from large companies, known as "megaplayers."

Policies of the 2015 Medium-Term Business Plan

- **Build a strong financial foundation**
- **Reinforce resilience to technological and business risks**
- **Enhance services that utilize IoT**

Viewing the changes taking place in the global energy situation as an opportunity to expand our business scale, we are building up strong financial and technological bases and pursuing three measures to progress.

For our first measure, building a strong financial base, we are accelerating PMI* at Mitsubishi Hitachi Power Systems (MHPS), reinforcing the servicing business, and enhancing profitability. Specifically, we are optimizing operations on a global scale by consolidating and right-sizing production bases and integrating core systems, etc. In the servicing business, we are shifting personnel from other divisions and deploying servicing menus horizontally to expand existing business. In addition, we are developing new businesses, such as industrial facility relocation. We are also identifying businesses that we need to sustain going forward as well as engaging in business selection and focus to make effective use of limited resources.

Furthermore, by shortening production lead times and creating a unified inventory management system for all bases worldwide, we aim to make progress in reducing operating capital and shrinking total assets.

Our second measure is to reinforce our resilience to technological and business risks. We will strengthen our development and design structures and reduce technical risk by reinforcing progress management and gate control. At the same time, we will strive to prevent problems from occurring by liaising with the newly established Business Risk Management Division and Engineering Headquarters and augment our ability to resolve problems that occur by consolidating our engineering, procurement, and construction (EPC) expertise.

Third, we will enhance services that utilize IoT. We have established a remote monitoring center, which supervises the operational status of thermal power plants. Located in the Philippines, this facility is our third, following centers in the city of Takasago, Hyogo Prefecture, and Orlando, Florida, in the United States. The new center will conduct overall monitoring of coal-fired and GTCC power plants in Asia and the Middle East, providing sophisticated support and services to customers based on its analysis of big data. Links with a boiler factory in the Philippines are also adding functionality to the global service center.

*PMI: Post-merger integration

R&D Case Study: Key Technologies for Ultrahigh-Temperature Gas Turbines

The research on technologies for 1,700˚C-class gas turbines is moving forward as a national project, aiming at the practical application of highly efficient thermal power generation technology using ultrahigh-temperature gas turbines. The first step in this project was to develop element technologies (shielding coatings, cooling technology, combustors, turbines, compressors, and heat-resistant materials) for gas turbines. The second step was to pursue development with the aim of practical application. The third step, now under way, includes more than 10 items targeting the development, manufacturing, and test runs of practical equipment. Furthermore, the Company has applied to its 1,600˚C-class J-series gas turbines some of the leading-edge technologies for which performance and reliability improvements were confirmed during the technological development of 1,700˚C-class gas turbines.

HIGHLIGHT

MHI Developing Robots to Support Work Surrounding Nuclear Disasters

We are developing robots that can support work in areas with high levels of radiation or that have been devastated by disasters. In fiscal 2012, MHI participated in the Unmanned Anti-disaster System R&D Project of the New Energy and Industrial Technology Development Organization (NEDO). As part of this project, we developed the Super Giraffe, a mobile robot with a manipulator capable of performing work at heights of up to eight meters. Developed with a modular design to allow for a high degree of expandability, the Super Giraffe was envisioned for use at the site of the Fukushima Daiichi Nuclear Power Plant disaster. To this end, the robot has undergone repeated verification tests in SBO*1 environments and is expected to handle operations at disaster sites. In addition, the Company has signed a technical cooperation agreement with the Chiba Institute of Technology involving the manufacture and sale of the Sakura II mobile robot, as well as the development of another mobile robot, the MHI-HERCULeS*2.

Meanwhile, as part of preparations for putting these robots to use, in collaboration with the Japan Atomic Power Company (JAPC) MHI has developed a power assist suit (PAS). This suit, which aims to leverage the combination of robot power and human capabilities, will facilitate diverse operations. Going forward, we plan to enhance the performance of the PAS and propose solutions for making use of this technology.

*1. SBO: Station Blackout
*2. HERCULeS: HEx crawler ResCUe robot with Lighting and Exploring System

Commercial Aviation & Transportation Systems

We are moving forward with MRJ business development plans and reinforcing the comprehensive engineering business within transportation systems. As a result, we are working to create a growth foundation with a view to a business scale of ¥1 trillion.

Yoichi Kujirai
Domain CEO, Commercial Aviation & Transportation Systems

S Strengths

- Commercial aircraft: Competitiveness through production innovations and supply chain management (SCM) reforms
  Design and manufacturing technologies for large composite main wings and other structural components
  Complete aircraft (MRJ) offering high levels of efficiency and reliability and outstanding economy
- Transportation systems: Strong system integration and project management capabilities
- Commercial ships: Superiority over competitors in environmental and energy-saving technologies

W Weaknesses

- Commercial aircraft: Comprehensive strength in complex SCM for aircraft parts, limited experience in the development of complete aircraft
- Transportation systems: Shortage of engineering resources in response to business expansion
- Commercial ships: Cost competitiveness in comparison with specialized domestic companies filling multiple orders for ships built to the same specifications

O Opportunities

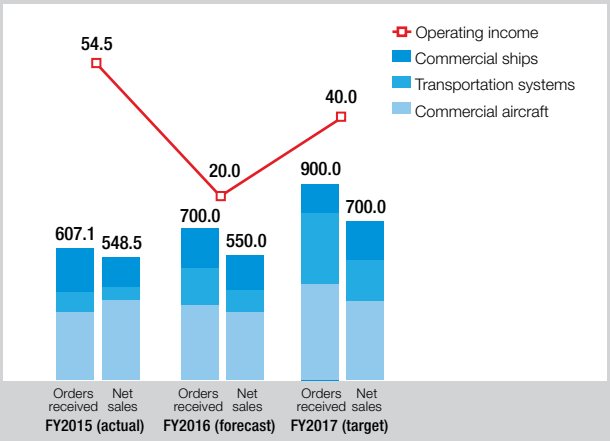
- Commercial aircraft: New demand for nearly 40,000 aircraft over the next 20 years
  Expected market scale over the next 20 years of around 3,500 aircraft with 70–90 seats
- Transportation systems: Numerous infrastructure plans, including in urban transport
- Commercial ships: Growing demand for gas carriers, passenger and cargo ships, and roll-on roll-off passenger ships/ferries (ROPAXs)

T Threats

- Commercial aircraft: Competition for orders and on prices heating up with Boeing and Airbus; increasingly severe competition in the market for regional jets
- Transportation systems: Competition from China and the Big Three
- Commercial ships: Slowdown in logistics, particularly for resources, due to falling crude oil prices

Targets of the 2015 Medium-Term Business Plan

Billions of yen



Courtesy of Mitsubishi Aircraft Corporation

Operating Environment

Due to the combination of replacement and new demand, during the next 20 years the size of the commercial aircraft market is forecast to double, growing to nearly 40,000 aircraft and reaching a scale of US$5 trillion. Against this backdrop, competition for orders and on prices is heating up with the two major overseas original equipment manufacturers (OEMs) of airframes. At the same time, new demand is anticipated for regional jets with 70–90 seats, with the market growing in scale to around 3,500 aircraft over the next 20 years. Although one leading airframer plans to launch a next-generation aircraft in the 90-seat class in 2020—a head-to-head competitor with the MRJ—the MRJ is the only next-generation aircraft in the 70-seat class.

The transportation systems business is estimated to have a current market scale of around ¥22 trillion, expanding at an annual rate of 2% to 3%. Infrastructure demand is particularly firm in such regions as South America, the Middle East, and Southeast Asia, and we anticipate solid market growth.

In the commercial ships business, the market is forecast to remain oversupplied for the foreseeable future, but shale gas development projects are engendering demand for gas carriers, an area where MHI excels. After meeting this demand, we expect steady growth from projects in East Africa and other areas, as well as for replacement demand for LNG carriers. We also anticipate steady growth in the ROPAX and passenger ship markets.

Policies of the 2015 Medium-Term Business Plan

- **Promote production system reforms in the commercial aircraft business**
- **In the MRJ business, move forward with the development of three bases in Japan and the United States, and put mass-production structures in place**
- **In the transportation systems business, strengthen engineering, procurement, and construction (EPC) execution capabilities and reinforce the operations management and maintenance (O&M) business**
- **In the commercial ships business, pursue structural reforms and engage in initiatives in the markets for passenger and cargo ships and ROPAXs**

While boosting profitability centered on the commercial aircraft business, we are building the foundations for our next business plan in the MRJ, transportation systems, and commercial ships businesses.

In the commercial aircraft business, we will respond to growing competition in commercial aircraft by pursuing production system reforms aimed at augmenting production elasticity, shortening lead times, and reducing production losses. As part of these efforts, we will engage in the introduction of new equipment and development to automate our factories. We have set up an industrial cluster in Matsusaka city intended to radically improve lead times and logistics by eliminating outsourcing that spans multiple processes. In the commercial aero engines business, we will strengthen our production foundation with a view to full-scale production expansion and better cost competitiveness.

In the MRJ business, we aim to establish a firm position in the market for regional jets. To achieve this aim, we are moving forward with the development of a three-base structure in Japan and the United States. In addition to Aichi Prefecture, which is home to Mitsubishi Aircraft Corporation and the final assembly hangar at the Komaki-Minami Plant, we are launching the Seattle Engineering Center and the Moses Lake Flight Test Center. We are simultaneously putting in place a mass-production structure to step up the rate of production once sales have commenced, enabling us to catch up on development schedule delays.

In the transportation systems business, to ensure we win large-scale projects in the Middle East, Southeast Asia, and other regions, we will strengthen our EPC execution capabilities. To enhance our overall capabilities in this area, we will consolidate at the Engineering Headquarters the experience, expertise, and human resources currently spread throughout the Company and enhance relations with this headquarters. We also intend to win O&M orders for existing and planned projects. With this objective, we are moving human resources and other key supplies of resources from overseas Group O&M companies and setting up the MIHARA Test Center as a base for human resource training.

In the commercial ships business, we are accelerating structural reforms under a new organization with two affiliated companies established in October 2015: Mitsubishi Heavy Industries Shipbuilding Co., Ltd., and Mitsubishi Heavy Industries Hull Production Co., Ltd. Furthermore, we will expand our passenger and cargo ships business by leveraging design and construction capabilities cultivated through the construction of cruise ships and domestic ferries.

R&D Case Study: Development of the *Sayaringo STaGE*, a Next-Generation LNG Carrier

Given the growing demand for LNG in recent years, we have developed a new LNG carrier that has better volumetric efficiency than conventional LNG carriers as well as improved environmental friendliness. To maximize cargo capacity while taking into consideration the New Panamax limits and compatibility with more than 100 LNG terminals worldwide, the carrier features a newly developed tank design. Ordinary LNG tanks consist of semispheres and a cylinder; by adjusting the balance between these shapes and adding a torus, we have succeeded in increasing total tank capacity from 155,000m^3 to 180,000m^3. The carrier also includes a newly conceptualized hybrid propulsion plant dubbed STaGE, for "Steam Turbine and Gas Engine," and a continuous tank cover that lowers wind resistance. This combination reduces environmental impact substantially. Currently being built at the Nagasaki Shipyard & Machinery Works, sequential deliveries of the *Sayaringo STaGE* are planned from 2018. Going forward, we will continue to promote the development of new products and technologies to meet the diverse needs of customers and society.

HIGHLIGHT

Progress on Development and Setting Up a Mass-Production Structure in the MRJ Business (As of August 31, 2016)

MHI is positioning the MRJ business as a pillar of next-generation growth. Following the successful first flight of our first jet in November 2015, our second jet made its first flight successfully on May 31, 2016. Since June, we have been conducting two-jet flight tests. We will move the aircraft to Grant County International Airport, at Moses Lake, in the United States, and begin further flight testing there. Ultimately, we will gather test data on five jets as we work to satisfy type certification requirements. By moving forward with a three-base development structure in Japan (Aichi Prefecture) and the United States (Moses Lake and Seattle), we are working to shorten the flight testing period, and reflect these flight test results securely and swiftly into MRJ design and production processes.

We are simultaneously making inroads on setting up our mass-production system. In July 2016, a new plant began assembling airframes produced at our new plant. Engine assembly will start in fall 2016, and we plan to commence production at a rate of around one jet per month from 2017. We aim to deliver the first mass-produced aircraft in mid-2018 and ramp up production to 10 aircraft per month by around 2020.

Integrated Defense & Space Systems

While continuing to strengthen our existing businesses, we are preparing to expand our business scale by commercializing new projects for overseas markets.

Hisakazu Mizutani
Domain CEO, Integrated Defense & Space Systems

S Strengths

- Leading-edge technologies fostered through the development of defense and space products
- Defense: Ability to make proposals for integrated defense systems
  Expertise and channels cultivated through Japan–U.S. joint development of the SM-3 missile
- Space: Developing capabilities in rockets and rocket engines
  Maintaining world-leading product reliability and quality control

W Weaknesses

- Defense: Limited experience in pursuing and leading in projects overseas
- Space: Inadequate cost and competitive pricing

O Opportunities

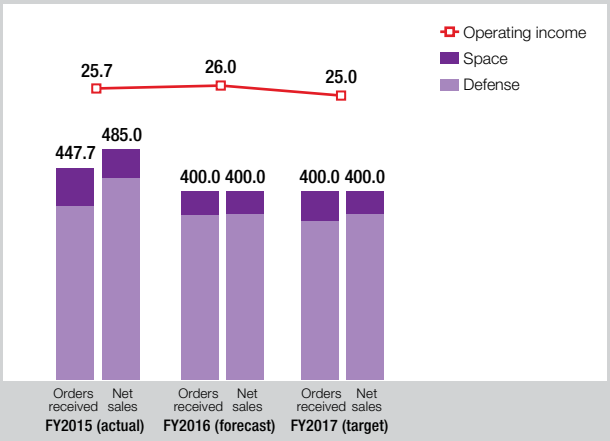
- Defense: Growing overseas demand for defense equipment
  Accelerating development and procurement of new products in line with the formulation of Japan's Medium-Term Defense Program
- Space: Increasing need for satellite launches by emerging countries
  Under Japan's New Basic Plan on Space Policy, domestic market scale expected to grow to ¥5 trillion over the next 10 years

T Threats

- Defense: Severe competition with domestic and overseas manufacturers
- Space: Concern regarding price competition as new U.S. companies enter the market for overseas satellite launch services

Targets of the 2015 Medium-Term Business Plan

Billions of yen



Operating Environment

The Integrated Defense & Space Systems business is performing steadily, but its operating environment is changing.

In defense, the Ministry of Defense's Medium-Term Defense Program formulated in 2013 indicated the Japanese government's intent to build a "Dynamic Joint Defense Force," and new defense equipment development and procurement is expanding. Furthermore, the 2014 Cabinet decision adopting the Three Principles on Transfer of Defense Equipment and Technology established clear principles for transferring defense equipment overseas. As a result, we anticipate an increase in overseas projects, centering on joint international development.

In space systems, the formulation of the new Basic Plan on Space Policy in January 2015 and the work schedule for this plan, revised in December 2015, clarified the vision for the future, thereby facilitating investment forecasts. The scale of the domestic market is expected to grow to ¥5 trillion over the next decade. Demand is also increasing in relation to gathering and analyzing information, determining conditions overseas, and providing resulting products and services related to the space systems market.

Policies of the 2015 Medium-Term Business Plan

- **Develop business overseas, taking the Three Principles on Transfer of Defense Equipment and Technology to locations where opportunities for new markets exist**
- **Promote private-sector projects, leveraging the cutting-edge technologies cultivated through the defense and space business**
- **Take advantage of land, sea, air, and space synergies to expand domestic business**

We are implementing three growth strategies as we continue to prepare for expansion during the period of the next business plan.

First, we will develop business overseas that takes advantage of opportunities provided by the Three Principles on Transfer of Defense Equipment and Technology. Through the Japan–U.S. joint development and production of the SM-3 missile, we will gain expertise in joint international development. We expect to apply this expertise toward commercial development in fields that match MHI's technological expertise. We also aim to utilize our advanced technologies and channels with U.S. and European business partners to participate in new international joint development projects. Furthermore, we will build upon a track record of conducting final assembly and functional tests of F-35 fighters on schedule, and we will consider participating in areas providing back-up support.

Second, we will leverage the leading-edge technologies we have cultivated through the defense and space business to promote projects in the private sector. Through joint development with Nippon Telegraph and Telephone Corporation (NTT), which possesses cutting-edge security technologies, we will develop cybersecurity technologies for key infrastructure control systems. We will develop cybersecurity-related products and services, giving shape to technologies that detect and respond in real time to unknown threats. In space systems, we will promote H-IIA rocket launch services to countries new to space exploration and accelerate activities to attract orders for H-IIA and H3 launch services from leading global satellite operators. We are also considering commercialization in areas related to the development, launch, and operation of small satellites, based on the expertise and knowledge gained through the operational testing of our own small satellites commencing in fiscal 2015.

Third, we will take advantage of land, sea, air, and space synergies to expand orders in domestic areas of business. In defense, we will incorporate the elemental technologies relating to jet fighters that we have accumulated and advanced to date into future jet fighters. We will also apply cutting-edge technologies cultivated through defense equipment to the development of new naval ships and mass-production projects. Meanwhile, in space systems we will carry out our duty to secure Japan's autonomous national launch capacity through the development of the H3 rocket. At the same time, we will strengthen global competitiveness through cost reductions to expand launch vehicle services in the global market.

R&D Case Study: X-2 Advanced Technology Demonstrator

In April 2016, MHI successfully completed the maiden flight of the X-2, an advanced technology demonstrator jet, from Nagoya Airport in Aichi Prefecture to the Japan Self-Defense Force's Gifu Air Base.

The X-2 is a prototype stealth aircraft for Japan's Ministry of Defense. It is the first in Japan to feature technology impeding its detection by radar and engineered for extremely high maneuverability. The prototype integrates an airframe, engines, and other advanced systems and equipment all adaptable to future fighters. As the coordinating company of the X-2 development project, MHI began developing the aircraft's airframe in 2009 with cooperation provided by 220 domestic companies and guidance from Japan's Acquisition, Technology & Logistics Agency (ATLA). We completed the airframe assembly in fiscal 2014. After engine testing, we completed taxiing tests at Nagoya Airport before moving on to the maiden voyage. Going forward, the aircraft will be subjected to repeated flight tests at the Gifu Air Base with a view to enhancing performance and technological effectiveness.

HIGHLIGHT

MHI Successfully Launches Telesat's Telstar 12 VANTAGE Satellite

On November 24, 2015, MHI successfully delivered Telesat's Telstar 12 VANTAGE satellite into planned orbit on the H-IIA launch vehicle F29.

The H-IIA launch vehicle F29 lifted off from the Yoshinobu launch pad at the Tanegashima Space Center at 15:50 local time (6:50 GMT and 01:50 EST). The launch vehicle flew as planned and, at about four hours and 27 minutes after liftoff, the separation of the Telstar 12 VANTAGE satellite was confirmed. H-IIA F29 incorporates the enhancements of the H-IIA upgrade. The upgrade relates to improvements in the launch vehicle's upper stage, and MHI has been implementing these improvements with strong support and oversight from the Japan Aerospace Exploration Agency (JAXA). These efforts led to the launch vehicle's success in bringing the satellite near geostationary orbit. Including the H-II rocket's F30 vehicle, launched on February 17, 2016, H-IIA/H-IIB launch vehicles have been successful 29 consecutive times, resulting in a success rate of 97.1%.

MHI intends to market more proactively its H-IIA satellite launch services both in Japan and abroad, continuing to play a key role in the Japanese space industry.

Machinery, Equipment & Infrastructure

By accelerating PMI on independently managed joint ventures and focusing resources on growth businesses, we will expand business scale and profits, achieving a highly profitable structure.

Kazuaki Kimura
Domain CEO, Machinery, Equipment & Infrastructure

S Strengths

- Expertise cultivated in a wide range of product fields and extensive resources
- Metals machinery: Meet market needs with a full product lineup and global presence
- Turbochargers: Development of sophisticated products leveraging high-speed rotational technologies
- Forklift trucks: Third in the world by business scale
- Air-conditioning and refrigeration: Extensive product lineup

W Weaknesses

- Tends to be affected by short-term economic fluctuations
- Overlaps in functions and bases after integration

O Opportunities

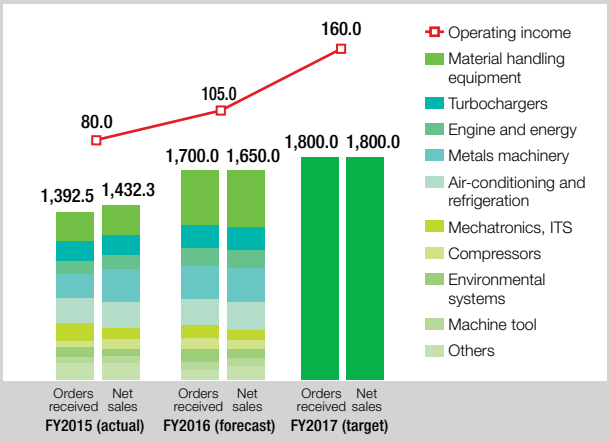
- Compressors: Long-term expansion in the oil and gas business due to increasing global population and economic expansion in developing countries
- Turbochargers: Expanding Chinese and North American markets Growing trend toward the use of turbochargers on downsized engines in response to environmental and fuel performance regulations
- Engines: Growing power generation market in line with increases in distributed power systems

T Threats

- Rise of manufacturers in emerging countries
- Sense of uncertainty in the global economy
- Ongoing commoditization
- Compressors: Slowing demand due to slumping crude oil prices
- Metals machinery: Global gap between steel supply and demand causing the market to shrink

Targets of the 2015 Medium-Term Business Plan

Billions of yen



Operating Environment

As of March 2016, 13 strategic business units (SBU), which were streamlined from the original 26, continued to handle a wide-ranging variety of businesses. Turbocharger demand is expanding robustly, benefiting from tax reductions on small cars in China and in response to more stringent fuel standards in the North American market. Demand is also growing for businesses that require high environmental performance, such as engines, environmental systems, and air-conditioning and refrigeration systems, due to global trends toward energy savings and reductions in greenhouse gas emissions. Global demand for forklift trucks is generally holding steady, with some disparities among regions.

Meanwhile, in metals machinery a gap between the global supply and demand for steel is causing a market slump. As a result, the market scale in the metals machinery business shrank from around ¥2.4 trillion in fiscal 2014, to approximately ¥2.0 trillion in fiscal 2015, and we think a recovery will take time. Although demand for compressors is likely to grow over the long term in line with market expansion in the oil and gas fields, we anticipate demand will remain lackluster for the foreseeable future due to the impact of falling crude oil prices.

2015 Medium-Term Business Plan Policies

- **Accelerate PMI in independently managed joint ventures M-FET and Primetals Technologies**
- **Expand business scale in growth businesses: compressors, environmental systems, air-conditioning and refrigeration systems, mechatronics, and intelligent transport systems (ITS)**
- **Enhance business and earning capacity in small and medium-scale businesses, through measures including M&A**

Mitsubishi Heavy Industries Forklift, Engine & Turbocharger Holdings, Ltd. (M-FET), launched in March 2016, will expand M-FET's business scale to a target sales level of ¥1 trillion by ensuring economies of scale; leveraging integration synergies at procurement, development, manufacturing, and sales bases; and integrating product technologies and mass production technologies. In metals machinery, we foresee the market environment to remain challenging for the foreseeable future. In this area, we will accelerate post-merger integration (PMI) at Primetals Technologies, a joint venture with Siemens AG, striving to reduce costs and reinforce the sales structure.

In primary growth businesses, we are implementing the following key measures. In compressors, we will strengthen our service businesses and ensure profitability. In environmental systems, we will expand overseas businesses including EPC and so on. In air-conditioning and refrigeration systems, we will further develop the thermal solutions businesses to save energy, reduce CO_2 emissions, and make use of unutilized energy. Furthermore, in mechatronics and ITS we will make full use of workforce synergies through a wide-ranging product mix.

In small and medium-scale businesses, we will strengthen business activity and earning capacity through various methods, including M&A. In agricultural machinery, we are reinforcing globalization through synergies with Mahindra & Mahindra Ltd., in India, through a capital tie-up we entered in October 2015. In April 2015, we partnered with Miyaji Engineering Group, Inc., in bridges, and we look forward to improved profitability and increased orders. We transferred our industrial cranes business to Sumitomo Heavy Industries Material Handling Systems Co., Ltd. in October 2015, and this operation is expanding.

Through these initiatives, we aim to create leading businesses in global niche markets, expand business scale, and improve earning capacity.

R&D Example: MHI Develops Compact Energy-Efficient Centrifugal Chillers Using New Environmentally Friendly Refrigerant

In September 2015, MHI launched the ETI-Z series of next-generation centrifugal chillers, the first in the world to use the new environmentally friendly HFO-1233zd(E) refrigerant. This new refrigerant produces minimal greenhouse gas emissions, has no impact on ozone depletion, and is not subject to Japan's Freon Emissions Control Law and its regulations for emissions, leaks, recovery, and disposal. However, the refrigerant gas has about five times the volume of MHI's current refrigerant, so achieving the same capacity means using larger compressors and heat exchangers—potentially affecting overall size.

To achieve compactness, the ETI-Z series uses a new shape of blade, faster motor speeds, and high-performance tubes, arranged to optimize space. This new design also enables best-in-class energy efficiency through the use of a compressor with a high-speed direct motor drive, reducing motor drive energy loss. Through this innovation, the ETI-Z series is able to achieve significant reductions in emissions without compromising on compact size.

HIGHLIGHT

MHI, MCO, and MHPS to Collaborate with ExxonMobil in Advanced Gas Turbine Technology

In April 2016, MHI, Mitsubishi Heavy Industries Compressor (MCO), and Mitsubishi Hitachi Power Systems (MHPS) announced their collaboration with Exxon Mobil Corporation in the liquefied natural gas (LNG) field.

MCO's compressors and turbines account for around half the world market in the ethylene plant field, and the company has delivered plants in 62 countries around the world. By developing new applications for the latest MHPS H100 gas turbines, as well as MCO's state-of-the-art compressor technologies, we aim to reduce the complexity of LNG plants and lower life-cycle costs. Specifically, H-100 gas turbines offer LNG mechanical drives the benefits of space savings, broad variable-speed operation, and full-pressure start-up.

This development of main LNG refrigeration packages by MCO and MHPS is a good example of efforts to integrate the MHI Group's product lineup and create business across multiple domains.

Note: The photo in the center of the left-hand page shows a pyrolysis gasification compressor and steam turbine for an ethylene plant.