

# Power Systems Business Operation

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# 1. Progress of 2010 Business Plan

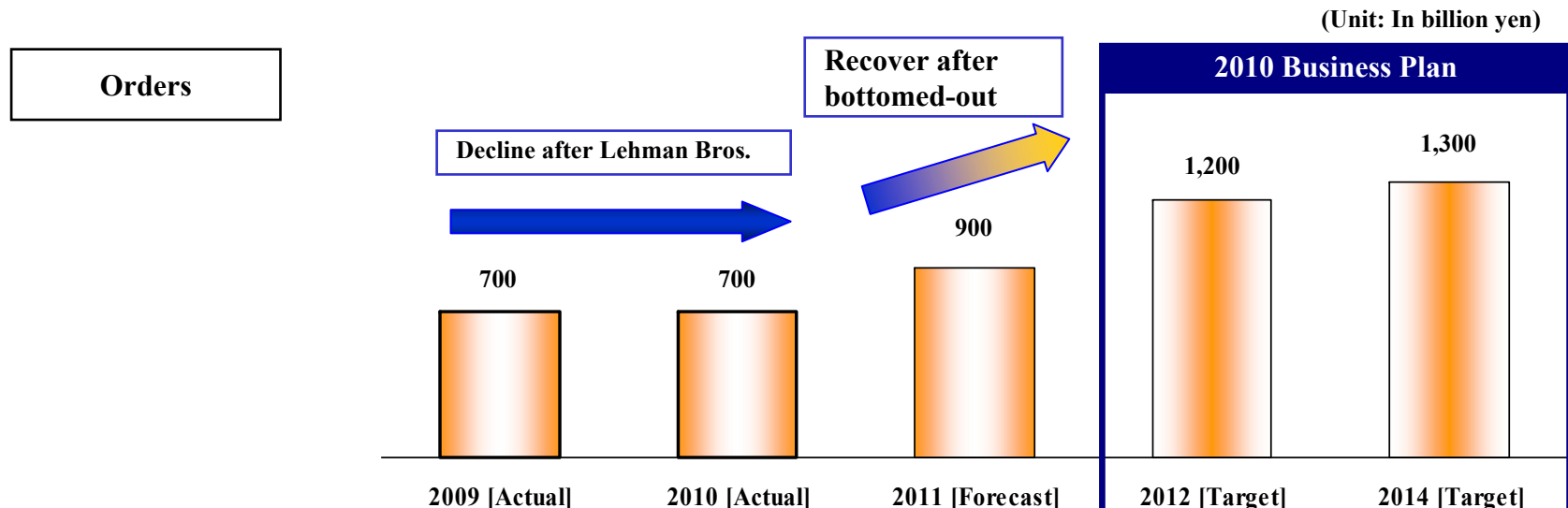
# 1. Progress of 2010 Business Plan

## Review of 2010

- **Orders: Secured the same level as the previous year.**  
Got orders for thermal power plants worldwide though the strict market condition has been continued due to the yen appreciation etc.
- **Sales/Profits: Profits have increased on year on year basis.**  
Overcame sales decline and yen appreciation by cost reduction through business process improvement and procurement.

## Prospect for 2011

- **Demand is rising continuously in Asia and emerging countries. Demand is recovering in North America and other industrial countries. Aim to get orders in an aggressive way.**



# 1. Progress of 2010 Business Plan

## Major activities and results in 2010

### **(1) Business Expansion with Localization in Promising Markets**

- Plants of JV with Larsen & Toubro Limited (L&T) in India launched full-scale operation producing Supercritical-pressure Boilers, Steam Turbines, and Generators.
- Build GT assembly plant in Georgia and Wind Turbine manufacturing plant in Arkansas in the U.S.

### **(2) Boosting the Service Business System**

- Promote service business with expansion of global network (e.g., Capital participation in Italian company ATLA).

### **(3) Product Development in Growing Fields**

- Began trial operation of J-series gas turbine, the world's highest thermal efficiency model
- Promote development of large offshore wind turbine (applying hydraulic drive technology through the acquisition of Artemis Intelligent Power, Ltd.).
- Completed construction of commercial production verification plant for lithium-ion secondary batteries

### **(4) Review of Business Operation**

- Business Integration in hydroelectric power generation system with Hitachi, Ltd. and Mitsubishi Electric Corporation
- Began discussion with Taiwanese firm Auria on business collaboration in Photovoltaic

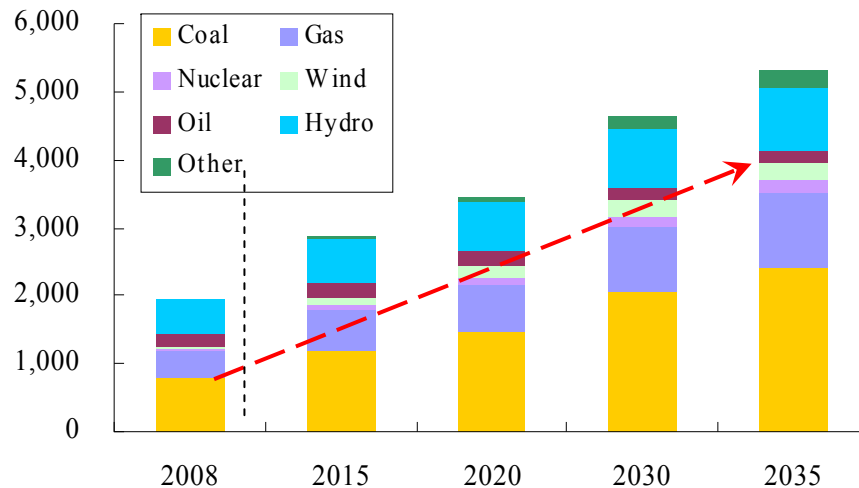
## 2. Trends in the Power Systems Market

## 2. Trends in the Power Systems Market

### Emerging countries (BRICs, Southeast Asia, Middle East etc.)

- Demand for power sources continues to rise.
- Nearly 80% of the increase that is projected to 2035 comes from an increase in demand in emerging countries.
- Coal firing is a major power source while the diversification of power sources leads to an increase in demand for natural gas-fired power generation.

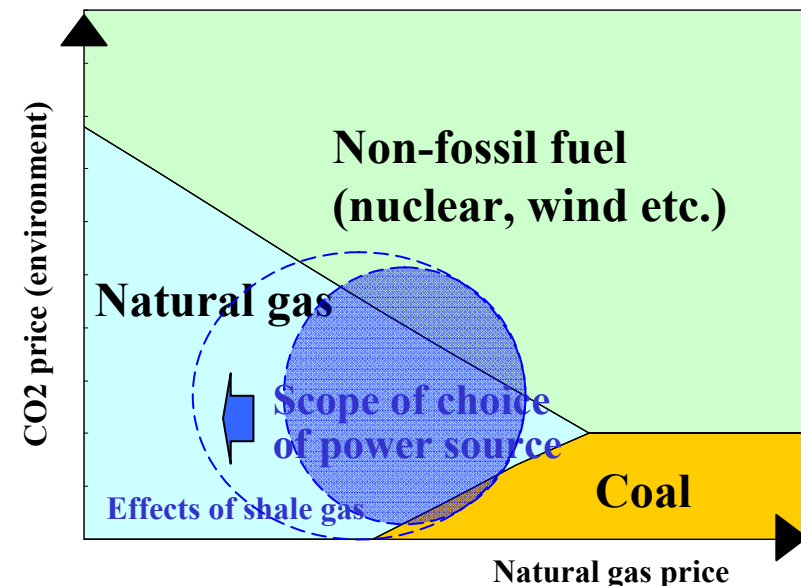
**[Emerging countries:  
Cumulative installed capacity forecast]**  
(GW)



(MHI's estimate from World Energy Outlook 2010)

### Industrial countries (North America, Europe, and Japan)

- Choice of power source continues to be based on efforts to balance the environment, economic efficiency, and energy security (3E).
- Unconventional gas (shale gas) is developed to keep gas prices low.
- The tightening of environmental regulations leads to the abolishment of obsolete coal-fired power generation. ⇒ Demand for GTCC increases.



## **3. Business Expansion with Localization in Promising Markets**



# 3. Business Expansion with Localization in Promising Markets (India)

## L&T-MHI Joint Ventures in India

- Joint Ventures with Larsen & Toubro (L&T)**  
 Boiler production capacity: 4 GW/year  
 Turbine/Generator production capacity: 4 GW/year
- Opening ceremony was held as the Boiler plant and Turbine plant began full-scale operation in January 2011.**

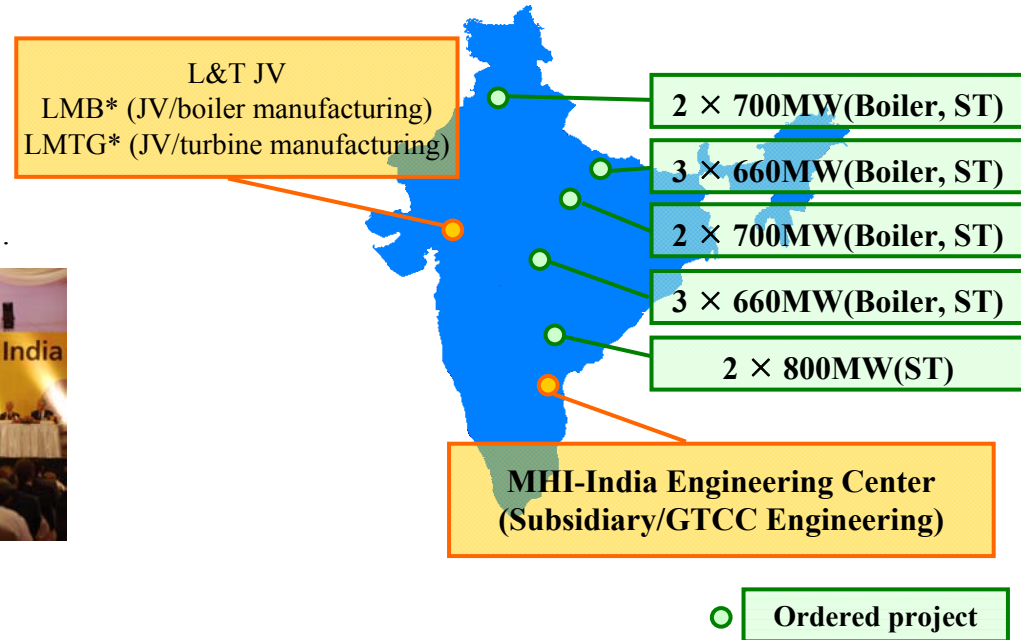


Got Orders consistently  
(Boilers (10 units) and Turbines (12 units))

### Turbine plant



### Boiler plant



\* LMB: L&T-MHI Boilers Private Limited  
LMTG: L&T-MHI Turbine Generators Private Limited

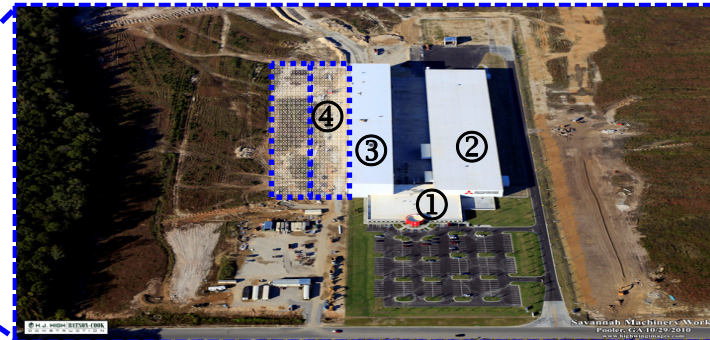
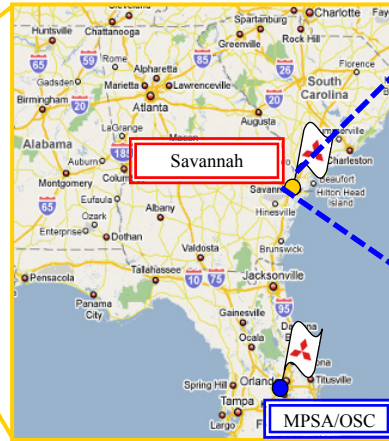
# 3. Business Expansion with Localization in Promising Markets (United States)

Following Orlando Service Center in Florida, Savannah Machinery Works in Georgia is being constructed in North America, a major market for Gas Turbines.

## U.S. Savannah Machinery Works



Savannah, Chatham County, Georgia



Site area: 400 thousand m<sup>2</sup>

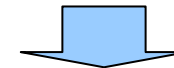
- ①: Office
- ②: Gas Turbine Combustors (hot gas path parts) plant
- ③: Rotor servicing plant
- ④: Gas Turbine assembly plant

Combustor manufacturing plant commenced full-scale operations and Opening ceremony was held in May 2011.



### Expanding factions of Savannah Machinery Works

- Establishing system to avoid risk from exchange rate fluctuation
- Reinforcing supply chain

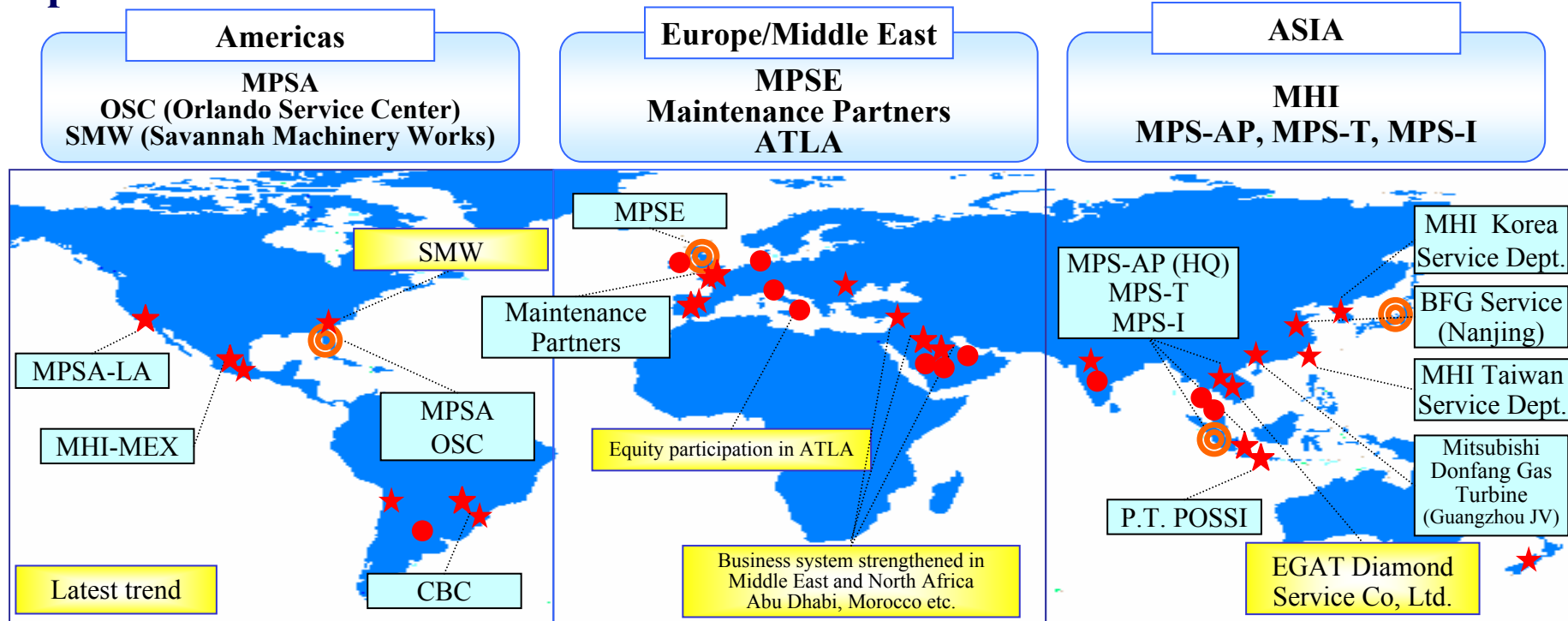


**Establish US-Japan production system**

## 4. Strengthening the Service Organization

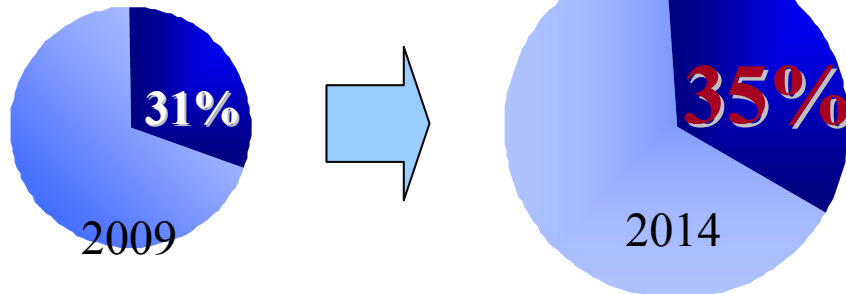
# 4. Strengthening the Service Organization

## Expansion of *Diamond Service Network*



Expand service business through *Diamond Service Network*

[Service ratio]



MPSA : Mitsubishi Power Systems Americas  
 MPSE : Mitsubishi Power Systems Europe  
 MPS-AP : Mitsubishi Power Systems Asia Pacific

★ : Base  
 ● : Partner

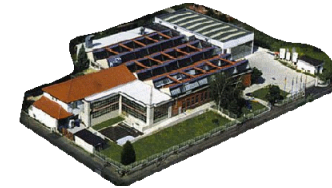


## 4. Strengthening the Service Organization

Under the slogan **CS First!** (Customer Satisfaction First), attractive service is developed.

### Europe

After the acquisition of Maintenance Partners, a Belgian company focused on maintenance and services including field services, we have concluded equity participation of gas turbine repair and manufacturing company in Italy, ATLA, to further expand our service capability in Europe.



### Southeast Asia

As a joint venture with the Electricity Generating Authority of Thailand (EGAT), a new company for gas turbine component repair shop (EGAT Diamond Service) is established.

May 2011: The repair factory begins operation.

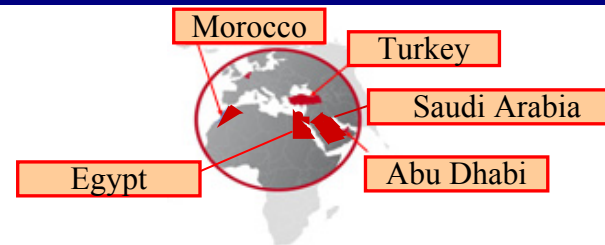


### North America

Besides Orlando Service Center (OSC), Savannah Machinery Works will commence its operation such as gas and steam turbine rotor inspection, gas turbine component manufacturing, and large ST rotor manufacturing.

### Middle East and North Africa




Our service organization including field service and shop capability is been developed in the Middle East, where many deliveries were made.



## 5. Product Development in Growing Fields

# 5. Product Development in Growing Fields

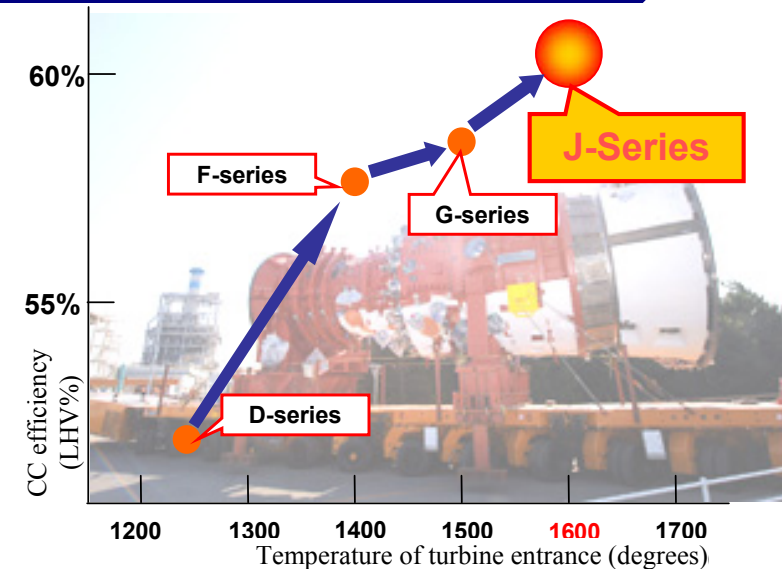
## Power Systems: Product portfolio

Fuel	Natural gas	Coal	Renewable energy
<b>Characteristics and issues</b>			
<b>Product development</b>	<ul style="list-style-type: none"> <li>Well-balanced power source with economic efficiency and environmental-friendliness</li> <li>Development of unconventional gas stabilizes gas price and supply</li> <li>Gas price are higher than coal price. It is important to increase economy and reduce GHG emission by improving thermal efficiency.</li> </ul>	<ul style="list-style-type: none"> <li>Coal is easy to be procured in the world and fuel is readily available at reasonable prices. In particular, coal is a major power source in emerging countries.</li> <li>But coal emits a great deal of CO<sub>2</sub> and establishing new coal facilities is difficult in industrial countries. More eco-friendly streamlining is needed.</li> </ul>	<ul style="list-style-type: none"> <li>Eco-friendly and CO<sub>2</sub>-free power source</li> <li>Development of offshore wind turbine is essential due to constraints on onshore locations for large ones.</li> <li>Countermeasures for grid-stabilization are needed because power output depends on natural conditions.</li> </ul>
	<ul style="list-style-type: none"> <li>Next-generation GTCC with world's highest efficiency</li> </ul>	<ul style="list-style-type: none"> <li>IGCC with world's highest efficiency</li> </ul>	<ul style="list-style-type: none"> <li>Highly-reliable offshore wind turbine</li> <li>Lithium-ion secondary battery</li> </ul>

# 5. Product Development in Growing Fields (Gas Turbine)

Contributing the realization of low-carbon society by pursuit of higher temperature and higher efficiency  
=Highest efficiency in the world: Development of “J” series gas turbine=

- Achieved 1,600 degrees Celsius with M501J at a MHI’s demonstration plant.
- World’s highest thermal efficiency, over 60% is projected.
- Got order for M501J × 6 units from Kansai Electric Power Co., Inc. for Himeji No. 2 Power Station (First Units) Begin commercial operation in October 2013
- Strategic model in the GTCC market  
Taking advantage of high economic efficiency by the world’s highest thermal efficient technology



Model	M501J	M701J
Frequency	60 Hz	50 Hz
CC* output	460 MW	670 MW
CC* efficiency	Over 60% (world’s highest level)	
CO2 emissions	50% reduction from conventional coal-fired power plant (comparison with MHI’s power plant)	
Planned shipment of 1st unit	2011	2014



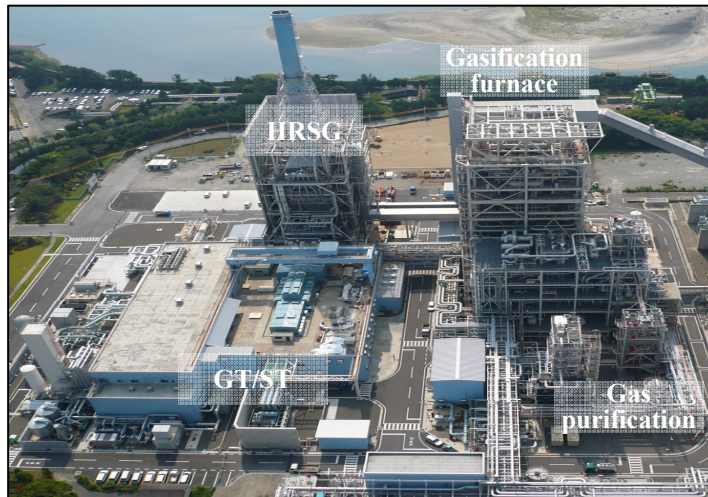


# 5. Product Development in Growing Fields (Clean Coal Technology)

## Coal gasification/IGCC

Verified high reliability  
Into the stage of commercialization and global expansion

- Cumulative operating hours : over 10,500 hours
- Availability : over 90%

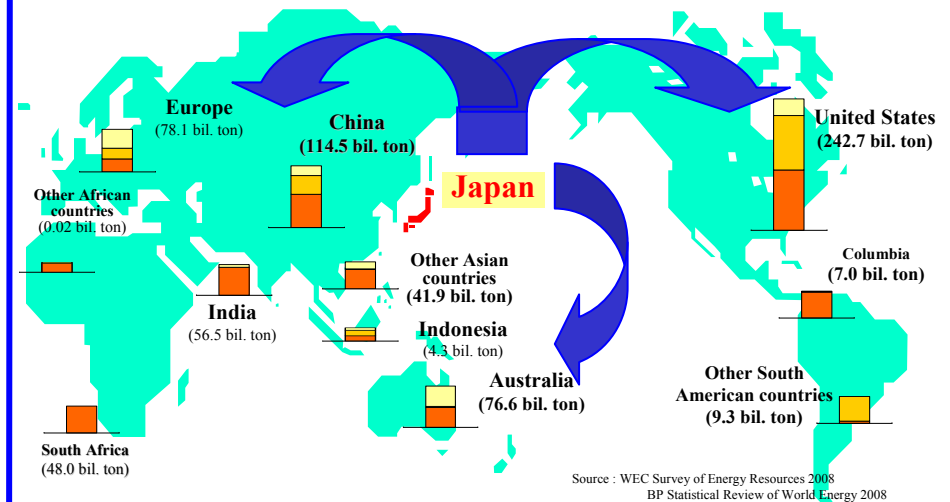
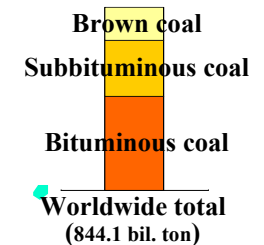
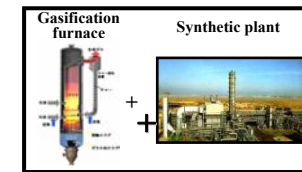


### Features of MHI's IGCC/coal gasification furnace

- World's highest power generation efficiency (in gasification combined power generation)
- MHI's gasification system of low-grade coal(\*) is optimal to the production of liquid fuels and chemical raw materials.

\*: Brown coal, sub-bituminous coal and other kinds of coal that account for half of all coal reserves and are not conventionally used due to their incompatibility with boilers

### Spread Japanese technologies to global markets (coal-producing countries)



# 5. Product Development in Growing Fields (Offshore Wind Turbine)

## Market trends and Development of offshore wind turbines

- The market of wind turbine continues to expand and is projected to reach 40 GW by 2020 (EWEA).
- Last July, a memorandum on the development of low-carbon energy was signed with Scottish and Southern Energy, a British company that developed a plan for the world's largest offshore wind turbine (32 GW). We will cooperate extensively with this company in this field.
- Based on the above, a 5-7 MW hydraulic-drive, large wind turbine is being developed.

## Acquisition of Artemis (Britain) leads to development of hydraulic-drive wind turbine

- Artemis Intelligent Power, Ltd. (Britain) has been acquired, providing access to Artemis' proprietary and ingenious hydraulic drive technology.
- Advantages of the hydraulic drive  
Making large wind turbines required larger speed-up gears.  
⇒ This has become easier after the introduction of a hydraulic drive.  
(Reduction of weight and improvement of reliability)
- Combined with our wind turbine technology, a new hydraulic-drive wind turbine is being developed. We expect it to be very reliable and competitive.



# 5. Product Development in Growing Fields (Lithium-Ion Secondary Batteries)

- Construction of Nagasaki Plant was completed in 2010, in preparation for the full-scale launch of the business of lithium-ion secondary batteries.
  - Introduction to internal and external applications accelerates.
- <Example>

## For energy storage systems

### 100 kW battery-charging system

100 kW control rack



+

20 kWh battery rack



#### Application

- Anti-blackout measure
  - Reduction of electricity demand at peak times
- Applicable to the maintenance of lifelines for high-rise apartments etc. accommodating nearly 300 households (elevators, feed-water pump etc.)

Introduced to apartment in Kokubunji, Tokyo

### 2 MW container battery-charging system



The system will reach the market at the end of 2011.

Demonstrative operation will be commenced in July 2011.



### Portable power source

Output: 100 W

Effective capacity: 390 Wh  
(load of 300 W)



Emergency relief to victims of earthquake disaster

Supplied to electricity companies etc. for use as emergency power source

## For vehicles

### Forklifts



### Demonstrative driving of electric bus



### Industrial vehicles



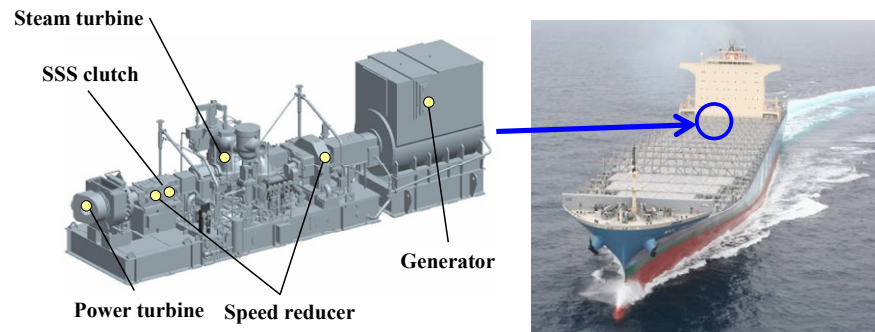
# 5. Product Development in Growing Fields (Marine Machinery and Engines)

<Project MEET > is underway to propose solutions for environmental regulations and improve fuel efficiency.

(MEET stands for Mitsubishi Marine Energy & Environmental Technical Solution-System.)

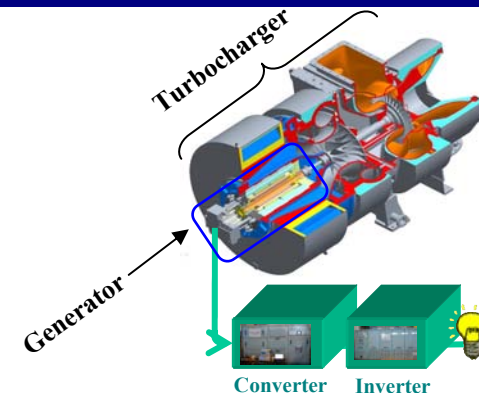
## MERS (Mitsubishi Energy Recovery System) for marine heat recovery

Collect energy from the exhaust of marine diesel engines to generate power on a ship.



## Development of marine hybrid turbochargers

- The world's first-ever hybrid turbocharger has been developed: the function of the generator is incorporated in the turbocharger of the marine engine.
- Energy from extra exhaust gas is used to generate power on a ship. This helps save energy during a voyage.





## **6. Actions for Restoration After Great East Japan Earthquake**

# 6. Actions for Restoration after Great East Japan Earthquake

The production facilities of our Power Systems were not affected by the Great East Japan Earthquake.

We are contributing to the restoration of damaged power sources and the supply of new emergency power.

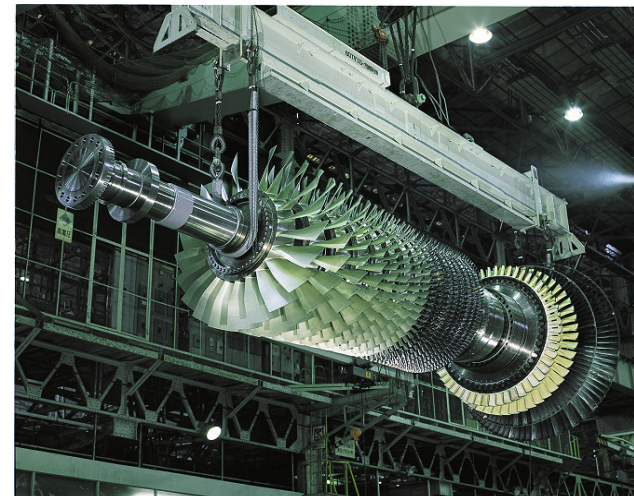
## Restoration of disaster-stricken power sources (power generators delivered by our company\*)

- An Emergency Task Force was set up immediately after the earthquake.
- Using our Company-owned helicopter, we began sending staff on Sunday, March 13 to facilitate restoration.
- To date, we have helped restore nearly 4.5 million kW of electricity.
- The total number of workers we have sent to the disaster-stricken power stations is more than 9,000 persons/day.
- At the same time, we have supplied emergency relief to disaster-stricken power stations and evacuation centers in neighboring municipalities.

\* Power sources delivered to Tokyo Electric Power, Tohoku Electric Power and clients of diesel engine/gas turbine generators

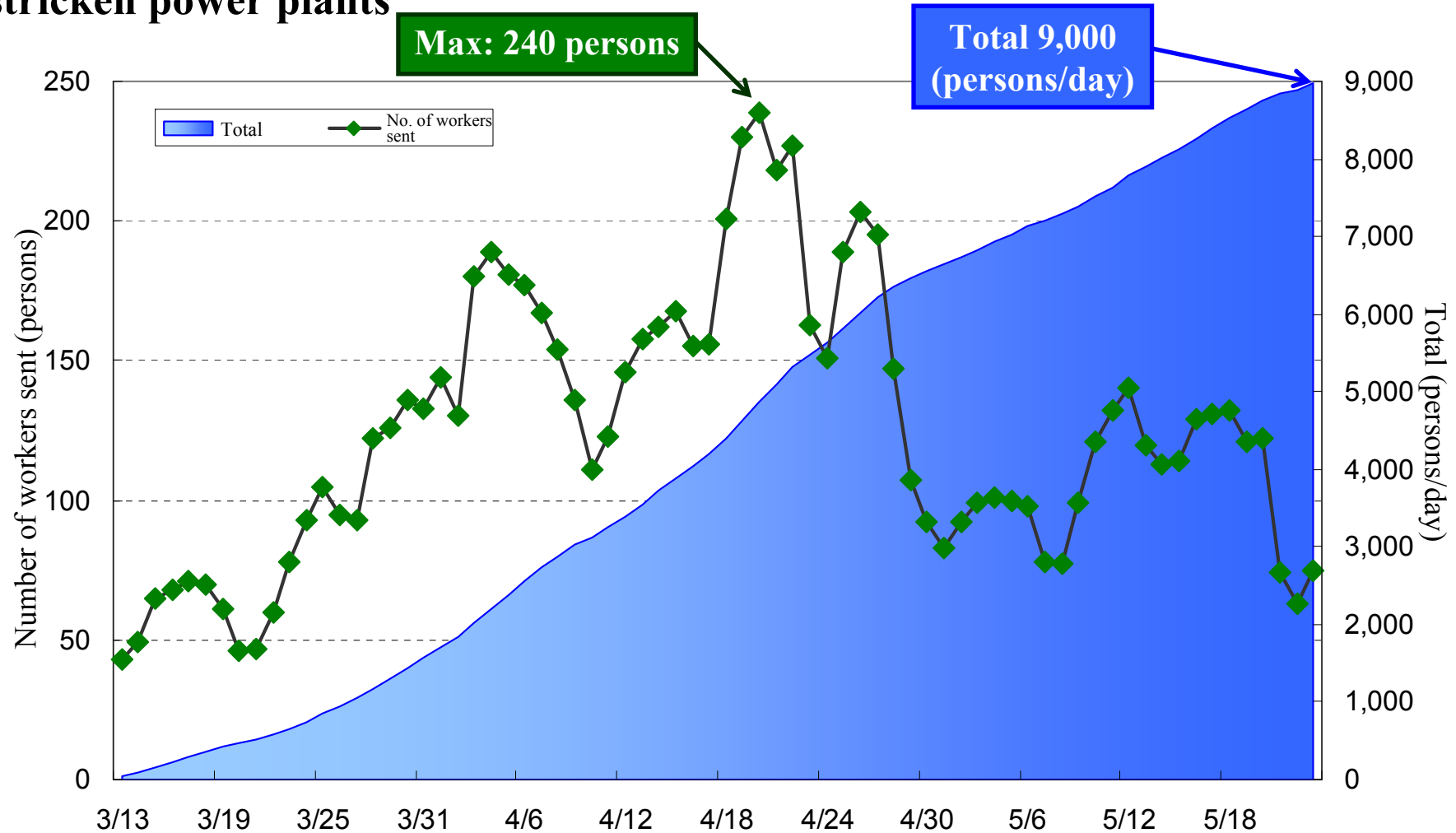
## Supply of new emergency power source

- A total of five gas turbines have been urgently supplied to Tokyo Electric Power and Tohoku Electric Power.
- Currently responding to requests from several companies for the urgent supply of gas/diesel engines.



# 6. Actions for Restoration after Great East Japan Earthquake

## ■ Number and total number of workers sent to assist with restoration of disaster-stricken power plants





Our Technologies, Your Tomorrow

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