Special Feature

The Potential of Our Target Markets and the Fuji Electric Group's Advantages

The Fuji Electric Group operates in a variety of business fields ranging from electrical energy "supply" to "distribution" and "demand."

This section introduces examples of how the Fuji Electric Group is making use of "technology to unlock the potential of electricity" in the field of "energy and the environment."

TARGET FIELD 1

Geothermal Power Generation

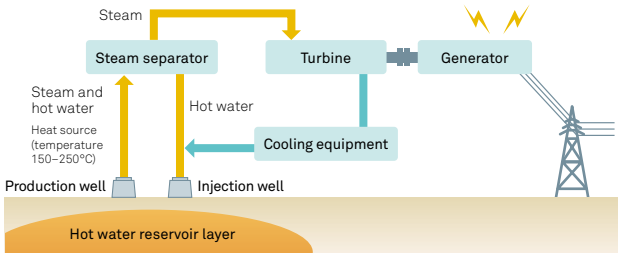
Market's Growth Potential

Renewable Energy with Stable Power Generation

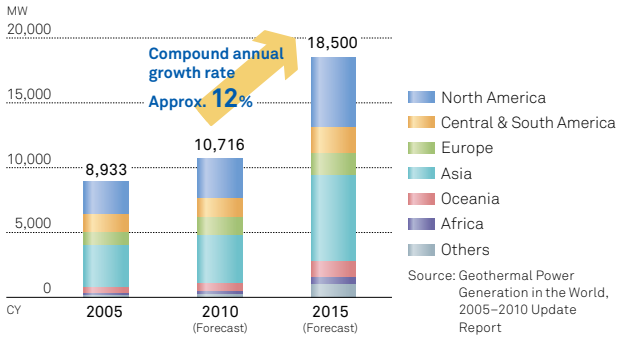
Geothermal power generation is an environmentally friendly method of generating electricity, using underground water heated by magma pools as steam energy. The steam and hot water used are returned underground, and the evaporated steam returns to the ground as rainwater, making this a renewable energy source. Unlike wind and photovoltaic power generation, which are also renewable energy sources, geothermal power provides stable generation of electricity because it is unaffected by the weather or climatic conditions. As countries around the world work to prevent global warming, geothermal power generation holds promise as a clean energy source with low CO_2 emissions.

Going forward, an annual average capacity of 1,600MW of new geothermal power plants are expected to be built around the world, with a particularly large number being built in Asia and North America. In addition, an average annual capacity of 160MW of new binary power plants, which can generate electricity from lower-temperature heat sources, are expected to be built in a number of countries from 2011 to 2014. Furthermore, developing new technologies including steam extraction by artificially injecting water into high-temperature rock bodies (bedrock with a high temperature but insufficient water) is being developed, and rapid growth is forecast to occur within 5 to 10 years.

Geothermal Power Generation Framework



Global Geothermal Power Generation Markets



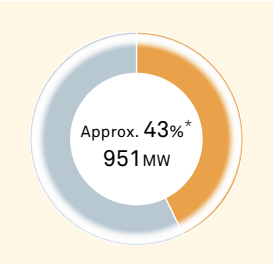
Source: Geothermal Power Generation in the World, 2005–2010 Update Report

Fuji Electric Group's Advantages

Global Leader in Geothermal Turbine Technology

The Fuji Electric Group has a high level of technical expertise, with reaction-type turbine technology that makes the highly efficient generation of electricity possible. In addition, geothermal steam contains highly corrosive gasses, but the Group also has an extensive track record in anti-corrosion technology for turbines and generators. With roughly 50 years of experience, we are able to provide comprehensive plant construction that spans from power generation system design to construction and test operations. Backed by these technological capabilities, Fuji Electric delivered 951MW of plant capacity over the 10 years to March 2010, representing approximately 43% of the 2,207MW of geothermal power generation capacity built during that period.

Fuji Electric Group's Share of Geothermal Power Generation Facilities



* Share of geothermal power generation capacity created over the 10 years to March 31, 2010. According to Fuji Electric surveys.

Fuji Electric delivered the world's largest-capacity* (140MW) geothermal power plant to the Nga Awa Purua geothermal power station in New Zealand.

* As of September 2010, according to Fuji Electric surveys.

Materials specially suited to resist the corrosive components contained in geothermal steam are used in turbines for geothermal power generation.

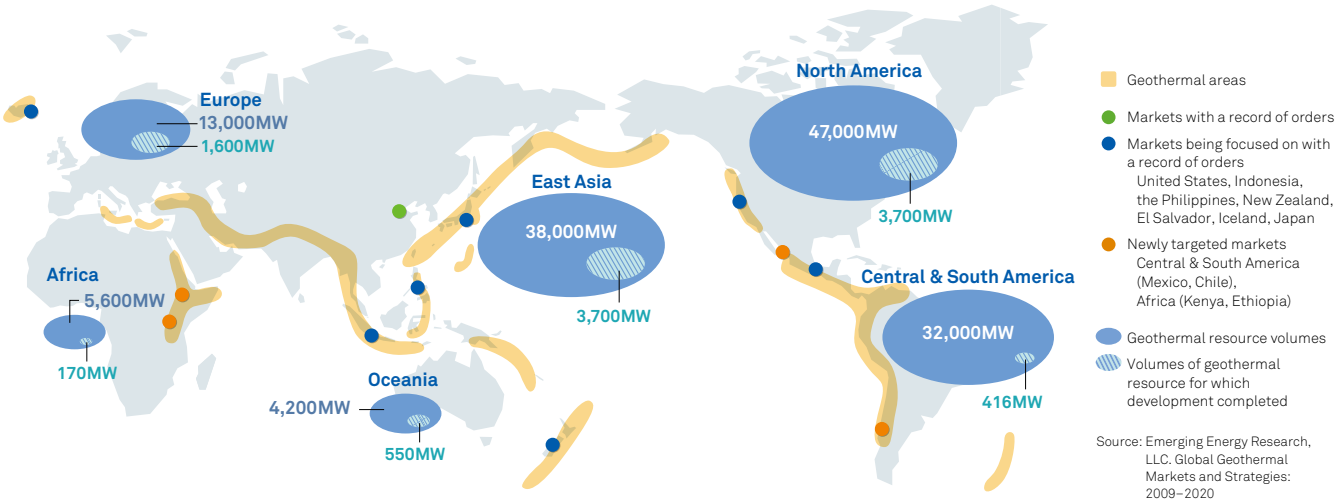
Looking Ahead

Strengthening Regions with a Record of Orders and Developing Potential Markets with Abundant Resources

Utilizing its advanced technological capabilities and expertise built up over more than 50 years, Fuji Electric intends to expand its geothermal power generation business as a renewable energy source with high growth potential.

Geothermal power plants need to be built in areas with geothermal resources. This means that the regions in which geothermal power generation is possible are limited relative to thermal and nuclear power generation, but there are abundant amounts of untapped resources in geothermal regions, as well as many regions that have yet to be developed. The Fuji Electric Group has an extensive track record in countries including Indonesia, the Philippines, New Zealand, and Iceland, and going forward we will emphasize orders in the priority regions of the United States, which is promoting renewable energy sources, as well as Central and South America, which have undeveloped geothermal resources.

Geothermal power is generally created by steam that has been heated to 150–250°C turning turbines, but the Fuji Electric Group has also developed "binary power generation" technology that uses lower-temperature steam as a heat source, with the condensation of media with a lower boiling point used to generate electricity. Using this technology, we are developing markets in regions that do not have the high-temperature heat sources normally required for geothermal power generation.



Source: Emerging Energy Research, LLC. Global Geothermal Markets and Strategies: 2009–2020

Unique Features of Fuji Electric's Binary Power Generation

1. By effectively utilizing lower-temperature steam that could not previously be used, and lower-temperature hot water returned underground after being used for geothermal power generation, regions for geothermal power generation can be expanded.
2. Electricity is generated using normal pentane, which has a low global warming coefficient and low boiling point of 36°C, as a secondary media.
3. The use of air-cooled heat exchangers eliminates the need for coolants.

Vertically Expanding the Business Field

In addition to our main products of steam turbines and turbine generators, we are expanding the "turnkey businesses" of comprehensive plant construction, including the steam generators and cooling equipment required by geothermal power plants, and the construction for their installation. We are also considering becoming involved in the geothermal power generation business in the future.

TARGET FIELD 2

Power Semiconductors

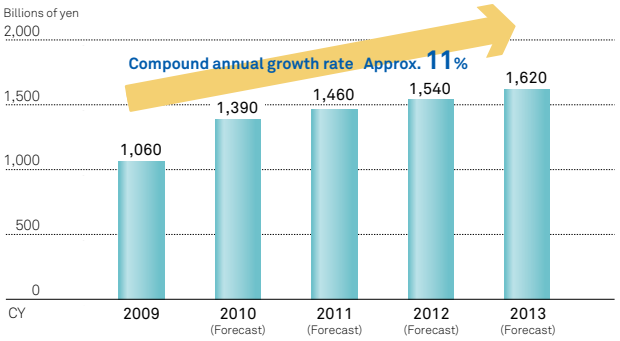
Market's Growth Potential

Power Semiconductors as Key Devices for Energy Savings

Power semiconductors are semiconductor devices that are capable of large-current, high-voltage electric power conversion. "IGBT" is a type of power semiconductor for which expectations are high as a key component for achieving energy savings in the areas of industrial and social infrastructure.

IGBTs are used to control equipment that uses even greater electric power, to control the drive of motors, and to convert and control electrical power (current and voltage). These devices not only contribute to reduced energy consumption by factories and commercial buildings, which are the biggest users of electricity, they are also becoming increasingly important in the growing areas of hybrid and electric vehicles.

Global Power Semiconductor Market

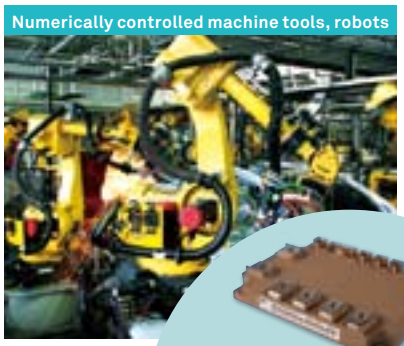


Source: Fuji Electric estimates based on WSTS data.

Markets in which IGBTs are Used

Factories

IGBTs are used to control the drive of machine tools and robots. They are also used in inverters, which convert direct current to alternating current, and control motors for a stable drive with smooth acceleration and deceleration.



Transportation
(automobiles, railways)

IGBTs are used in the power control units that control the motor drive of hybrid and electric vehicles. In railcars, they are used in the main converters that control the drive for a stable ride.

Renewable Energy Sources
(photovoltaic power, wind power)

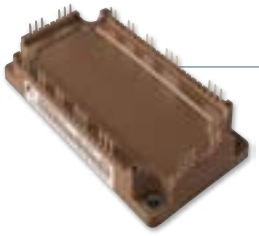
IGBTs are used in photovoltaic power generation in the power conditioners that convert electrical voltage and current for use by the equipment. Wind and photovoltaic power generation are easily affected by the weather and climatic conditions, and IGBTs are also used in the power stabilizers that equalize the energy being generated.

Fuji Electric Group's Advantages

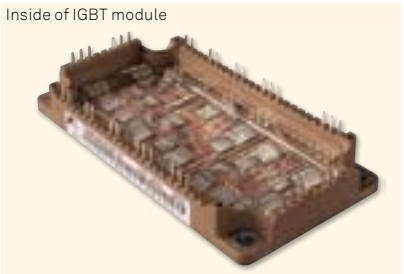
Fuji Electric's Power Semiconductors Achieve High Efficiency and Reliability

We are using our proprietary technology to make IGBT chips as thin as possible, to improve efficiency with lower loss and lower noise. This also requires sophisticated technological capabilities and expertise in mounting the chips on substrates and in superior heat-resistant modularization. The Fuji Electric Group excels in technologies that incorporate various analog technologies, including packaging for high reliability.

Based on this technological strength, the Group's power semiconductors are highly regarded for their quality and reliability, and are used by well-known manufacturers around the world in fields like factory automation and automobiles. In particular, the Group has a leading global share in industrial-use IGBTs.



Industrial-use IGBT module



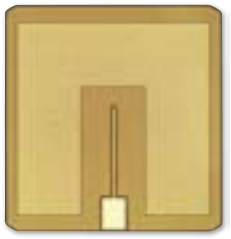
Inside of IGBT module

Looking Ahead

Addressing Calls for Higher Performance in the Field of "Energy and the Environment"

With an emphasis on IGBTs, where it has a strong competitive position with significant growth potential, the Fuji Electric Group is pursuing synergies by loading IGBTs on its other products to expand its power semiconductor business in the field of "energy and the environment." A large portion of the Group's IGBTs are used in the industrial sector, primarily for inverters, and going forward we will work to expand their use to hybrid and electric vehicles, and renewable energy.

We are also working to further strengthen our competitive position by developing next-generation power devices using silicon carbide (SiC) and gallium nitride (GaN), which have improved heat resistance compared with traditional silicon and achieve significant loss reduction and miniaturization. Users are seeking improved energy efficiency and smaller devices, but manufacturers are nearing the limits in terms of loss reduction and miniaturization as they work to improve efficiency using conventional silicon chips. Next-generation power devices are also highly superior in terms of heat resistance. The Fuji Electric Group plans to start by shipping samples of SiC diodes* during fiscal 2010, and then using these in modules mounted with IGBTs.



SiC device jointly developed with the National Institute of Advanced Industrial Science and Technology (size: 2.5 x 2.5mm)

* Diode: An electronic element that acts as a rectifier (allowing electric current to flow in one direction only).

Effect of Using SiC Versus Silicon (estimated reduction benefit)

Application	Benefit	
	Loss	Equipment volume weight
Server power supply	−35%	—
General-use / high-voltage inverter	−60%	−75%
UPS	−60%	−40%

TARGET FIELD 3

Smart Grid

Market's Growth Potential

Smart Grid Market Taking Shape Globally

As renewable energy sources like photovoltaic and wind power become increasingly popular, the smart grid market for next-generation power transmission networks that distribute both the supply and demand of electricity is expected to grow. In addition, as the populations of countries around the world become increasingly concentrated in urban areas, energy consumption and CO_2 emissions are becoming concentrated in cities, and in response verification testing has begun at the city level for greater ecology in what are being called smart communities. These smart communities are seeking to address the spread of renewable energy sources with stabilization and energy savings in the city's power transmission grid.

The smart grid market includes a very broad range of supporting industries, including the smart meters used to manage information regarding the supply and demand of electricity via a telecommunications network, stabilizers used in wind and photovoltaic power generation, power conditioners that convert the direct current generated to alternating current, and control systems used to stabilize and increase the energy efficiency of the power transmission grid, and this market is seen as having the potential of creating many business opportunities.

Fuji Electric Group's Advantages

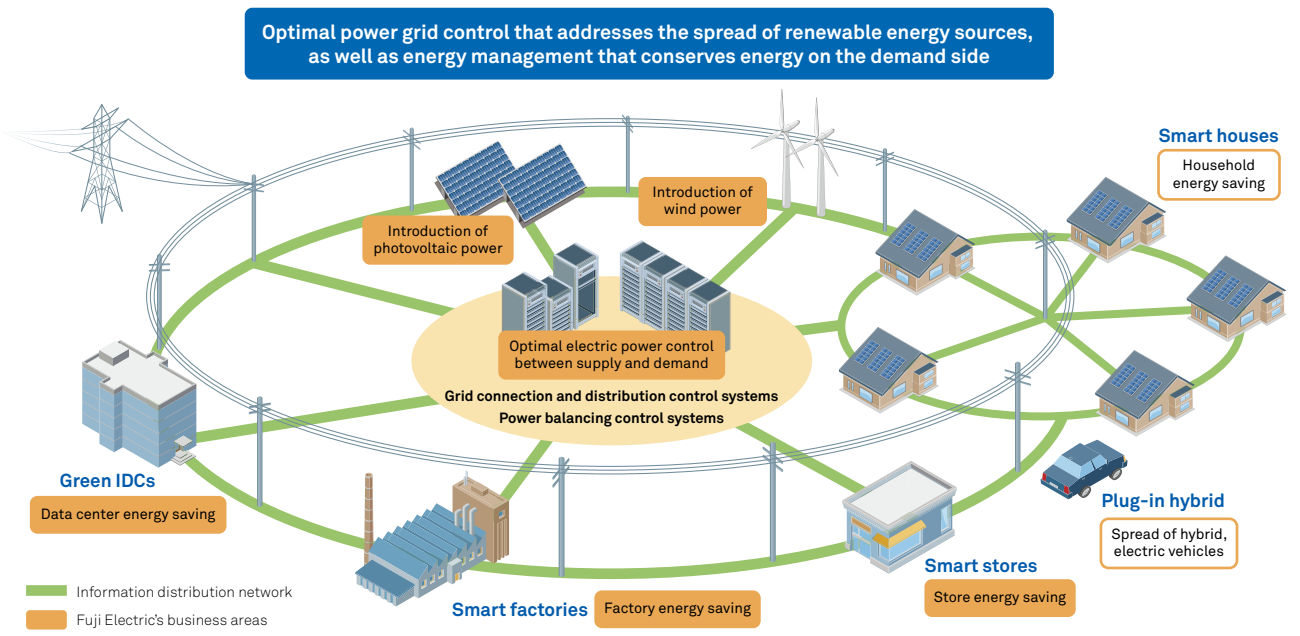
Contact Points with Markets in a Wide Variety of Fields

The Fuji Electric Group has a long history in control systems used to connect power stations to grids and distribute and stabilize electricity, and has developed technologies and expertise in the control systems for electric power supply that form the backbone of smart grids.

On the demand side, we supply power semiconductors, inverters, energy control systems, and other equipment and systems that contribute to more-efficient use of electricity. The Group has a wide lineup of products required on the demand side, and offers these in combination with a variety of power electronics equipment that achieves energy savings.

Few companies in the world are able to match the Fuji Electric Group in terms of having businesses on both the supply side and demand side of electrical power. With a wide variety of contact points with the smart grid market, we are able to provide integrated solutions, and using this strength we intend to strengthen this business while monitoring the full-scale formation of the market.

Fuji Electric Group's Range of Contact Points with the Smart Grid Market



Looking Ahead

Strengthening Businesses in Supply, Distribution, and Demand

Energy Supply

We are working to expand our business in the clean energy market with renewable geothermal power generation, our unique photovoltaic power generation systems, and fuel cells. We are also developing businesses in equipment for energy conversion and power stabilization (power conditioners, power stabilizers, etc.) for wind and photovoltaic power generation.

Power stabilizers

Energy Distribution

We are entering the smart grid market with grid connection and distribution control systems that achieve stable power distribution from power plants and power balancing control systems that control the amount of electricity being supplied. Smart meters, which measure the amount of electrical power being generated and consumed and manage that information, are important devices in the smart grid market. Fuji Electric already has a large share of the domestic market for watt-hour meters, and going forward we plan to offer high-performance smart meters that we are jointly developing with General Electric Company of the United States.

Energy Demand

We are working to expand our business in power electronics products, focusing on inverters that achieve energy savings in factories' manufacturing lines and air conditioning equipment, and on the IGBT power semiconductors that are core components of those inverters. The Group has a wide range of businesses related to electricity, including UPSs, power supplies, and substation equipment. Going forward, we will work to expand our businesses related to energy saving with packaged energy management systems that achieve highly efficient energy usage.

Energy-Saving Businesses Offered by Fuji Electric Group

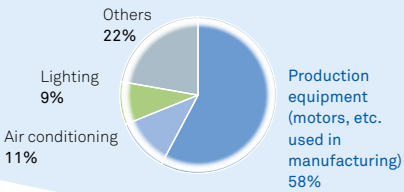
Power electronics products

Power electronics equipment
- Power semiconductors
- Inverters
- Motors
- Measuring instruments
- Sensors
- UPSs
- Power supplies
- Air conditioners
- Refrigerated and freezer showcases

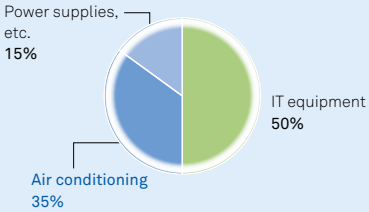
Power receiving and distribution substation equipment
- Transformers
- Industrial-use power supplies
- Gas insulated switchgears

Energy management systems
"Visualization," "Analysis and evaluation," "Optimal operational control"

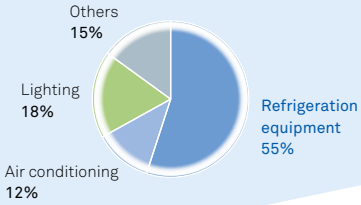
Breakdown of Electricity Usage in Factories*



Breakdown of Electricity Usage in Data Centers*



Breakdown of Electricity Usage in Stores*



* According to Fuji Electric surveys.

Promoting energy saving on the demand side by packaging optimal devices in energy management systems

Special Feature