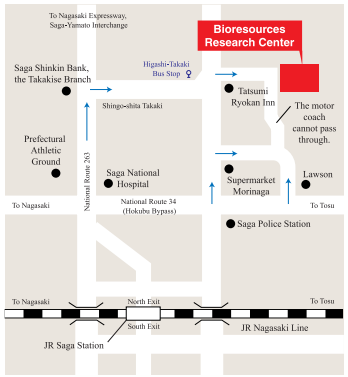
RESEARCH LABORATORY INFORMATION

Research Laboratory

Access

- Take subway from Fukuoka Airport, get off at Subway Hakata Station.
- Take a Nishitetsu bus (Destination Nos. 47s, 48s) from JR Hakata Station, get off at Shimizu 4-chome Bus Stop, and walk 1 min.
- Take a Nishitetsu bus (Destination No. 63s) from Tenjin, get off at Shimizu 4-chome Bus Stop, and walk 1 min.
- Take a Nishitetsu bus (Destination Nos. 49s, 62s) from Tenjin, get off at Minami Keisatsusho-iriguchi (Minami Police Station) Bus Stop, and walk 5 min.
- Take a Nishitetsu bus (Destination Nos. 47s, 48s) from Nishitetsu Ohashi Station (Tenjin-Omuta Line), get off at Shimizu 4-chome Bus Stop, and walk 1 min.
- On foot, 10 min. from JR Takeshita Station
- By taxi, 15 min. from JR Hakata Station and 25 min. from Fukuoka Airport.
- 3km from the Hanmichibashi Exit on Route 2 of the Fukuoka Urban Expressway (15min. by car)

Bioresources Research Center



Access

- Take a Saga Municipal bus (Destination No. 32s) from JR Saga Station, get off at Higashi-Takaki Bus Stop, and walk 10 min.
- 6km from Saga-Yamato Interchange (15 min. by car)
- 3km from JR Saga Station (10 min. by car)

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FAX: +81 (0)952-33-8579

KYUSHU ELECTRIC POWER CO.,INC.

To be kyuden' s technological jewel, all researchers are working together to tackle R&D

Research Laboratory

1-47, Shiobaru 2-chome, Minami-ku, Fukuoka City, 815-8520, Japan TEL: +81 (0)92-541-3090 FAX: +81 (0)92-541-3255

Kyushu Electric Power Co., Inc. **http://www.kyuden.co.jp/** | Kyushu Electric Power Group **http://www.q-style.jp/**

- Please visit our websites for a report (Techno Report) summarizing the latest research conducted by the Research Laboratory.

May 2008

RESEARCH LABORATORY INFORMATION

Kyushu Electric Power Co.,Inc.

KYUSHU ELECTRIC POWER CO.,INC.

Ensuring Inspiration and Abundance for Tomorrow

Energy supports comfortable lifestyles and industries.
Energy offers us endless possibilities for creating the future of which we dream. For more than 50 years, the Research Laboratory of Kyushu Electric Power Co., inc. has conducted technological R&D related to many aspects of the energy supply to customers. We have now entered an era marked by growing concerns about environmental conservation; therefore, we have accelerated our efforts to engage in R&D with an even stronger sense of mission and the motivation to take on challenges as we address the issues that face our world.

Toshiro Noguchi
General Manager
Research Laboratory

■Preface

The Research Laboratory of Kyushu Electric Power Co., Inc. was established in 1952 to meet the need for R&D activities. Throughout its history of over 50 years, the laboratory has focused on R&D to maintain and improve the level of power system technologies and has tackled new technologies responsive to the needs of the age. The former includes technologies used for keeping the power system stable and reducing costs, and the latter pertain to environmental conservation and renewable energy sources. We promote R&D so that new technologies and findings can be shared among Kyushu Electric's group companies. In this way, we can build on and improve our capacity to create profit and offer more benefits to society at large.

We are committed to progressing with our efforts to conduct R&D on new technologies so that we can keep up with business environments and technological progress and respond to electricity liberalization and progress in the IT field. As Kyushu Electric's research laboratory, we are tackling a wide range of developments in technology and providing useful information that attends to the customer's viewpoint and proposes new ways of living.

■History

- **Feb. 1952**
  Opened Technical Research Laboratory
- **Jun. 1956**
  Changed name to Research Laboratory
- **Sept. 1965**
  Moved from Yakuin (Central Ward) to present location at Shiobaru (South Ward)
- **Jul. 1983**
  Abolished General Affairs Office and reorganized structure into 4 research sections: Technological Development, Power Engineering, Thermal Power, and Civil Engineering
- **Jul. 1986**
  Reorganized structure into the Research Planning Office and 4 research sections: Demand Development, Power Engineering, Energy Research, and Civil Engineering
- **Jul. 1988**
  Changed name from Research Planning Office to Research Planning Section
- **Jul. 1991**
  Changed name from Demand Development Section to Electricity Utilization Research Section
- **Jun. 1992**
  Constructed new main building and remodeled former main building into lab used exclusively for experimentation
- **Jul. 1997**
  Reorganized structure into the Research Planning Section, a Bioresources Research Center and 13 research groups
- **Jul. 2000**
  Reorganized structure into a Bioresources Research Center and 17 research groups
- **Jul. 2001**
  Reorganized structure into a Bioresources Research Center and 14 research groups
- **Aug. 2001**
  Reorganized structure into a Bioresources Research Center (2 groups) and 13 research groups
- **Jul. 2004**
  Reorganized structure into a Bioresources Research Center (2 groups) and 14 research groups
- **Jul. 2006**
  Reorganized structure into a Bioresources Research Center (2 groups) and 15 research groups

■Major research fields

- Field 1 — Stable power system & cost reduction
- Field 2 — Environmental conservation
- Field 3 — Demand creation
- Field 4 — New businesses
- Field 5 — New technology

RESEARCH LABORATORY

Organizational structure

Research Structure Facilitating Extensive and Intensive Research

The need for energy has become more and more complex as a result of increasing diversity in lifestyles and awareness of the global environment as well as the aging of society and greater reliance on IT. To meet the challenge posed by these changes, the laboratory has 17 specialized research groups that carry out extensive, detailed R&D on itemized categories.

General Manager

Administrative and planning groups

Administration Group
- Administration of Research Laboratory
- PR for research activities

Research Planning Group
- Mid- and long-term research strategy planning
- Evaluation and management of research results
- Planning and management of research

Patent Affairs Group
- Management of patents and utility model rights
- Patent strategy planning

New Business Promotion Group
- Administration of research activities for new businesses

Research groups

Lithium Battery and Electric Vehicle Technology Group
- Li-ion battery technology
- EV technology

Environment and Chemistry Engineering Group
- Chemical analysis and evaluation technology
- Anti-corrosion technology
- Environmental conservation and restoration, and waste treatment technology
- Effective utilization of coal ash
- Waste volume reduction and recycling technology

Mechanical and Metallurgical Engineering Group
- Power equipment integrity evaluation technology
- Power equipment life assessment technology
- Power equipment troubleshooting technology
- High-precision nondestructive inspection technology

Electricity Utilization Technology Group
- Electric heating technology
- Home electrification technology
- Lifestyle support technology

Transmission Facility Engineering Group
- Distribution and transmission technology
- Insulation technology
- Power generation and substation technology
- Lightning protection technology

Power System Engineering Group
- Power systems phenomena analysis technology
- Power quality technology

Civil Engineering Group
- Civil structure residual life assessment technology
- Equipment maintenance preventing sediment disasters

Information and Telecommunication Technology Group
- Office IP telephony systems architecture
- Image processing and radio ID technology

Power Storage Engineering Group
- Momentary voltage drop prevention testing and evaluation
- Superconductivity application technology
- Charge/discharge control technology for electric energy storage devices
- Superconducting material evaluation technology

New Power Generation System Technology Group
- Photovoltaic power generation technology
- Geothermal power engineering technology
- Biomass utilization technology
- Hydrogen engineering technology

Distributed Resources Technology Group
- Fuel cells technology
- Gas engine technology

Bioresources Research Center

Practical Biotechnology Group
- Cultivation facility development and cultivation technology
- CO_2 fixation utilizing plants
- Agricultural and fishery engineering technology

Agricultural Product Cultivation Group
- Agricultural electrification technology
- Effective use of coal ash for agricultural sector

Field 1

Stable power system & cost reduction

Delivering a Stable Supply of Electricity Chosen by the Customer

One of the missions of the Research Laboratory is to deliver a reliable power supply to Kyushu Electric Power's customers at the lowest possible cost and to ensure the continuation of comfortable lifestyles. To keep our promise, we take various approaches in our R&D to achieve a more stable supply of power and to reduce costs.

Improved reliability and lowered cost thanks to power generation equipment with longer life spans

Determined to improve the reliability of power plants and reduce costs, the laboratory conducts R&D to prolong the life of facilities, enhance water quality control and O&M technology, and enable materials diagnosis, inspection and analysis using the latest equipment.

Technologies for prolonging the life of power equipment

Environment and Chemistry Engineering Group

To prolong the life of power generation equipment, such as boilers and tanks, we must improve their resistance to rust and abrasion. We work to achieve this through our R&D by treating equipment surfaces using metallic or ceramic spraying. The scope of our research includes corrosion protection for steel transmission towers and distribution facilities.

Composite cycle test system

Enhancing water quality control at power plants

Environment and Chemistry Engineering Group

The group has been responsible for various research projects implemented jointly with the head office and power plants, one example being All Volatile Treatment (AVT). Until now we have developed and put into use Combined Water Treatment (CWT), which is utilized to prolong intervals between chemical cleanings, technology for reducing corrosion products at nuclear power plants and condensate filters, as well as other technological developments.

Water treatment test

Advanced power plant O&M technology

Environment and Chemistry Engineering Group

Our endeavors include conducting research to prepare facility diagnosis technologies using the oscillation method and the Acoustic Emission (AE) method* for use on site and to reduce radiation exposure at nuclear power plants. We also developed technology to regenerate the catalyst of a denitrification facility. The regenerated catalyst's quality is similar to that of a new one, allowing us to avoid total replacement. Since then, the technology has been used on site.

*The AE method is a method that is used to diagnose and assess material degradation or damage by detecting in a high-frequency band (from a few dozen kHz to 1MHz) the weak elastic waves emitted when a material cracks or is worn or leaking.

Diagnosis technology using the AE method won the Society of Plant Engineers Japan Best Paper Award 2007.

Catalyst restoration test system

Diagnosis, testing and analysis using the latest equipment

Environment and Chemistry Engineering Group

We adopt cutting-edge technologies and equipment to diagnose, test and analyze the corrosion status of materials, water quality, and other factors. This equipment includes inductively coupled plasma emission spectrometers that can simultaneously analyze trace elements, electron probe micro analyzers (EPMA), scanning electron microscopes (SEM) and X-ray diffractometers (XRD).

*An X-ray diffractometer (XRD) is used to examine the elements of which a substance is composed (right).
*An electron probe micro analyzer (EPMA) is used to find the types and distributions of elements on the surface of a substance (far right).

X-ray Diffractometer (XRD)

Electron Probe Micro Analyzer (EPMA)

More precise and efficient inspection and diagnosis of power generation equipment

We are working on the development of diagnosis technologies, the improvement of inspection technologies and integrity research for power generation equipment such as boilers and turbines. We are also responsible for analyzing the basic properties of metallic materials used in power generation equipment.

Improving technology used for diagnosing aged power generation equipment

Mechanical and Metallurgical Engineering Group

The group is developing technology to be used for diagnosing the level of aging and deterioration of power generation equipment to prevent damage. The equipment to be diagnosed includes boilers used with high-temperature steam at about 600°C and turbines subject to rotation at high speeds. Although technology for diagnosing boilers is already in use, we work to enhance the efficiency of testing by carrying out the R&D of discharge sampling equipment and life assessment technology using a new method, the Small Punch (SP) creep test.

The discharge sampling equipment shown on the right won the Technical Development Award of the Japan Institute of Energy and Promotion Award for Electrical Science and Engineering (OHM Technology Award).

Residual life assessment using the SP creep test won the Thermal and Nuclear Engineering Society Best Paper Award.

Electric discharge sampling equipment

Improving inspection technologies for power generation equipment

Mechanical and Metallurgical Engineering Group

As part of our endeavor to make power facility inspection safer and more efficient, we are working to develop technology for diagnosing the integrity of the welded parts of large-caliber thick-wall pipes using ultrasonography.

Scan Acoustic Tomograph (SAT)

Supporting integrity research of thermal power generation equipment

Mechanical and Metallurgical Engineering Group

We make ourselves available at thermal power plants during regular repairs and other work, inspect the integrity of boilers and other components, and offer our assistance to support repair processes. If a failure is found in the equipment, the group looks into its cause and proposes appropriate measures to be taken.

Laserbeam microscope

Analyzing the basic properties of metallic materials

Mechanical and Metallurgical Engineering Group

The group carries out research on the mechanisms of high-temperature strength, fatigue strength and stress corrosion cracking of materials used in power generation equipment and this research is aimed at creating applied technologies.

*With the transmission electron microscope, we can observe the contents of metals to the crystal level (at a magnification of 1,000 to 600,000)

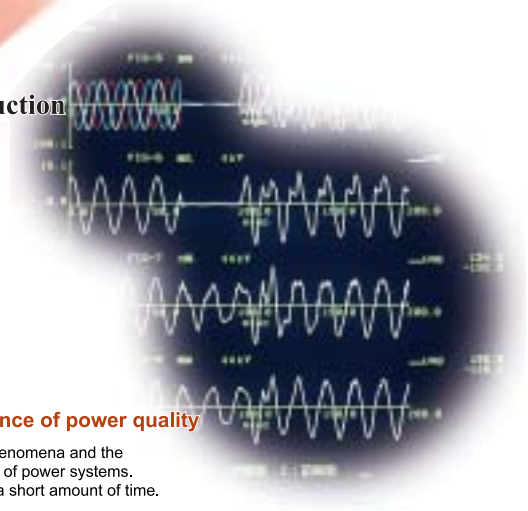
Transmission Electron Microscopy (TEM)

Microstructure as seen through TEM

Field 1

Stable power system & cost reduction

Delivering a Stable Supply of Electricity
Chosen by the Customer



Reliable operation of power systems and maintenance of power quality

Our R&D efforts are focused on the simulation analysis of electrical phenomena and the maintenance of power quality in order to achieve the reliable operation of power systems. Our efforts have yielded a device that estimates the life of batteries in a short amount of time.

Simulation analysis for power systems

Power System Engineering Group

Because power systems include a complex network of power facilities and equipment that interact with one another, unexpected phenomena that interfere with the reliable supply of electricity can occur. To find effective countermeasures, we simulate and analyze electrical phenomena and conduct R&D to investigate their causes. Our R&D is also aimed at making possible simulation technologies that better reflect actual electrical phenomena so that the system analysis carried out in the development of facility and operational plans can be made more accurate.

Electrical power system analysis simulator

Measures taken against momentary voltage drops for the maintenance of power quality

Power System Engineering Group & Power Storage Engineering Group

Momentary voltage drops affect power facilities and equipment. We study the impact of these voltage drops by using a test apparatus to reproduce them, and we are developing devices to suppress the exciting inrush current that flows into transformers and may result in voltage drops. We are also working to find ways to maintain frequency and voltage within certain ranges and pursuing the development of low-cost devices that can control momentary voltage drops.

Portable sag generator

Control system for inrush current of transformer

Capacity measurement system of lead acid battery

Transmission Facility Engineering Group

Conventionally, the capacity of batteries used as emergency power sources at thermal power plants or substations has been tested by completely discharging the batteries. This process is time-consuming and accelerates battery deterioration. However, with the use of our measuring equipment, battery capacity can be measured without having to completely discharge the batteries, avoiding unnecessary battery deterioration and wasted time and expense.

Capacity measurement system of lead acid battery

Reliable power supply and development of effective equipment

Lightning is a major cause of damage experienced by power facilities. We address lightning issues in our research to ensure a reliable power supply and develop low-cost, reliable and effective equipment.

Research to improve reliability of power supply

Transmission Facility Engineering Group

To implement measures against lightning (measures against momentary voltage drops) that are suitable for an area, we observe lightning current waveforms and electromagnetic waveforms from lightning strikes in order to better understand the properties of lightning. We also verify the lightning protection performance of power facilities using an impulse voltage generator.

Lightning condition

Measures taken against lightning for distribution lines

Transmission Facility Engineering Group

In order to reduce the number of outages caused by lightning damage on 22kV distribution lines, we developed polymer insulators for these lines that are equipped with built-in ZnO elements. The new insulators are smaller and lighter than traditional ceramic insulators.

The polymer insulator for 22kV distribution lines shown on the right won the Promotion Award for Electrical Science and Engineering (OHM Technology Award).

Polymer insulator for 22kV distribution lines

Development of arc horn for 66kV transmission lines

Transmission Facility Engineering Group

The optimal design of a discharge withstand current rating led to the development of a KO horn* that is lighter, smaller (about 2/3) and cheaper (about 1/3) than the conventional current-limiting arc horn. To verify its performance as a measure to prevent lightning faults, we are carrying out demonstration testing of the KO horn on actual lines.

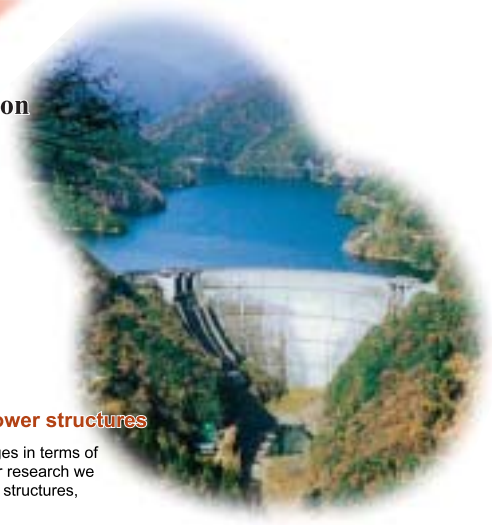
*The KO horn was created to "knock out" lightning.

KO horn (arc horn for 66kV transmission lines)

Field 1

Stable power system & cost reduction

Delivering a Stable Supply of Electricity
Chosen by the Customer



Stability improvement and cost reduction in electric power structures

The construction and maintenance of dams and power plants pose challenges in terms of geotechnical engineering, and it is our duty to come up with solutions. Other research we are conducting includes an assessment of the residual life of large concrete structures, and research on the effective use of coal ash in concrete.

Diagnosis for foundations and structures

Civil Engineering Group

Before we can solve the geotechnical engineering issues that arise in the construction of dams and power plants, as well as facility maintenance, we must first grasp and evaluate the condition of foundations. We conduct R&D on foundation characteristics such as static strength, deformability and seismic behavior. Examples of our research are the integrity and aseismic stability examinations carried out for Hitotsuse Dam and Kamishiiba Dam (located in Miyazaki prefecture).

The large-sized triaxial compression test apparatus shown on the right can be used to test the strength of large-sized rock materials used in dam construction. It is the only apparatus of its kind in Kyushu.

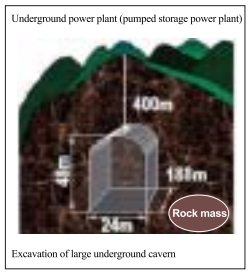
A large-sized triaxial compression test apparatus

Evaluation of the stability of base rock structures

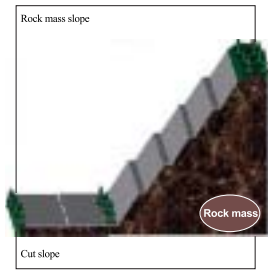
Civil Engineering Group

In order to reduce the cost of constructing rock structures such as tunnels and underground caverns, we devised a system that is capable of designing a series of evaluations ranging from evaluations on the mechanical properties of rock mass to evaluations on the stability of rock structures. This highly valued system won various technological awards and was registered in the New Technology Information System (NETIS) by the MLIT of Japan.

This development system received the prizes from the following Societies.
- **Japan Electric Power Civil Engineering Association**
- **Japanese Committee for Rock Mechanics**
- **The Japanese Geotechnical Society (Kyushu branch)**



Excavation of large underground cavern

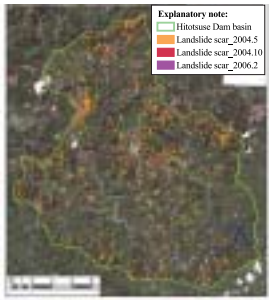


Cut slope

Study on the prediction of landslides

Civil Engineering Group

With the aim of predicting landslides caused by earthquakes or local downpours, we established an optimal method for the examination and prediction of landslides using satellite image, and identified high-risk slopes in the upstream basin of Hitotsuse Dam.

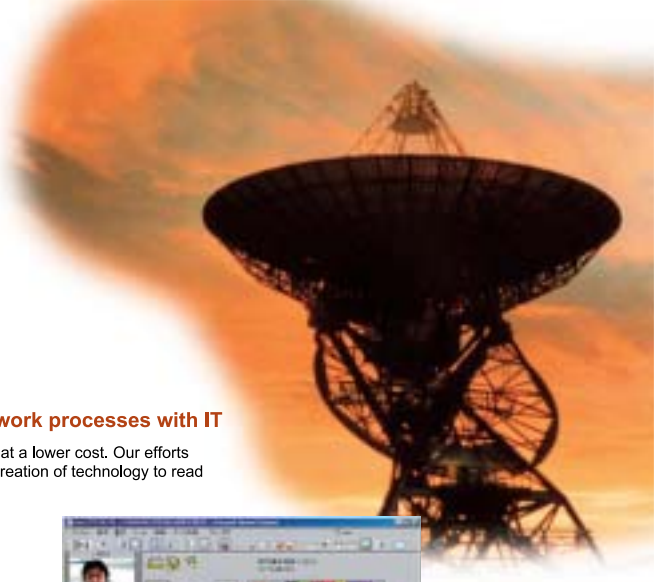


A graphic of landslide slope extracted by using satellite image and Geographic Information System (GIS)

Residual life assessment of concrete structures and effective use of coal ash in concrete

Civil Engineering Group

Our R&D on concrete structures ranges from research on improving strength and durability to ensure better reliability, deterioration diagnosis, residual life assessment, and repair methods that help reduce lifecycle cost. To contribute to a recycling-based society, we examine ways to effectively use the coal ash from coal-fired thermal plants as an ingredient for making concrete.



Faster, more efficient and less expensive work processes with IT

We find ways to get work done faster, more efficiently and at a lower cost. Our efforts include the in-house application of IP technology and the creation of technology to read analog meters through images.

Application of IP technology to teleconferencing

Information and Telecommunication Technology Group

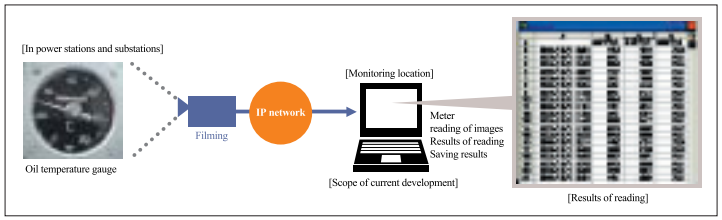
In our attempt to make possible convenient in-house teleconferencing using IP technology, we are examining sound and image quality, data sharing functions and operability suitable for our needs as well as the possible creation of a system that would include networks. Thanks to IP, teleconferencing can take place wherever a LAN has been installed, and document files can be shared among participants, making the work process faster and more efficient.

Example of teleconferencing with IP

Development of analog meter reading technology

Information and Telecommunication Technology Group

We have developed technology with which we can read, digitize and save indicated values from images of analog meters, which use three scale needles of different colors, such as the oil temperature gauges found in power stations and substations.

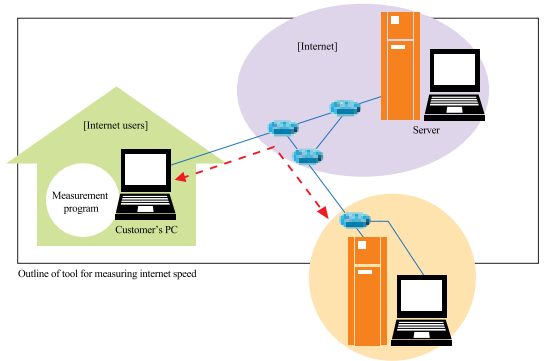


Example of reading analog meter images

Improvement of measurement technology

Information and Telecommunication Technology Group

We have developed a tool to measure communication speed via the internet. Its key feature is its ability to measure speed through websites and PCs. The time required for measurement is short because large amounts of data no longer need to be downloaded, as was the case in the past. We are looking into possible users of the tool such as providers.



Outline of tool for measuring internet speed

Being Gentle on the Planet to Create a Better Future

This century is marked by increased environmental awareness, and many hope for R&D that will help us nurture our planet. In responding to this situation, this R&D must also contribute to our future affluence. We are fully aware of this need and are working hard in response to it.

Measures to handle global environmental issues

We are involved in the development of large Li-ion batteries suitable for electric vehicles (EV) and plug-in hybrid electric vehicles (PHEV), both of which are expected to help remedy environmental issues by reducing CO_2 emissions and contributing to the goal of zero-emission. We also conduct R&D on ways to improve the infrastructure that will become necessary when such vehicles are widely adopted. Other environmental conservation measures being taken include research on CO_2 control using trees and research on global warming.

Electric vehicle

Development of Li-ion batteries for EVs

Lithium Battery and Electric Vehicle Technology Group

Basing our research on Li-ion batteries developed for electric energy storage, we launched the development of large Li-ion batteries for EVs. By enhancing their energy density and output density, we created novel Li-ion batteries that allow for increased travel distance and fast recharging, resolving some of the issues facing EV use. While we proceed with our R&D, we will seek ways to reduce costs by widening the battery's application range, which includes its use for storing electricity. We are pushing EVs to the next level so that they meet the expectations consumers have for them as eco-friendly, zero-emission vehicles.


Li-ion batteries

Development of quick charging stations and other infrastructure

Lithium Battery and Electric Vehicle Technology Group

We started conducting research on quick charging stations for EVs in 2006, and developed stations with added functions for processing information. We are seeking other ways to enrich the contents of information and communication and further reduce their cost and size.


Quick charging station

R&D on CO_2 fixation

Practical Biotechnology Group

Trees fix CO_2 in the process of photosynthesis. In 2000, in our R&D, we started selectively propagating the seedlings of Melia Azedarach, or chinaberry, for CO_2 fixation purposes using tissue culture and planted them on company-owned land to test the species. In 2002, based on the results of this experiment, we started forestation projects using these trees in China's Loess Plateau.

Rooftop greening

Practical Biotechnology Group

The group has developed a new base material for rooftop greening by combining and solidifying rubber chips from waste tires and coal ash. The material is lighter and easier to work with than the light soil conventionally used. Demonstration testing on the materials is now taking place.


Experimental forestation in Shanxi Province, China


Experimental growing of rooftop-lawns

Harmoniously coexisting with the local environment

In our commitment to address environmental issues, we are taking various approaches that include maintaining and restoring local environments, improving waste reduction technologies and propagating rare plants.

Research for the practical restoration of marine environments

Environment and Chemistry Engineering Group

In recent years, "rocky-shore denudation", or decreases in algae communities, has become an issue of grave concern because of global warming and other reasons. Algae communities offer marine animals habitats in which to live and also help to purify water. We study possible ways of restoring algae communities by creating a habitat for them. So far, we have observed satisfactory algae growth and colonies of marine animals in the habitat we created, and have confirmed the germination of algae producing spores in the surrounding rocky areas.


Algae test bed

Research on asbestos analysis and treatment

Environment and Chemistry Engineering Group

It is expected that waste containing asbestos will continue to be generated now and in the future, raising concern about issues such as the lack of sites for final disposal. The efficient analysis and treatment of asbestos waste will become increasingly important. This situation has prompted us to conduct R&D on technologies to render asbestos harmless as well as on analytical methods that can be used to detect the presence of asbestos in waste on site.


Melted disposal test of asbestos


Asbestos analysis device

Research on the purification of wastewater containing dioxins

Environment and Chemistry Engineering Group

The dismantlement of waste incinerators and other facilities can produce wastewater containing a high-level of dioxins and heavy metals. We have developed a system to eliminate toxins from this wastewater. The system applies coagulating sedimentation to separate solids and is capable of reducing and treating waste at a lower cost than that required by conventional systems. It was evaluated favorably in demonstration testing carried out during the dismantlement of Kyushu Electric's incinerators.


Processing system of wastewater including Dioxin

Research on the propagation of rare flora

Agricultural Product Cultivation Group

The group conducts studies on the propagation and protection of rare and endangered flora in Kyushu.


Orchis graminifolia


Propagation of *Calanthe discolor*

Field 2

Environmental conservation

Being Gentle on the Planet to Create a Better Future

Projects on natural energy sources

Kyushu Electric Power has been expanding power generation with clean energy sources, such as photovoltaic, wind and geothermal, to decrease consumption of finite fossil fuels, which impact on the climate of the earth.

Photovoltaic power generation

New Power Generation System Technology Group & Transmission Facility Engineering Group

Photovoltaic, a clean and sustainable method to produce electricity without CO_2 emission, is suitable to both humans and the environment. Therefore, Kyushu Electric Power has been doing examinations for efficient utilization of its output energy and stable operation connected to the power grid, in order to overcome its defects such as low density of the input energy and instability of the output. The laboratory has been evaluating for more than twenty years the long term reliability of photovoltaic generation facilities through the data collected from actual operations.

Sakito Photovoltaic Power Plant

Wind power generation

Power System Engineering Group

Wind power generation harnesses natural energy and, as a result, has a variable output. Our Kyushu service area is suitable for the practicing of this method of generation because many wind power facilities have already been installed in the area, and their number is increasing. Fluctuation in output results in frequency and voltage variation and affects power quality. The laboratory has installed measuring instruments in wind power plants to better understand output fluctuation and analyze its effect on power systems.

Cape Noma Wind Park

Geothermal power generation

New Power Generation System Technology Group

Kyushu Electric Power operates 5 geothermal power stations with a total capacity of 209,500kW, about 40% of Japan's total. The laboratory lends its support to these power stations in the areas of operational stability and cost reduction, and is developing techniques for recovering silica and rare metals in geothermal groundwater.

Hacchoubaru Geothermal Power Station

Projects to supply energy by biomass

Biomass refers collectively to bio-resources that are of animal or plant origin, including livestock waste, food waste, and wood residue derived from logging, lumbering, construction and the dismantling of buildings. The laboratory has been conducting R&D to utilize biomass effectively as a range of energy sources, as these will establish recycling-based societies with a low impact on the earth.

Use of livestock waste

New Power Generation System Technology Group

To utilize livestock excrement effectively, the group has developed a biogas-generating system combined with a process to break down livestock excrement. The process raised the amount of generated gas by 33% and decreased the sludge resulting from the treatment of the system's waste water by 57%.

Pilot plant (methane fermentation facility)

Gasification of wood biomass

New Power Generation System Technology Group

As wood biomass, including residue derived from logging, lumbering, construction and the dismantling of buildings, exists in widely scattered areas, it poses significant problems of high cost, collection and transportation. In this context, the group is working on the development of a small system for gasification of wood biomass, which utilizes biomass as energy near the site where the biomass originally exists.

Wood biomass gasification facility

Measures taken against industrial waste for the creation of a recycling society

Some of the measures we promote are the reducing and recycling of waste and the effective use of coal ash in concrete and as a soil conditioner.

Recycling and reducing the volume of waste

Environment and Chemistry Engineering Group

We are moving from a mass-consumption, mass-disposal society to a recycling society. Keeping up with this societal trend, we are working to recycle and reduce the volume of waste generated in the carrying out of Kyushu Electric's business. For example, one R&D project we are conducting involves the recycling of coal ash by using it to create non-fired tiles or by mixing it with liquid, turning it into slurry*, and using it in concrete.

* Slurry: a mixture of fine grains and liquid

Slurry of coal ash

Unsintered tiles "LIMIX"

Using coal ash in agriculture

Agricultural Product Cultivation Group

Clinker ash, or the coarser form of coal ash resulting from coal-fired thermal power plants, has a porous property similar to that of sand. To take advantage of its properties, research on its use as a soil conditioner to improve farmlands with poor drainage is underway.

Cultivation testing on soil with improved drainage

Exploring and Cultivating New Possibilities for Electricity

Electric energy supports every aspect of our lives. However, there are some issues, such as diversified customer needs and environmental concerns, that we have to respond to in a flexible manner so that we can continue to make use of this kind of support. We are committed to R&D efforts that explore and cultivate new possibilities for the use of electricity.

The Li-ion battery – a new form of electricity

In addition to being light and compact, Li-ion batteries have a higher energy density than lead batteries. To maximize their benefits, we have proceeded with the development of Li-ion batteries as a power storage system to help load leveling. Another endeavor is focused on the development of Li-ion batteries for eco-friendly EVs, which can benefit from the application of power storage technology and create more demand for electric services.

Power storage system

Lithium Battery and Electric Vehicle Technology Group

The group launched the full-fledged development of a power storage system in 2002 using large-scale Li-ion batteries featuring a large capacity and a long life. In 2003, the group started their demonstration by interconnecting a power storage system connected to the power grid. This was the first such attempt in Japan. The fiscal year 2005 saw the incorporation of power storage systems in all-electric homes for field testing to verify their functions for load leveling and as emergency power sources. The technology produces no exhaust gases and is applied in the development of battery technologies used to drive EVs, which are expected to become eco-friendly, next-generation vehicles that help alleviate global warming, air pollution and other global environmental issues.

Power storage system

Li-ion batteries (right side: traditional lead battery)

The heat pump, an active component in agriculture

High-efficiency heat pumps are found in greenhouses and at other agricultural sites.

Application of heat pumps in agriculture

Agricultural Product Cultivation Group

Triggered by global environmental concerns and a rise in fuel oil prices, demand for greenhouse heat pumps has increased. To prompt the widespread use of heat pumps in agriculture, we are conducting experiments jointly with universities and public research labs on the growing of fruit trees, flowering plants and foreign species of orchids in test facilities. Another service we provide is consultation, which is based on optimal operation methods, technical data and our accumulated know-how on heat pumps.

Growing fruit trees at test station in Saga Prefecture

Cultivation testing of flowering plants with air conditioning at night

Making electricity more efficient and convenient

We are proud of our R&D that is enhancing the performance and efficiency of eco-friendly energy technologies and making our lives more convenient and comfortable.

Electric heating technology

Electricity Utilization Technology Group

The group developed Takumi Hachirin, a "clean" cookware for commercial use. The flavor of charcoal grilling is achieved while most of the smoke and fumes are removed. The group also works to take advantage of electricity's unique properties in their development of efficient, advanced electric cookers and heating technologies for home and commercial use.

No-smoke commercial cookware *Takumi Hachirin*

Development of IH Cooler

Electricity Utilization Technology Group & New Business Promotion Group

We can now use the IH cooker for cooling food, too. Thanks to the Peltier effect*, the group developed a system that cools the surface by placing a special plate on the IH cooker. The plate uses no electric cords because a high-frequency induction field is used for power and enables both the heating and cooling of food using the existing IH cooker.

*Peltier effect: a phenomenon in which electricity flows into a material, cooling one side while heating the other.

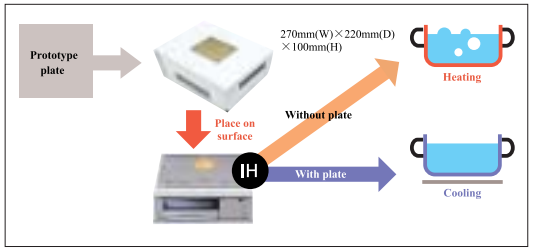


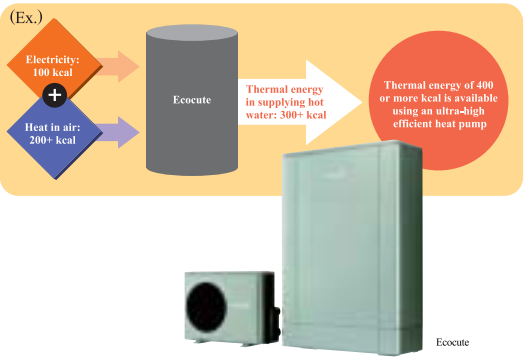
Diagram of IH cooler use

Research on the promotion of Ecocute

Electricity Utilization Technology Group

We are conducting R&D to reduce the size and improve the shape of Ecocute and better insulate its oil feeding tank to further promote the equipment.

"Ecocute" is a heat pump that uses the heat already existing in nature and is capable of producing an amount of thermal energy three times larger than that of the energy it consumes. It uses CO_2 as a coolant instead of ozone-depleting Freons and still manages to heat water to 90°C, an achievement once considered impossible.



Ecocute

Field 4 New businesses

Always Ready and Willing to Venture Out

We are eager to explore new areas and new territories by building on the results of past R&D on electric energy.
We are proud to be pioneers.

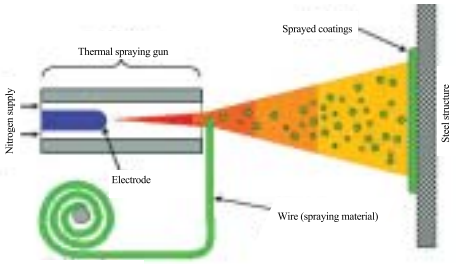
Development of corrosion protection technology that lasts

High reliability is a prerequisite for power facility maintenance technologies. Basing our thinking on such technologies, we respond to the needs of customers and work to prolong the service life of infrastructure. We are dedicated to the creation of a safer, more comfortable and eco-friendly future for our children.

Development of coating technology for 100 years of anti-rust protection (Plaswire Method®)

Environment and Chemistry Engineering Group

The Plaswire Method® was developed as an anti-rust technology for our own steel structures, such as steel towers and piping, as well as for bridges, buildings and highways outside the company. An anti-rust effect lasting 100 years or longer can be expected with this technology, and the thermal stress imposed on members is small. The technology is highly regarded in and outside of the company. Aiming to increase orders for the product, we are working to improve its application on flat plates through automation and to develop application technology for bends using a robot.



Concept of Plaswire thermal spraying method


Fukuoka Expressway No.5


Wind power generation tower in Itsuwa Town

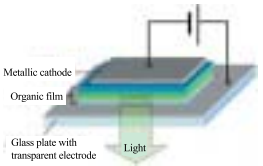
Research on new display technology

We are tackling R&D on Organic Light-Emitting Diodes (OLEDs) and Polymer-Network Liquid-Crystals (PNLCs).

OLED technology

Electricity Utilization Technology Group

OLED is a luminescent device that has a high luminous efficiency and can be made into a flat form. OLEDs are employed to display moving images and are expected to be used in the making of an ultra-thin flat panel display that will take the place of liquid crystal or plasma displays. OLEDs are also expected to be adopted as a next-generation lighting source that may be installed on curved surfaces. We are undertaking R&D on organic semiconducting materials to make practical use of this technology.



Organic EL element


OLEDs

PNLC film display

Electricity Utilization Technology Group

We have developed a PNLC film display by blending polymer and liquid crystal into a film that is bendable. With this film, a simple structure can control the level of light transmission.

PNLC film display

Measures in the fields of safety, agriculture and forestry

We strive to create safer nighttime environments for pedestrians and production technologies with high added value in the fields of agriculture and forestry.

Streetlights for crime prevention

Electricity Utilization Technology Group

In terms of luminous efficiency, our new streetlights are brighter by about 20%. Moreover, they are longer-lasting, lighter and smaller, and they cost less. More effective crime prevention is made possible thanks to the adoption of DC lighting.


Setup of streetlights for crime prevention

Research on Japanese horseradish cultivation on company land

Agricultural Product Cultivation Group

"Wasabi", or Japanese horseradish, is an expensive food item. We are cultivating wasabi by making use of the company's forests and mountains and using container cultivation technology in what is the first attempt of its kind in Kyushu. In 2008, our research efforts are expected to culminate in the creation of a new business of Kyushu Rinsan Co., Inc.


Mature Japanese horseradish

Development of equipment for pine death prevention using electric shock

Practical Biotechnology Group

We have developed a piece of equipment that uses electric shocks to prevent pine trees from dying. It was made available commercially in July 2000 under the name *Matsugoro*.


Matsugoro setup

Kitchen garden kit

Agricultural Product Cultivation Group

We have a history of supporting agriculture with R&D on the latest technologies, such as hydroponics cultivation. We created a kit with the same hydroponics technology for home use, to offer people the joy of growing vegetables in limited spaces. The planters may be small, but they are packed with the fruits of R&D conducted over many years.


Kitchen garden kit

New Creations Born Here Are Launched from Here

The history of the Research Laboratory is also the history of new technological developments. We will be the one to create new technologies. We will be the one to create a new future, and with this passion, we will keep challenging what some consider “impossible”.

Fuel cells – a clean method for generating power with high efficiency

Fuel cells produce electricity by directly converting a fuel’s energy into electricity via a chemical reaction. As a result, high generation efficiency is achieved, and few air pollutants are emitted. The waste heat from the process can also be put to use.

Fuel cells

Distributed Resources Technology Group

There are various types of fuel cells including the Solid Oxide Fuel Cell (SOFC), the Polymer Electrolyte Fuel Cell (PEFC), the Molten Carbonate Fuel Cell (MCFC) and the Phosphoric Acid Fuel Cell (PAFC), which is commercially available. The SOFC is expected to become a high-efficiency, combined-cycle power generation system as it has the highest generation efficiency and can use hydrogen and carbon monoxide as fuel. We are promoting research for its commercialization through SOFC single cell performance evaluation tests and national research projects. The PEFC is compact and can be operated at low temperatures. It is expected to be used for stationary purposes as well as for automobile applications. We are evaluating the applicability of the PEFC co-generation system in homes using operation tests simulating household demand.

SOFC single cell testing system

PEFC cogeneration system for residential use

Production of hydrogen utilizing waste heat

We are engaged in R&D on hydrogen as a potential material in next-generation energy supply without CO_2 emission.

Hydrogen production technology using hydro-electrolysis

New Power Generation System Technology Group

The group is working on advanced technologies of hydro-electrolysis to produce hydrogen efficiently without CO_2 emission. For example, together with Kyushu University and other organizations, the group has developed a device to produce hydrogen efficiently from steam with a temperature of about 600℃, which can be generated utilizing waste heat from factories. Moreover, the group joins research activities on hydrogen supply systems.

Hydrogen generator with steam electrolysis

Superconducting technologies that support next-generation electric technologies

Our other endeavors embrace the development of electric appliances making use of superconductivity.
This includes the development of SMES and superconducting power transformers. We are also studying and evaluating the properties of high-temperature superconducting materials essential for the high performance of superconducting appliances.

Development of Superconducting Magnetic Energy Storage (SMES) System

Power Storage Engineering Group

SMES can meet the various needs of power systems as it stores electricity as magnetic energy very efficiently and can be controlled with a high degree of precision and speed. We take part in national projects for SMES development, including that for SMES with a storage capacity of 1kWh and an output of 1MW. We also tackle the development and demonstration testing of large-scale systems, as well as research on the effects of their introduction.

SMES won IEEJ Technical Development Award twice in 2001 and 2004

Model coil test for SMES

Development of superconducting power transformers

Power Storage Engineering Group

Because of their small size, high efficiency and non-combustibility, superconducting power transformers help reduce the area of installation as well as operating costs. To take advantage of such characteristics, we conduct system tests with single-phase transformers and 500kW-class three-phase AC equipment and participate in national projects to promote the development of element technologies, including technology for high-current applications and the reduction of losses.

Superconducting Tr won Superconductivity Science and Technology Award

Superconducting AC power applications

Superconducting power transformer

Research on superconducting magnetic separation

Power Storage Engineering Group

Our research on applied superconducting technologies for environmental protection includes studies on a magnetic separator that purifies water by rapidly separating impurities using the high-field properties of superconductivity (bulk superconductor).

Superconducting magnetic separation

Evaluation of HTS materials’ characteristics

Power Storage Engineering Group

Before applied superconducting technologies can be put to practical use, the optimal design of equipment and the examination of operational technology and economic feasibility are necessary. These, in turn, require a technology for evaluating superconductive materials as their base. For this purpose, we have independently developed a method and device to evaluate accurately and objectively the temperature of the critical current, field-dependency and AC loss of materials and are now studying ways to simplify and improve the accuracy of such evaluation technology.

Device for evaluating superconducting properties