History of Japan’s Electric Utility Industry

Electricity was first used in Japan on March 25, 1878 at the Institute of Technology in Toranomon, Tokyo when an arc lamp was switched on in commemoration of the opening of the Central Telegraph Office. In those days, electricity was still unfamiliar and uncommon not only in Japan but also in Europe and the United States. In 1886, Tokyo Electric Lighting, a private company, commenced operations as the nation’s first electric power company, and began supplying electricity to the public in the following year.

In the early days, use of electricity grew primarily for lighting because of its safety and cleanliness, and gradually found broader applications as a power source to replace the steam engine. By 1896, the number of electric utilities established throughout the nation reached a total of 33. The early 20th century marked the establishment of long-distance transmission technology. As larger thermal and hydro power plants were introduced, generation costs fell and electricity came into wider use throughout the country. Consequently, electricity became an indispensable energy source for people’s lives and industry.

In the years that followed, the electricity utility business grew in tandem with the modernization of Japan and development of its industry. At the same time, the electric utility industry experienced a major restructuring that led to the dissolution of 70 electric utilities, which merged to create five major electric utilities after the First World War. During the Second World War, the electric utility industry was completely state-controlled and utilities were integrated into Nihon Hatsuoden Co. (a nationwide power generating and transmitting state-owned company) and nine distribution companies. After the end of World War II in 1945, supply and demand for electricity remained very tight in Japan. A series of intense discussions were held on restructuring the electric utility industry as one of the measures for democratizing the economy. As a result, nine regionally privately owned and managed General Electricity Utilities—Hokkaido, Tohoku, Tokyo, Chubu, Hokuriku, Kansai, Chugoku, Shikoku and Kyushu Electric Power Companies — were established in 1951 and assumed the responsibility of supplying electricity to each region. This fundamental structure remains to this day, and with the return of Okinawa to Japan in 1972, Okinawa Electric Power Co. joined as a tenth member.

At the end of the 20th century, a trend toward deregulation and competition took hold throughout society, and the electric utility industry started to be liberalized. In December 1995, organizations such as the independent power producers (IPP) were allowed to provide electricity wholesale services and in March 2000, electricity retail supply for extra-high voltage users (demand exceeding 2MVA) was liberalized. The scope of retail liberalization was then expanded in April 2004 to users of more than 500kW, and subsequently in April 2005 to users of more than 50kW. Thus, a Japanese model of liberalization based on fair competition and transparency while maintaining the vertical integration of generation, transmission and distribution to ensure a stable supply of electricity, was established.

**Contents**
- Japan’s Energy Supply Situation and Nuclear Safety
- Ten Electric Power Companies & Market Liberalization
- Electric Power Sources
- Nuclear Fuel Cycle
- Environmental Conservation
- International Exchanges
- Location of Power Stations
- FEPC
- Data
- Business Addresses
Japan’s Energy Supply Situation

Resource-poor Japan is dependent on imports for 96% of its primary energy supply; even if nuclear energy is included in domestic energy, dependency is still at 80%.

Thus, Japan’s energy supply structure is extremely vulnerable. Following the two oil crises in the 1970s, Japan has diversified its energy sources through increased use of nuclear energy, natural gas and coal, as well as the promotion of energy efficiency and conservation. Despite these improvements, oil still accounts for about 50% of Japan’s primary energy supply, and nearly 90% of imported oil comes from the politically unstable Middle East. Moreover, although Japan has one of the highest proportions of electricity demand in total energy demand at over 40%, prospects for importing electricity from neighboring countries are very poor because Japan is an island nation. In addition, there is an urgent need for global warming countermeasures such as reduction of carbon dioxide emissions from the use of energy. To ensure Japan’s stable electricity supply, it is crucial to establish an optimal combination of power sources that can concurrently deliver energy security, economic efficiency, and environmental conservation, while making safety the top priority.

For the future, it is important for Japan’s energy mix to continue to include a certain level of nuclear energy premised on ensuring safety, while maximizing the use of renewable energy and using a reasonable proportion of thermal power considering the stability of fuel supply.

Electric Power Companies’ Commitment to Safety Measures at Nuclear Power Plants

The Great East Japan Earthquake on March 11, 2011 led to a nuclear accident at the Fukushima Daiichi Nuclear Power Station, resulting in the release of radioactive materials into the environment. Determined to avoid a repeat of this accident, the electric power companies have been taking both tangible and intangible measures since immediately after the accident, starting with emergency safety measures including the installation of additional emergency power source vehicles and fire engines, as well as upgrading procedure manuals and conducting drills.

Even after implementing the emergency safety measures, the electric power companies are making further efforts to improve safety, including installing air-cooled emergency power generators, filtered ventilation systems and earthquake-isolated emergency response centers, to achieve even higher levels of safety and reliability.

In order to improve the safety of nuclear power stations, electric power companies themselves must voluntarily make continuous efforts to improve safety and achieve the highest safety level in the world. To enable these efforts to be constantly and objectively evaluated, the Japan Nuclear Safety Institute was established in November 2012 to evaluate the safety improvement activities of electric power companies and to give them technical advice with strong leadership from an independent standpoint. The electric power companies take to heart the evaluations and recommendations made by the Japan Nuclear Safety Institute and are striving to achieve the highest safety level in the world.

By July 2013, the new regulatory safety requirements formulated by the Nuclear Regulation Authority will come into effect. The power companies are prepared to fully meet these standards, and will strive to achieve the highest safety level in the world by introducing the latest knowledge and technologies on safety in a timely manner.
Ten Electric Power Companies as Responsible Suppliers of Electricity

Currently, the ten privately-owned electric power companies are in charge of regional power supply services as General Electricity Utilities and are responsible for supplying electricity from power generation to distribution to the consumers in their respective service area. General Electricity Utilities must obtain approval from the Japanese Government by providing supply conditions such as electricity rates as general supply provisions to those consumers who are excluded from the retail liberalization. They are also responsible for supplying electricity to consumers subject to retail liberalization, based on the provisions for last resort service, if they cannot conclude contracts with power producers and suppliers (PPSs).

The electric power companies work closely with each other to enhance the stability of electricity supply to customers nationwide. For example, they exchange or provide electricity via extra-high voltage transmission lines linking the entire country from north to south, in order to cope with emergency situations resulting from accidents, breakdowns, or summer peak demand.

Classification of Businesses Specified in the Electricity Utilities Business Act (extract from the Act)

<table>
<thead>
<tr>
<th>Business Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Electricity Utilities (market liberalized)</td>
<td>Business of supplying electricity to meet general demand exceeding 1 MW for at least 5 years or supplying electricity to meet general demand exceeding 100 MW for at least 5 years or supplying electricity to meet general demand exceeding 1 MW for at least 10 years or exceeding 50kW for at least 5 years</td>
</tr>
</tbody>
</table>

Wholesale Electricity Business (Commonly called IPPs) | Business of supplying electricity exceeding 1 MW for at least 5 years |

Specified Electricity Business (Business of supplying electricity exceeding 1 MW for at least 10 years or exceeding 50kW for at least 5 years) |

Specified-Scale Business (specification service point (license required) |

Specified-Scale Business (specified service point (license required) |

Wholesale Supplies Business (Commonly called PPSs) | Supply of electricity to a General Electricity Utility for use in its General Electricity Business using the power generation facilities |

Fair Competition and Transparency

The electric power market in Japan has been progressively liberalized to ensure competitive neutrality on the basis of a stable power supply by the existing ten General Electricity Utilities which consistently handle all functions from power generation to distribution.

In 1995, a law was revised to enable IPPs to participate in the electricity wholesale market in addition to the conventional Wholesale Electricity Utilities. Then, in March 2000, use of the transmission/distribution network owned by the electric power companies was liberalized, and the retail market was partially liberalized to allow power producers and suppliers (PPSs) to sell electricity to extra-high voltage users requiring more than 2.5MW.

The scope of liberalization was then expanded in April 2004 to users requiring more than 50kW, and subsequently in April 2005 to users requiring more than 50kW. Thus, by 2011, the scope of liberalization covers approximately 60% of total electricity demand in Japan. Electric power companies have responded to this trend of liberalization by increasing their business efficiency while lowering electricity prices and offering a variety of pricing plans.

Currently, expansion of the scope of liberalization to low-voltage users requiring less than 50kW, such as general households, is being considered.

To maintain fair and transparent use of the electric power transmission and distribution system, the Electric Power System Council of Japan (ESCJ) was established as the sole private organization to make rules and supervise operations from a neutral position, and started full-scale operation on April 1, 2005. In addition, Japan Electric Power Exchange (JEPX) was established in November 2003, with investments by the electric power companies, PPSs, self-generators, etc., and started business on April 1, 2005.

* In Okinawa, the scope of market liberalization is different.
Electric power companies in resource-poor Japan are committed to developing an optimal combination of power sources that combines various energy sources such as hydro, thermal and nuclear power in order to provide electricity, which is essential for modern living, in a stable manner at the lowest prices.

As electricity is nearly impossible to store in large quantities, electric power companies generate electricity by combining various power sources, considering optimal operational and economic performance, to ensure that the fluctuating demand, such as during the daytime in the height of summer, can always be met.

### Hydroelectric Power

Hydroelectric power has been one of the few self-sufficient energy resources in resource-poor Japan for more than 100 years. Hydroelectric power is an excellent source in terms of stable supply and generation cost over the long term. Though it used to compare unfavorably with thermal power for some time, hydroelectric power saw a renaissance following the oil crisis.

Although the steady development of hydroelectric power plants is desired, Japan has used nearly all potential sites for constructing large-scale hydroelectric facilities, and so recent developments have been on a smaller scale. As the gap in demand between daytime and nighttime continues to widen, electric power companies are also developing pumped-storage power generation plants to meet peak demand. The share of pumped-storage generation facilities of the total hydroelectric power capacity in Japan is growing year by year.

### Thermal Power

Initially, coal was the dominant fuel for thermal power generation in Japan, but it later lost that place to oil. Today, a diverse range of fuels including coal, oil, and LNG are used for the important generating role that thermal power plants play. In particular, in response to global environmental concerns, electric power companies are promoting the introduction of LNG fired plants, as they emit less CO2 and other pollutants.

To enhance thermal efficiency further, combined-cycle power plants with both gas and steam turbines have been installed. As a result, gross thermal efficiency (maximum designed value) has exceeded 50%. In the future, we will continue to research and develop new technologies in order to increase thermal efficiency as well as the use of integrated coal gasification combined cycle (IGCC) power generation.

### Nuclear Power

Japan’s first commercial nuclear power plant started operation in Ibaraki Prefecture in 1966. The electric utility industry believes that nuclear power generation will retain an important position in the optimal combination of power sources from the viewpoint of assuring energy security and mitigating global warming.

Electric utilities are firmly committed to implementing extensive safety measures following the recent accident at the Fukushima Dai-ichi Nuclear Power Station, reinforcing the mechanism to reflect the latest findings from both Japan and overseas, and enhancing the safe operation of the country’s nuclear power plants. We will also continue to publish the latest information to contribute to the safety of nuclear power generation throughout the world.

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Electric Power Sources

**Optimal Combination of Power Sources**

- **Hydroelectric Power**
  - Okumino Hydroelectric Power Station (Pumped-storage)
  - Takami Hydroelectric Power Station

- **Thermal Power**
  - Kawasaki Thermal Power Station (LNG Combined-cycle)
  - Yoshinoura Thermal Power Station (LNG-fired)

- **Nuclear Power**
  - Ohi Nuclear Power Station (PWR)
  - Ohi Nuclear Power Station (ABWR, Under Construction)
Japan's Nuclear Fuel Cycle

The nuclear fuel cycle is a series of processes consisting of reprocessing spent fuel that has been used at nuclear power plants and recovering and recycling plutonium and residual uranium as nuclear fuel.

Japan has chosen a closed nuclear fuel cycle policy since the dawn of its nuclear power generation development. Having few resources, Japan decided to recycle spent nuclear fuel domestically in order to establish nuclear power as a homegrown energy source. The benefits of a closed nuclear fuel cycle for Japan are significant: it adds to long-term energy security by reducing dependence on imported fuels; it conserves uranium resources; and it reduces the amount of high-level radioactive waste that must be disposed of.

Reprocessing is a chemical process that recovers plutonium from spent fuel and separates radioactive wastes into more manageable forms.

Once recovered, the plutonium is ready to be re-introduced into the nuclear power plants in the form known as uranium-plutonium mixed oxide (MOX) fuel.

Japan's electric power companies have continuously committed to a plan to utilize recovered plutonium — in the form of MOX fuel — in 16 to 18 nuclear reactors by fiscal 2015 at the latest.

In the past, Japan has relied on countries such as the U.K. and France to reprocess most of the spent fuel it produced. However, to place Japan's domestic nuclear fuel cycle on a firmer footing, Japan Nuclear Fuel Limited (JNFL) is preparing for completion of construction of a reprocessing plant in October 2013 at a site in Rokkasho-mura in the northern prefecture of Aomori. Currently, the reprocessing plant is in the stage of “Final Commissioning Test.” In addition, JNFL engages in uranium enrichment, temporary storage of vitrified waste, and disposal of low-level radioactive waste. JNFL has also begun construction of a MOX fuel fabrication plant.

Electric utilities regard nuclear power as an important power source for Japan from the viewpoints such as assuring energy security and mitigating global warming. We will make utmost effort to establish the nuclear fuel cycle on the premise of securing thorough safety.

Outline of JNFL’s Nuclear Fuel Cycle Facilities (as of February 2013)

<table>
<thead>
<tr>
<th>Facility</th>
<th>Reprocessing Plant</th>
<th>MOX Fuel Fabrication Plant</th>
<th>Wasted waste storage center</th>
<th>Uranium enrichment plant</th>
<th>Low level radioactive waste disposal center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>Ukedo, Aomori city, Aomori, Aomori Prefecture</td>
<td>Kashiwazaki, Kashiwazaki Prefecture</td>
<td>Kashiwazaki, Kashiwazaki Prefecture</td>
<td>Chibiki, Fukuoka city, Fukuoka Prefecture</td>
<td>Chibiki, Fukuoka city, Fukuoka Prefecture</td>
</tr>
<tr>
<td>Capacity</td>
<td>Maximum capacity: 30,000 ton Uranium (40,000 tons of MOX)</td>
<td>Maximum capacity: 120,000 tons of U (50,000 tons of Plutonium)</td>
<td>Storage capacity: 30,000 tons of vitrified waste</td>
<td>Enrichment capacity: 1,140 tonnes/year</td>
<td>Storage capacity: 30,000 tons of vitrified waste</td>
</tr>
<tr>
<td>Completion of construction</td>
<td>2013</td>
<td>2013</td>
<td>2013</td>
<td>2013</td>
<td>2013</td>
</tr>
<tr>
<td>Start of operation</td>
<td>2013</td>
<td>2013</td>
<td>2013</td>
<td>2013</td>
<td>2013</td>
</tr>
</tbody>
</table>

(*) “ton-HM” stands for “tons of heavy metal” which indicates the weight of plutonium and uranium metallic content in MOX.

The most remarkable feature of the manufacturing technology at the Rokkasho plant is called co-denitrification. The process, developed and the performance of equipment and facilities before the start of commercial operations. On November 14, 2006, JNFL successfully recovered MOX powder through the testing. The most remarkable feature of the manufacturing technology at the Rokkasho plant is called co-denitrification. The process, developed in Japan, does not yield pure plutonium, but produces MOX powder, which deters proliferation and will be fabricated into MOX fuel for reactors.

Status of MOX Fuel Utilization


The Safeguards Program

The safeguards program managed by the International Atomic Energy Agency (IAEA) is a series of inspection and enforcement measures designed to prevent the diversion of nuclear materials for any purpose other than peaceful uses of nuclear energy. The IAEA safeguards program is implemented at Japan’s nuclear facilities and is supplemented by inspections conducted by Japan’s own Nuclear Regulation Authority (NRA) and the Ministry of Economy, Trade and Industry (METI).

The peaceful use of nuclear energy has been a cornerstone of Japan’s nuclear policy since the country’s first nuclear power generation was completed in 1970. The IAEA safeguards program, which is supported by the Japanese government and implemented by the IAEA through its network of inspectors, ensures that Japan’s nuclear activities are conducted in a manner consistent with international non-proliferation standards. The program is designed to prevent the diversion of nuclear materials for any purpose other than peaceful uses, including nuclear weapons proliferation.

The IAEA safeguards program is implemented through a series of inspections and enforcement measures. These measures include the inspection of nuclear facilities, the verification of nuclear materials, and the monitoring of nuclear activities. The IAEA safeguards program is supported by the Japanese government and implemented by the IAEA through its network of inspectors. The program is designed to prevent the diversion of nuclear materials for any purpose other than peaceful uses, including nuclear weapons proliferation.

Start of the “Active Test” and the Recovery of MOX Powder at Rokkasho Reprocessing Plant

On March 31, 2006, JNFL started the final-stage testing, called the “Active Test,” at Rokkasho Reprocessing Plant. The Active Test processes real spent fuel and validates the plant’s safety features and the performance of equipment and facilities before the start of commercial operations. On November 14, 2006, JNFL successfully recovered MOX powder through the testing. The most remarkable feature of the manufacturing technology at the Rokkasho plant is called co-denitrification. The process, developed in Japan, does not yield pure plutonium, but produces MOX powder, which deters proliferation and will be fabricated into MOX fuel for reactors.
Measures by the Electric Utility Industry to Suppress CO2 Emissions

Efforts for environmental conservation including countermeasures against global warming, creating a recycling-based society and managing chemical substances, are key challenges for the electric utility industry. In particular, emissions of carbon dioxide (CO2), a major cause of global warming, are closely related to energy utilization in economic activities and daily life, and so the reduction of CO2 emissions is a major challenge for the industry.

With the major assumption of a stable supply of high-quality and inexpensive electricity to customers, the electric power companies are making the necessary efforts on both the supply and demand sides of electricity including supplying low-carbon energy, and improving/promoting high-efficiency electrical devices to enhance the efficient use of electricity by customers. The companies are also conducting various projects for R&D and international cooperation.

CO2 emissions accompanying electricity consumption may increase or decrease depending on various conditions such as weather and the status of electricity use by customers, which cannot be controlled by the utilities themselves.

Therefore, the electric utility industry is striving to achieve the voluntary target of reducing the CO2 emissions intensity (emissions per unit of end electricity) averaged over the five fiscal years from 2008 to 2012, by approximately 20% from the level in FY1990 (to approximately 0.34 kg-CO2/kWh) by using the CO2 emissions intensity that the electric utilities can affect by their own efforts.

The user-end CO2 emissions intensity for FY2011 was 0.476kg-CO2/kWh, up 14% from FY1990. This is attributed to the increase in thermal power generation due to the long-term shutdown of nuclear power stations after the Great East Japan Earthquake and tsunami.

Decarbonization of Energy on the Supply-side

Promoting nuclear power generation assuming safety, and improving the thermal efficiency of thermal power plants further

Nuclear power emits no carbon dioxide (CO2) in the process of power generation, and even considering CO2 emissions over the entire life cycle of various energy sources, those from nuclear power are lower than those from thermal power, and are even lower than those from solar or wind power.

Considering that nuclear power generation will continuously play a key role in combating global warming, the industry is committed to making the utmost effort to improve the safety of nuclear power generation and to restore the trust of citizens.

The electric companies are also striving to increase the share of LNG-fired thermal power which has the advantage of relatively low CO2 emissions, and to improve the efficiency of thermal power plants.

Currently operating state-of-the-art gas turbine combined cycle power plants have achieved the world’s highest level of 59% in thermal efficiency, by, for example, raising the combustion temperature at the gas turbines.

Since the Oil Shocks of the 1970s, electricity demand has grown approximately 3.3-fold while CO2 emissions have grown only 2.6-fold. This was achieved through measures on both the supply and demand sides, reducing the CO2 emissions of energy on the supply side while improving the efficiency of energy utilization by users. As a result, CO2 emissions per unit of end-use electricity have decreased by 20% from 1970 levels.
Environmental Conservation

Decarbonization of Energy on the Supply-side
Development and expansion of the use of renewable energy sources

Hydroelectric, geothermal, photovoltaic, wind, and biomass energy are all clean and renewable, and the electric utilities are striving to develop them.

For example, the electric utilities are developing mega-solar power generation plants (large-scale photovoltaic power generation plants) in addition to the efforts such as utilizing woody biomass fuel at their existing coal-fired power plants. We are planning to build Mega Solar Power Plants with a total capacity of about 140 MW at around 30 sites throughout the country by fiscal 2020, and some plants have already started commercial operation.

Japanese electric power companies have been purchasing electricity generated from the solar and wind power systems of our customers, and thus renewable energy sources account for about 10% of total electricity.

The feed-in tariff system for renewable energy commenced in July 2012, whereupon the electric power companies are obliged to buy such electricity at a fixed price for a certain period. The cost of purchasing this electricity is finally borne by customers in the form of a surcharge which in principle is proportional to the amount of electricity consumed.

Renewable energy such as photovoltaic power has problems involving efficiency, cost of power generation and stability of output. R&D on the latest power system control technologies for combining existing power plants and storage batteries will be actively conducted to help stabilize the system, when introducing large amounts of wind and photovoltaic power, which are susceptible to the weather.

Electric utilities will keep striving to develop and improve renewable energy sources.

As a result of taking various environmental measures at thermal power plants, Japan has achieved the world’s top-level energy efficiency. Based on this achievement, the electric utility industry in Japan has been making efforts to establish a mechanism for sharing such advanced technologies with electric power industries in other countries (see the column).

Through the cooperation between advanced and developing countries, and with the ‘sectoral approaches’ for sector-by-sector improvement of energy efficiency, it will be possible to achieve compatibility between economic growth and global environmental preservation. The electric utility industry of Japan has been proposing the sectoral approaches to the world as a new focus for the post-Kyoto period.

It is estimated that the introduction of Japanese technologies to coal-fired power plants in three big countries alone, namely the United States, China and India, could reduce emissions by approx. 1.3 billion tons-CO2/year, which is almost equivalent to the total annual CO2 emissions in Japan today.

International Electricity Partnership (IEP)

In October 2008, the FEPC of Japan, Edison Electric Institute of the United States, and EURELECTRIC of Europe jointly announced the establishment of the International Electricity Partnership (IEP) to realize a global low-carbon future through advanced electric power technologies.

On December 15, 2009, the members of IEP presented their technology roadmap entitled ‘Roadmap for a Low-Carbon Power Sector by 2050’ on site at COP15 in Copenhagen, Denmark. In addition to providing analysis of the electric power technology and policies needed to realize a low-carbon society, this Roadmap may also be used as a guideline for transferring advanced electric power technologies to developing countries as a tool of sectoral approaches for reducing greenhouse gas emissions.

Participation in Asia-Pacific Partnership (APP) on Clean Development and Climate

APP is a framework for inter-regional partnership for responding to the challenges of growing energy demand, energy security, climate change, and so on. Under this framework, the seven participating countries (United States, Australia, China, India, South Korea, Japan and Canada) are pursuing the development, transfer and spread of clean and energy-efficient technologies.

CO2 emissions from the seven participating countries account for more than half of global CO2 emissions, and so these seven countries’ efforts for reducing CO2 emissions will have a global impact. Electric utilities in Japan have been actively involved in these efforts.

The activities of the APP were completed by the end of April 2011, and were taken over by the Global Superior Energy Performance Partnership (GSEP).

Comparison of Thermal Power Plant Efficiency in Japan and Other Countries

U.K./Ireland
Japan
Northern Europe
France
Korea RP
Germany
U.S.A.

Wind Power

Photo voltaic Power

Mikuni Solar Power Station

Comparison of Thermal Power Plant Efficiency in Japan and Other Countries

Source: ECOFYS ‘INTERNATIONAL COMPARISON OF FOSSIL POWER EFFICIENCY AND CO2 INTENSITY’ August 2012.

*Thermal efficiency is the gross generating efficiency based on the weighted averages of efficiencies for coal, petroleum and gas (low heat value standard).

*Comparisons are made after converting Japanese data higher heating value standard to lower heating value standard, which is generally used overseas. The figures based on lower heating value are around 5-10% higher than the figures based on higher heating value.

*Private power generation facilities, etc. not covered.
Demand-side Efforts for CO2 Reduction

In Japan, the energy demand for water heating constitutes about 30% of the total energy demand in the household sector, and so energy-saving and CO2 reduction measures in this area are very effective. Electric power companies have been working hard to develop and promote electric appliances and systems to reduce CO2 emissions. One example is EcoCute, a water heating system with a heat pump that uses CO2 as refrigerant.

EcoCute heats water by transferring the thermal energy in air, which is freely available, to water by means of refrigerant. With a single unit of electric energy for heat pump operation and two units of thermal energy from air, it produces three units of thermal energy. Thanks to this principle, CO2 emissions are cut by about 50% compared with conventional combustion type water heaters. Because of this advantage, the government and industry are jointly promoting the use of heat pump systems as a key means of preventing global warming in the consumer sector (household and commercial sectors). When heat pump systems fully penetrate the consumer and industrial sectors, the resulting CO2 emissions reduction will amount to about 12% of the present annual CO2 emissions in Japan, which is about 1.2 billion tons CO2.

Environmental Conservation

International Exchanges

Strengthening International Communication and Cooperation

Japan's electric power companies remain active on a worldwide basis. In order to cope with global warming and to ensure the safety of nuclear power generation, international cooperation is indispensable. Each of the electric power companies in Japan has individual agreements with overseas utilities in order to facilitate exchanges on a wide range of information such as power generation, customer relations, distribution and quality control. The industry's top executives actively participate in international meetings such as the International Electricity Summit and the World Association of Nuclear Operators (WANO) to exchange views, while we also accept trainees from overseas. We import most of our fuel such as oil and coal from overseas countries and also keep our doors open to foreign companies on the purchase of equipment such as generators.

Overseas Offices

Please feel free to contact your nearest office.

WASHING Tom, D.C.

- The Federation of Electric Power Companies of Japan, Washington Office
  The Federation's Washington Office was established in January 1994. Its principal objectives are to study U.S. energy policies and to exchange information with U.S. energy opinion leaders in order to promote a greater understanding of the Japanese electric power industry.
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Overseas Offices

Please feel free to contact your nearest office.

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Overseas Offices

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### Location of Power Stations

Japan's electric power industry operates some 1,800 hydroelectric, thermal, nuclear, and other power plants to meet the required demand. Here is a list and map of the country's major power plants:

#### Principal Thermal Power Plants (1,000MW or greater)

<table>
<thead>
<tr>
<th>Name of Plant</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Tomato-amaura</td>
<td>Hokkaido, 1,650</td>
<td>Coal</td>
</tr>
<tr>
<td>4</td>
<td>Higashigama</td>
<td>Tottori, 4,864</td>
<td>LCO, other Gas</td>
</tr>
<tr>
<td>5</td>
<td>Hanamachi</td>
<td>Tottori, 2,000</td>
<td>Coal</td>
</tr>
<tr>
<td>6</td>
<td>Hira</td>
<td>Tottori, 1,300</td>
<td>Coal, Fuel Oil</td>
</tr>
<tr>
<td>7</td>
<td>Hino</td>
<td>Tottori, 1,200</td>
<td>Coal</td>
</tr>
<tr>
<td>8</td>
<td>Futtsu</td>
<td>Tottori, 5,040</td>
<td>LCO</td>
</tr>
<tr>
<td>9</td>
<td>Kashiwagi</td>
<td>Tottori, 2,400</td>
<td>Coal, Fuel Oil</td>
</tr>
<tr>
<td>10</td>
<td>Hiyoshi</td>
<td>Tottori, 3,880</td>
<td>Fuel Oil, Coal, Fuel Oil</td>
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<tr>
<td>11</td>
<td>Sodegaura</td>
<td>Tottori, 3,712</td>
<td>LCO</td>
</tr>
<tr>
<td>12</td>
<td>Chiba</td>
<td>Tottori, 3,605</td>
<td>Fuel Oil, Fuel Oil, LCO, LPG</td>
</tr>
<tr>
<td>13</td>
<td>Yokohama</td>
<td>Tottori, 3,548</td>
<td>LCO</td>
</tr>
<tr>
<td>14</td>
<td>Yokosuka</td>
<td>Tottori, 3,325</td>
<td>Fuel Oil, Fuel Oil, LCO</td>
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<tr>
<td>15</td>
<td>Higashi-ogimine</td>
<td>Tottori, 2,000</td>
<td>LCO</td>
</tr>
<tr>
<td>16</td>
<td>Goto</td>
<td>Tottori, 1,886</td>
<td>LCO</td>
</tr>
<tr>
<td>17</td>
<td>Kawasaki</td>
<td>Tottori, 1,628</td>
<td>LCO</td>
</tr>
<tr>
<td>18</td>
<td>Minami-yokohama</td>
<td>Tottori, 1,150</td>
<td>LCO</td>
</tr>
<tr>
<td>19</td>
<td>Shinshibana</td>
<td>Tottori, 1,140</td>
<td>LCO</td>
</tr>
<tr>
<td>20</td>
<td>Nishi</td>
<td>Tottori, 1,050</td>
<td>Coal</td>
</tr>
<tr>
<td>21</td>
<td>Hachimanka</td>
<td>Tottori, 1,000</td>
<td>Coal</td>
</tr>
<tr>
<td>22</td>
<td>Kawanishi</td>
<td>Chiba, 4,802</td>
<td>LCO</td>
</tr>
<tr>
<td>23</td>
<td>Kanazawa</td>
<td>Chiba, 4,100</td>
<td>LCO</td>
</tr>
<tr>
<td>24</td>
<td>Chita</td>
<td>Chiba, 3,966</td>
<td>Fuel Oil, Coal, LCO, LPG</td>
</tr>
<tr>
<td>25</td>
<td>Shinagawa</td>
<td>Chiba, 3,058</td>
<td>LCO</td>
</tr>
<tr>
<td>26</td>
<td>Kuri</td>
<td>Chiba, 1,900</td>
<td>Fuel Oil, Coal</td>
</tr>
<tr>
<td>27</td>
<td>Chita Daiei</td>
<td>Chiba, 1,708</td>
<td>LCO</td>
</tr>
<tr>
<td>28</td>
<td>Youshikai</td>
<td>Chiba, 1,245</td>
<td>LCO</td>
</tr>
<tr>
<td>29</td>
<td>Nishinagaya</td>
<td>Chiba, 1,130</td>
<td>Fuel Oil, Fuel Oil, LCO, LPG</td>
</tr>
<tr>
<td>30</td>
<td>Takamatsu</td>
<td>Chiba, 1,125</td>
<td>Fuel Oil, Coal</td>
</tr>
<tr>
<td>31</td>
<td>Toyotomi Shinko</td>
<td>Hokkaido, 1,500</td>
<td>Fuel Oil, Coal</td>
</tr>
<tr>
<td>32</td>
<td>Kamasui</td>
<td>Hokkaido, 1,200</td>
<td>Coal</td>
</tr>
<tr>
<td>33</td>
<td>Shiokura</td>
<td>Hokkaido, 1,200</td>
<td>Coal</td>
</tr>
<tr>
<td>34</td>
<td>Kamin</td>
<td>Hokkaido, 2,100</td>
<td>Fuel Oil</td>
</tr>
<tr>
<td>35</td>
<td>Sakaiko</td>
<td>Hokkaido, 2,000</td>
<td>LCO</td>
</tr>
<tr>
<td>36</td>
<td>Soba</td>
<td>Hokkaido, 1,800</td>
<td>Fuel Oil, Fuel Oil</td>
</tr>
<tr>
<td>37</td>
<td>Nankai</td>
<td>Hokkaido, 1,800</td>
<td>LCO</td>
</tr>
</tbody>
</table>

#### Nuclear Power Plants

- **In Operation**

<table>
<thead>
<tr>
<th>Plant</th>
<th>Unit No.</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>1</td>
<td>Hokkaido</td>
<td>5,759</td>
<td>Pressurized Water Reactor</td>
</tr>
<tr>
<td>39</td>
<td>2</td>
<td>Hokkaido</td>
<td>5,759</td>
<td>Pressurized Water Reactor</td>
</tr>
<tr>
<td>40</td>
<td>3</td>
<td>Hokkaido</td>
<td>5,759</td>
<td>Pressurized Water Reactor</td>
</tr>
<tr>
<td>41</td>
<td>4</td>
<td>Hokkaido</td>
<td>5,759</td>
<td>Pressurized Water Reactor</td>
</tr>
<tr>
<td>42</td>
<td>5</td>
<td>5,759</td>
<td>Pressurized Water Reactor</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>6</td>
<td>5,759</td>
<td>Pressurized Water Reactor</td>
<td></td>
</tr>
</tbody>
</table>

- **Under Construction**

<table>
<thead>
<tr>
<th>Plant</th>
<th>Unit No.</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>1</td>
<td>1,100</td>
<td>Thermal Power Plant (1,000MW or greater)</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>2</td>
<td>1,100</td>
<td>Thermal Power Plant (1,000MW or greater)</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>3</td>
<td>1,100</td>
<td>Thermal Power Plant (1,000MW or greater)</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>4</td>
<td>1,100</td>
<td>Thermal Power Plant (1,000MW or greater)</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>5</td>
<td>1,100</td>
<td>Thermal Power Plant (1,000MW or greater)</td>
<td></td>
</tr>
</tbody>
</table>

- **Preventing for Construction**

<table>
<thead>
<tr>
<th>Plant</th>
<th>Unit No.</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>1</td>
<td>1,100</td>
<td>Thermal Power Plant (1,000MW or greater)</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>1,100</td>
<td>Thermal Power Plant (1,000MW or greater)</td>
<td></td>
</tr>
</tbody>
</table>

#### Principal Hydroelectric Power Plants (150MW or greater)

<table>
<thead>
<tr>
<th>Name of Plant</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>1</td>
<td>150</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>52</td>
<td>2</td>
<td>150</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>53</td>
<td>3</td>
<td>150</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>54</td>
<td>4</td>
<td>150</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>55</td>
<td>5</td>
<td>150</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>56</td>
<td>6</td>
<td>150</td>
<td>Pumped Storage</td>
</tr>
</tbody>
</table>

#### End of Operation

- **Fukushima**
  - Unit 1: Tokyo Electric Power Company decided to decommission Unit 1 to 4 and to abolish plans to build Unit 5 at the Fukushima Daiichi Nuclear Power Station which was severely damaged due to the Tohoku-Oki Earthquake and the tsunami that followed after 11 March 2011.

### Note

Electricity supply in Japan is carried out by privately-owned independent regional electric power companies and close cooperation among these companies is essential for efficient operations. In 1952, the nine electric power companies established the Federation of Electric Power Companies (FEPC) to promote smooth operations within the industry. Since then, FEPC has played an important role as a base for close communication between the electric power companies and as a forum for exchanging views to create the electric power industry of the future. Moreover, FEPC undertakes various activities to ensure stable operations of the electric power industry, with an awareness of its role in the energy industry of Japan.

With the return of Okinawa to Japan in 1972, the Okinawa Electric Power Company rejoined Japan’s electric power industry, becoming an FEPC member in March 2000.
Changes in Electric Power Generation

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ten Companies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydro</td>
<td>65.4</td>
<td>62.3</td>
<td>66.5</td>
<td>60.0</td>
<td>56.5</td>
<td>57.7</td>
<td>62.9</td>
<td>62.8</td>
</tr>
<tr>
<td>Thermal</td>
<td>392.0</td>
<td>401.1</td>
<td>426.4</td>
<td>459.3</td>
<td>506.1</td>
<td>456.6</td>
<td>485.4</td>
<td>610.7</td>
</tr>
<tr>
<td>Geothermal</td>
<td>1.4</td>
<td>2.8</td>
<td>3.0</td>
<td>2.9</td>
<td>2.5</td>
<td>2.6</td>
<td>2.4</td>
<td>2.5</td>
</tr>
<tr>
<td>Nuclear</td>
<td>181.1</td>
<td>271.4</td>
<td>302.3</td>
<td>287.0</td>
<td>247.1</td>
<td>266.1</td>
<td>217.3</td>
<td>107.0</td>
</tr>
<tr>
<td>Subtotal</td>
<td>639.9</td>
<td>737.6</td>
<td>798.4</td>
<td>809.2</td>
<td>812.3</td>
<td>783.0</td>
<td>820.6</td>
<td>776.8</td>
</tr>
<tr>
<td>Industry-Owned and Others</td>
<td>217.4</td>
<td>252.3</td>
<td>293.1</td>
<td>348.7</td>
<td>334.1</td>
<td>329.6</td>
<td>334.9</td>
<td>331.1</td>
</tr>
<tr>
<td>Total</td>
<td>857.3</td>
<td>989.9</td>
<td>1,091.5</td>
<td>1,157.9</td>
<td>1,146.3</td>
<td>1,112.6</td>
<td>1,156.9</td>
<td>1,107.8</td>
</tr>
</tbody>
</table>

Changes in Electricity Sales for Ten Companies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential (Lighting)</td>
<td>177.4</td>
<td>224.6</td>
<td>254.6</td>
<td>281.3</td>
<td>285.3</td>
<td>285.0</td>
<td>304.2</td>
<td>288.9</td>
</tr>
<tr>
<td>Commercial and Industrial</td>
<td>481.5</td>
<td>532.3</td>
<td>583.0</td>
<td>601.2</td>
<td>603.6</td>
<td>573.5</td>
<td>602.2</td>
<td>570.9</td>
</tr>
<tr>
<td>Commercial</td>
<td>116.3</td>
<td>152.8</td>
<td>157.9</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Low Voltage</td>
<td>100.1</td>
<td>108.0</td>
<td>115.8</td>
<td>39.4</td>
<td>34.6</td>
<td>33.1</td>
<td>35.5</td>
<td>33.1</td>
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<tr>
<td>Large Industrial</td>
<td>248.1</td>
<td>254.7</td>
<td>74.8</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Others</td>
<td>17.0</td>
<td>16.8</td>
<td>15.0</td>
<td>13.4</td>
<td>12.1</td>
<td>12.0</td>
<td>12.0</td>
<td>11.8</td>
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<tr>
<td>Total</td>
<td>658.9</td>
<td>757.0</td>
<td>857.9</td>
<td>882.3</td>
<td>888.9</td>
<td>858.5</td>
<td>906.4</td>
<td>859.8</td>
</tr>
</tbody>
</table>

Power Generation Composition by Source in Major Countries (2010)

<table>
<thead>
<tr>
<th>Source</th>
<th>Coal</th>
<th>Oil</th>
<th>Natural Gas</th>
<th>Nuclear</th>
<th>Hydroelectric</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.A.</td>
<td>43.8</td>
<td>43.0</td>
<td>25.88</td>
<td>19.27</td>
<td>8.88</td>
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<tr>
<td>China</td>
<td>77.8</td>
<td>77.8</td>
<td>17.0</td>
<td>17.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Japan</td>
<td>27.4</td>
<td>27.4</td>
<td>74.0</td>
<td>13.7</td>
<td>74.0</td>
</tr>
<tr>
<td>Russia</td>
<td>32.5</td>
<td>32.5</td>
<td>68.0</td>
<td>22.2</td>
<td>68.0</td>
</tr>
<tr>
<td>India</td>
<td>14.9</td>
<td>14.9</td>
<td>57.2</td>
<td>35.7</td>
<td>57.2</td>
</tr>
<tr>
<td>Canada</td>
<td>43.9</td>
<td>43.9</td>
<td>75.5</td>
<td>22.0</td>
<td>75.5</td>
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<tr>
<td>Germany</td>
<td>47.5</td>
<td>47.5</td>
<td>74.5</td>
<td>25.0</td>
<td>74.5</td>
</tr>
<tr>
<td>France</td>
<td>58.2</td>
<td>58.2</td>
<td>78.3</td>
<td>21.7</td>
<td>78.3</td>
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<tr>
<td>Brazil</td>
<td>22.7</td>
<td>22.7</td>
<td>78.2</td>
<td>21.8</td>
<td>78.2</td>
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<td>U.K.</td>
<td>28.7</td>
<td>28.7</td>
<td>48.0</td>
<td>23.6</td>
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<td>Korea</td>
<td>34.4</td>
<td>34.4</td>
<td>29.7</td>
<td>20.7</td>
<td>29.7</td>
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<td>Italy</td>
<td>52.5</td>
<td>52.5</td>
<td>67.1</td>
<td>32.9</td>
<td>67.1</td>
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Investment by Type of Power Facility for Ten Companies

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td>Generation</td>
<td>516</td>
<td>449</td>
<td>499</td>
<td>654</td>
<td>816</td>
<td>771</td>
<td>887</td>
<td>1,100</td>
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<tr>
<td>Distribution/Other</td>
<td>996</td>
<td>1,048</td>
<td>1,029</td>
<td>1,199</td>
<td>1,308</td>
<td>1,262</td>
<td>1,235</td>
<td>1,023</td>
</tr>
<tr>
<td>Total</td>
<td>1,512</td>
<td>1,497</td>
<td>1,529</td>
<td>1,854</td>
<td>2,124</td>
<td>2,034</td>
<td>2,123</td>
<td>2,123</td>
</tr>
</tbody>
</table>

Note: Figures rounded down to nearest digit
Source: Handbook of Electric Power Industry
Changes in Electricity Sales* / Consumption** for Major Countries

Source: Overseas Electric Power Industry Statistics (2011)

Note: (*) = 10 Electric Power Companies + Electric Power Development Company

SOx and NOx Emissions per Unit of Electricity Generated by Thermal Power in Each Country

Source: Overseas Electric Power Industry Statistics (2011)

Comparison of CO2 Emissions Intensity by Country (2010)

History of Japan's Electric Utility Industry

Addresses

Business

Nihon Hatsusoden Co. (a nationwide power generating and completely state-controlled and utilities were integrated into the Second World War, the electric utility industry was five major electric utilities after the First World War. During the dissolution of 700 electric utilities, which merged to create utility industry experienced a major restructuring that led to development of its industry. At the same time, the electric lives and industry.

electricity became an indispensable energy source for peoples' came into wider use throughout the country. Consequently, plants were introduced, generation costs fell and electricity transmission technology. As larger thermal and hydro power early 20th century marked the establishment of long-distance established throughout the nation reached a total of 33. The nation's first electric power company, and began supplying electricity to the public in the following year.

In the early days, use of electricity grew primarily for unfamiliar and uncommon not only in Japan but also in Europe and the United States. In 1886, Tokyo Electric lamp was switched on in commemoration of the opening of Institute of Technology in Toranomon, Tokyo when an arc

In the years that followed, the electricity utility business

Electricity was first used in Japan on March 25, 1878 at the

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Tel: (03) 3201-6501 URL http://www.jepic.denken.or.jp

1-5, Kanda-Mitoshiro-cho, Chiyoda-ku, Tokyo 101-0053, Japan

Central Research Institute of Electric Power Industry (CRIEPI)

6-1, Ohtemachi 1-chome, Chiyoda-ku, Tokyo 100-8126, Japan

Tel: (03) 3020-6001 URL http://criepi.denken.or.jp/

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15-33, Shibaura 4-chome, Minato-ku, Tokyo 108-0023, Japan

Tel: (03) 6351-8215 URL http://www.jepic.co.jp

World Association of Nuclear Operators Tokyo Centre (WANO-TC)

11-1, Iwado-kita 2-chome, Komae, Tokyo 201-8511, Japan

Tel: (03) 3480-4809 URL http://www.wano.info

The Federation of Electric Power Companies of Japan (FEPC)

Kesannen-kukan, 1-5-2, Otemach, Chiyoda-ku, Tokyo 100-8118, Japan

Tel: (03) 5221-1440 URL http://www.fepc.or.jp

Hokkaido Electric Power Co., Inc.

2, Higashi 1-chome, Odori, Chuo-ku, Sapporo, Hokkaido 060-8677, Japan

Tel: (011) 251-111 URL http://www.hepco.co.jp

Tohoku Electric Power Co., Inc.

1-7-1 Honcho, Aoba-ku, Sendai, Miyagi 980-8550, Japan

Tel: (022) 225-2111 URL http://www.tohoku-epco.co.jp

The Tokyo Electric Power Co., Inc.

1-1, Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100-8560, Japan

Tel: (03) 6373-1111 URL http://www.tepco.co.jp

Chubu Electric Power Co., Inc.

1, Higashi-shinsaibashi, Higashiyama-ku, Nagoya, Aichi 467-8680, Japan

Tel: (052) 951-8211 URL http://www.chuden.co.jp

Hokuriku Electric Power Co., Inc.

21-5, Uehonjo-cho, Toyama, Toyama 930-8681, Japan

Tel: (076) 441-2515 URL http://www.nikuden.co.jp

The Kansai Electric Power Co., Inc.

6-16, Nakamukojima 1-chome, Kita-ku, Osaka, Osaka 530-8270, Japan

Tel: (06) 6441-8821 URL http://www.kepco.co.jp

The Chugoku Electric Power Co., Inc.

4-33, Komachi, Naka-ku, Hiroshima, Hiroshima 730-8701, Japan

Tel: (082) 241-0215 URL http://www.energia.co.jp

Shikoku Electric Power Co., Inc.

2-5, Marumochi, Takamatsu, Kagawa 760-8733, Japan

Tel: (087) 821-5601 URL http://www.yoneden.co.jp

Kyushu Electric Power Co., Inc.

1-62, Watamabe-dori 2-chome, Chuo-ku, Fukuoka, Fukuoka 810-8720, Japan

Tel: (092) 765-3031 URL http://www.kyuden.co.jp

The Okinawa Electric Power Co., Inc.

2-1, Makiminato 5-chome, Urasoe, Okinawa 901-2602, Japan

Tel: (098) 877-2341 URL http://www.okiden.co.jp

Electric Power Development Co., LTD. (EPDC)

15-1, Ginza 6-chome, Chuo-ku, Tokyo 104-8165, Japan

Tel: (03) 3546-2311 URL http://www.eppower.co.jp

The Japan Atomic Power Company (JAPC)

1-3, Kanda-Mitsukoshi-cho, Chiyoda-ku, Tokyo 101-0053, Japan

Tel: (03) 6371-7400 URL http://www.japc.co.jp

Japan Nuclear Fuel Limited (JNFL)

4-108 Asa Ohashi, Osaki-ku, Fujisawa, Kanagawa-mura, Kamikita-gun, Aomori 039-3212, Japan

Tel: (0175) 71-2000 URL http://www.jnf.co.jp

Japan Atomic Energy Agency (JAEA)

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Tel: (029) 282-1122 URL http://www.jaea.go.jp

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