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 peoples’ 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 700 electric utilities, which merged to create five major electric utilities after the First World War.

The Okinawa Electric Power Co. was established with the return of Okinawa to Japan in 1972. 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 independent power producers (IPP) were allowed to provide electricity wholesale services, and in March 2001, electricity retail supply for extra-high voltage users (demand exceeding 2MW) 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.

With the Fukushima Daiichi Nuclear Power Station accident and subsequent tight demand and supply brought about by the Great East Japan Earthquake in March 2011 as a turning point, numerous discussions were held to maintain a stable supply and reduce energy costs, and in November 2013, the policy to implement three-phase reforms of the electric power system was adopted.

**History of Japan’s Electric Utility Industry**
Japan’s Energy Supply Situation

Resource-poor Japan is dependent on imports for more than 90% of its energy. 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 40% of Japan’s primary energy supply, and more than 80% 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. The 5th Strategic Energy Plan revised by the government in July 2018 also states that nuclear power is an important base load power source that can, strictly premised on safety, contribute to the stability of the supply and demand structure of energy.

Development of 2030 Energy Mix

After the Great East Japan Earthquake, almost all nuclear power stations have been halted and thermal power generation accounts for most of the energy mix. As a result, Japan’s energy self-sufficiency ratio has dropped from 20.2% at the time before the Earthquake to 6.4% in FY2014 and fuel costs have nearly doubled from 3.6 trillion yen to 7.2 trillion yen in the same time period. The increase in thermal power generation has also increased CO2 emissions.

In July 2015, reflecting these observations, the government decided the "Energy Mix" of FY2030 with the basic objectives of raising the nation’s energy self-sufficiency ratio higher than that even before the earthquake, lowering the electricity cost from the current level, and setting a CO2 emission reduction target comparable to those of western nations.

The Energy Mix proposes, in addition to a firm commitment to reduce overall energy consumption, that nuclear should account for 22-20%, thermal power for 56% (27% LNG, 26% coal, and 3% oil), and renewable energy for 22-24%.

In view of the Energy Mix decided by the Government, the electric power companies will strive to achieve energy security, economic efficiency, and environmental conservation, while putting top priority on safety.

Three Viewpoints Concerning Development of the Energy Mix

Three Viewpoints Concerning Development of the Energy Mix

Energy self-sufficiency rate:

- Only 6% at 2014
- Target: About 25%, surpassing the pre-earthquake level of about 20%

Electricity cost:

- Electricity rates have risen since the earthquake.
- The surcharge for purchasing renewable energy in FY 2018 is 2.4 trillion yen.
- Target: Bring it down from the present level*

Greenhouse gas emissions:

- Due to NNP shutdowns and the increase of thermal power generation, the CO2 emissions (from energy sources) in FY2013 were the worst ever.
- Target: A reduction comparable with those of western nations


Dependence on Imported Energy Sources by Major Countries (2016)

Japan’s Reliance on Middle East Crude Oil of Total Imports

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</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>33</td>
<td>22</td>
<td>12</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>87</td>
<td>78</td>
<td>68</td>
<td>71.5</td>
<td>87.7</td>
<td>87.7</td>
<td>86.6</td>
<td>82.5</td>
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<tr>
<td>China</td>
<td>92</td>
<td>93</td>
<td>92</td>
<td>92.6</td>
<td>91.9</td>
<td>91.7</td>
<td>88.3</td>
<td>84.6</td>
</tr>
<tr>
<td>India</td>
<td>70</td>
<td>68</td>
<td>68.8</td>
<td>78.6</td>
<td>87.1</td>
<td>87.1</td>
<td>86.6</td>
<td>82.5</td>
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<tr>
<td>South Korea</td>
<td>81</td>
<td>70</td>
<td>71.4</td>
<td>88.1</td>
<td>88.1</td>
<td>88.1</td>
<td>88.1</td>
<td>88.1</td>
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</tbody>
</table>

*Source: Petroleum Association of Japan

Greenhouse gas emissions:

| Source: METI “Long-term Energy Supply and Demand Outlook”

Electric power demand

<table>
<thead>
<tr>
<th>FY2013 (Actual value)</th>
<th>FY2030 (Target value)</th>
</tr>
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<tbody>
<tr>
<td>Electric power</td>
<td>Electric power</td>
</tr>
<tr>
<td>980.8 billion kWh</td>
<td>900.9 billion kWh</td>
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</tbody>
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Electric power demand

<table>
<thead>
<tr>
<th>Economic growth 1.7%/year</th>
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<tr>
<td>(Total power generation)</td>
</tr>
<tr>
<td>Through energy efficiency and conservation 1.06 billion kWh</td>
</tr>
<tr>
<td>NPP shutdowns before the earthquake (Total power generation) 1.278 billion kWh</td>
</tr>
</tbody>
</table>

Power source mix

<table>
<thead>
<tr>
<th>Renewable energy 22%</th>
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<tr>
<td>(Total power generation) 1.065 billion kWh</td>
</tr>
<tr>
<td>Nuclear power 17%</td>
</tr>
<tr>
<td>LNS 22%</td>
</tr>
<tr>
<td>Coal 26%</td>
</tr>
<tr>
<td>Wind power 24%</td>
</tr>
<tr>
<td>Solar power 7%</td>
</tr>
<tr>
<td>Hydrothermal power 8.8 to 9.2%</td>
</tr>
</tbody>
</table>

*Values are approximate
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 enable these efforts to be constantly and objectively evaluated, the Nuclear Safety Institute (JANSI), which evaluates the safety improvement activities of electric power companies and gives them technical advice, and the Nuclear Risk Research Center (NRRC), which uses Probabilistic Risk Assessment (PRA) and proposes solutions based on R&D, were established. The electric power companies take to heart the evaluations and recommendations and are striving to achieve the highest safety level in the world.

In July 2018, so that these autonomous and continuous initiatives of the nuclear industry become established practices, a new organization, the Atomic Energy Association (ATENA), was established to effectively utilize the knowledge and resources of the entire nuclear industry, formulate effective measures while engaging in a continuing dialogue with regulators and others, and encourage nuclear operators to incorporate these measures in their plant operations. The electric power companies will work to reliably incorporate the safety measures decided by ATENA in their safety improvement initiatives to continuously reduce risk and recover the trust of society.

Also, in July 2013, the new regulatory requirements set forth by the Nuclear Regulation Authority (NRA) were put into effect. As of September 2019, electric power companies have applied for a review of conformance with the new regulatory requirements for 27 units out of their 16 power stations. Thirteen units have passed the review and nine of them have restarted commercial operation.

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 former 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 conventional general electrical 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 2MW.

The scope of liberalization was then expanded in April 2004 to users requiring more than 500kW and subsequently in April 2015 to users requiring more than 50kW. Then, in April 2016, all users including individual households and retail stores were included in the scope of this liberalization so that everyone is free to choose an electric power company and price menu. 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.

With the three goals of ensuring supply stability, suppressing electricity rates to the maximum extent possible, and expanding the options for consumers and the business opportunities for operators, the government is planning to advance the reforms in three phases through the three key measures of enhancing nationwide grid operation, full deregulation of the electricity retail and generation sectors, and further ensuring neutrality in the transmission/distribution sector through the legal unbundling while thoroughly inspecting each phase to solve any issues and taking necessary measures based on the results of the inspections.

As practitioners, the electric power companies would like to continue taking an active role in the deliberation so the markets will be organized to secure the stable supply of electricity, including the market transactions that are already active, and so that the electric power system reform will truly bring benefits to the customers.
Optimal Combination of Power Sources

Electric power companies in resource-poor Japan are committed to developing an optimal combination of power sources including 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 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.

Though the steady development of hydroelectric power plants is desired, Japan has only one potential site 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 have developed pumped-storage power generation plants to meet peak demand. As a result, the share of pumped-storage generation facilities of the total hydroelectric power capacity in Japan has grown 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, electric power companies are promoting the introduction of LNG-fired plants in response to global environmental concerns, 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 60%. 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 voluntary safety measures by adopting best practice from both Japan and overseas, while also complying with the new regulatory requirements following the accident at the Fukushima-daiichi Nuclear Power Station.

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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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 reprocess 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 conserves uranium resources, and it reduces the volume of high-level radioactive waste that must be disposed of.

Reprocessing is a chemical process that recovers plutonium and reusable uranium 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. Under the policy of possessing no plutonium reserves without specified purposes, Japan’s electric power companies have sincerely committed to a plan to utilize recovered plutonium – in the form of MOX fuel – as soon as possible.

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 at a site in Rokkasho-mura in the northern prefecture of Aomori. JNFL has applied for a review of compliance with the new regulatory requirements, which came into effect in December 2013, and the plants are currently undergoing reviews by the Nuclear Regulation Authority. JNFL expects the construction to be completed in the first half of FY2021. 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 viewpoints such as assuring energy security and mitigating global warming. We will make the 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 January 31, 2018)

Japan’s electric power companies are fully committed to implementing the closed nuclear fuel cycle and plutonium utilization consistent with all domestic laws and international nonproliferation standards. Since 1955, the domestic laws of Japan require that all nuclear activities, including commercial activities, be conducted only for peaceful purposes. Also, since 1968, Japan has embraced the “Three Non-Nuclear Principles,” which state that Japan will not possess, produce, or permit the entry of nuclear weapons into its territory.

In addition, in 1976, the Government of Japan ratified the Nuclear Non-Proliferation Treaty (NPT) and thereby obligated itself to a national policy not to produce or acquire nuclear weapons. In order to ensure the application of more extensive safeguards, Japan signed the IAEA Additional Protocol in 1998, which allows the IAEA to carry out a range of additional inspection measures. In accordance with national laws, Japan’s electric power companies submit reports on material accounting and safeguards activities to the Minister of Education, Culture, Sports, Science and Technology, and accept joint inspections by the IAEA and Japanese regulatory authorities to check the reports.

The Safeguards Program

Enactment of the Spent Nuclear Fuel Reprocessing Fund Act

In May 11, 2016, the Spent Nuclear Fuel Reprocessing Fund Act was passed in the Diet. The objective of the legislation is to provide a framework for pursuing the national policy of reprocessing spent fuel in a most reliable and efficient manner even under a new business environment characterized by the liberalized electricity market and reduced dependence on nuclear energy.

The new bill is to implement a series of institutional measures, which include creating a new funding system aimed at securing adequate funds, organizing a government-authoritization corporation (the spent fuel reprocessing organization) which, as a principal business entity, conducts the reprocessing business both appropriately and efficiently, and establishing an authorized corporation acting as a decision-making organization (a management committee) from a proper governance viewpoint. The law also ensures a certain level of involvement of the National Government.

Furnishings, the supplemental resolution to the legislation reaffirms the policy of possessing no plutonium reserves without specified purposes. Also, according to the bill, the Governmental instructs the nuclear operators to conduct reprocessing businesses with this policy, and if an implementing body should make reprocessing plans that go against this policy, the Ministry of Economy, Trade and Industry can withhold approval of such plans.

The Peaceful Use of Nuclear Energy

The results of each of these Japanese initiatives were reflected in the IAEA’s conclusion in June 2004, which stated that all the nuclear materials in Japan are protected under IAEA safeguards and are not being diverted to the manufacture of nuclear weapons. As a result, more effective and efficient IAEA safeguards known as integrated safeguards came into effect in Japan in September 2004. Furthermore, the 5th Strategic Energy Plan states the following concerning the handling of plutonium: Japan will maintain the existing policy of holding no plutonium reserves without specified purposes and using it only for peaceful purposes, while steadily advancing the use of plutonium in order to reduce the plutonium stockpile while contributing to nuclear non-proliferation and gaining the understanding of the international community. To make these efforts effective, Japan will manage and use plutonium appropriately by further promoting MOX fuel generation while paying due consideration to the balance of plutonium collected and utilized, and promote R&D of fast reactors through international cooperation with the United States and France.

Status of MOX Fuel Utilization

The electric power industry in Japan intends to introduce MOX fuel in 16 to 18 nuclear reactors. So far 27 units have applied for a review of conformance with the new regulatory requirements, out of which 9 units have received permission to introduce MOX fuel and have gained the participation of the local municipalities. So far, 4 units have had restarted operation using MOX fuel thus far. The electric power companies recognize the importance of improving the transparency of the MOX fuel project. Based on the outlook of individual companies toward restarting nuclear power plants and considering the schedule and other details of the plan to start up the reprocessing plant, we shall compile and announce the MOX fuel project before restarting plutonium recovery operations.

"International Roundtable on Final Disposal of High-Level Radioactive Waste"

The Energy Ministers’ Meeting (G20 Ministerial Meeting on Energy Transitions and Global Environment for Sustainable Growth) was held in Karuizawa, Nagano on June 15 and 16, 2019. The energy ministers reached an agreement on establishing the “International Roundtable on Final Disposal of High-Level Radioactive Waste” for the first time in order to make the final disposal of high-level radioactive waste a which is a common concern for all countries that make use of nuclear power generation. A basic strategy for international cooperation on final disposal was formulated and best practices were compiled at this “International Roundtable on Final Disposal of High-Level Radioactive Waste”.

Sources: JNFL’s website and others
Measures by the Electric Utility Industry to Suppress CO₂ Emissions

The electric power companies are trying to reduce CO₂ emissions mainly through attaining the optimal energy mix, seeking to simultaneously achieve Energy security, Economic efficiency and Environmental conservation, under the major premises of Safety (S+3E).

In July 2015, 35 electricity utility companies jointly constructed a voluntary framework for a low carbon society and prepared an “Action Plan for a Low-Carbon Society” that laid out specific efforts to be made. In February 2016, “the Electric Power Council for a Low-Carbon Society (ELCS)” was founded to facilitate efforts toward this goal (a membership of 47 companies as of the end of September 2019).

According to the Action Plan, an end-user CO₂ emission factor of about 0.37kg CO₂/kWh will be targeted in light of the Government’s 2030 energy supply and demand outlook. Moreover, as the maximum reduction potential, a reduction of about 11 million t CO₂ will be expected by using economically achievable best available technologies (BATs) in light of the construction of new thermal power plants, etc.

The member companies will make efforts towards a low carbon society by utilizing nuclear power generation premised on ensuring safety or renewable energy, raising the efficiency of thermal power plants and optimizing their appropriate maintenance and control, and promoting energy-conservation or CO₂ reduction services on both the supply and demand sides.

Regarding global warming measures, the “Paris Agreement” was adopted in December 2015 at the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21), and it entered into force in November 2016, building a framework that all countries and regions of the world participate for global warming measures. In COP 24, held in December 2018, countries adopted a “rulebook” to implement the 2015 Paris Agreement starting in 2020. The COP 25 in 2019, in December, is the 25th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC).

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. However, because of the extended shutdown of nuclear power plants following the Great East Japan Earthquake, and subsequent increase in thermal power generation, the CO₂ emission factor has remained higher than that before the earthquake.

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 power companies are also striving to maintain and improve the efficiency of thermal power plants through the introduction of highly efficient plants of the latest design or through appropriate operation and maintenance of the existing plants. Currently operating state-of-the-art gas turbine combined cycle plants have achieved the world’s highest level of efficiency.

Decarbonization of Energy on the Supply-side

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

Historical Trends in CO₂ Emissions from Power Generation

Note:  Data up until 2007 is reported by FEPC.
Data from 2008 to 2016 is reported by SDAC and some IEPs.
Data from 2017 onward is reported by ELCS.
Up until 2001, the figure for nuclear power generation are on a gross output basis as reported by FEPC; whereas the figures from 2001 onward are on a net output basis as reported by ELCS.
The figures with an asterisk are adjusted values taking into account CO₂ credits and other adjustments.

CO₂ Emissions Intensity over the Entire Lifecycle by Source

- CO₂ Emissions from Nuclear Power Generation
- CO₂ Emissions from Coal
- CO₂ Emissions from Liquefied Natural Gas

Note:  Data up until 2007 is reported by FEPC.
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Up until 2001, the figures for nuclear power generation are on a gross output basis as reported by FEPC; whereas the figures from 2001 onward are on a net output basis as reported by ELCS.
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Decarbonization of Energy on the Supply-side
Development and expansion of the use of renewable energy sources

The feed-in tariff system for renewable energy began 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.

The Revised FIT Act was enacted in April 2017, making changes to the FIT system including creating a new authorization system, revising the method of setting purchase prices, and revising businesses obliged to purchase electricity under the policy of “maximizing the amount of electricity consumed while suppressing the burden on the public”.

However, renewable energy such as solar 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 stability of output. R&D on the latest power system control technologies for combining existing power plants and renewable energy sources.

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

Introduction amount of Generating Capacity (Renewable energy)*

Wind Power

Solar Power

Small and medium sized hydro

Geothermal

Biomass

Introduction amount of Generating Capacity (Renewable energy)*

Japan has achieved the world’s top-level in energy efficiency by introducing various technologies for higher energy efficiency to thermal power plants. 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.

With high-efficiency plants to be introduced and the improvement of operation and maintenance technologies, coal-fired plants’ CO₂ reduction potential in OECD countries and developing countries in Asia in FY 2030 is estimated to be a maximum of 900 million t-CO₂/year. The electric utility industry of Japan will contribute to the reduction of global CO₂ emissions with Japan’s expertise and advanced technologies.

India

Northern Europe

France

Australia

U.K./Ireland

Note: Values listed for heat efficiency are gross thermal efficiency values: a weighted average of the heat efficiency of coal, oil, and gas (lower heating value standard). Subject facilities are those of operators whose main business is selling electricity to third parties.

Subject facilities are those of operators whose main business is selling electricity to third parties.

Comparison of Thermal Power Plant Efficiency in Japan and Other Countries

Use of CO2-SUICOM at Ube Photovoltaic Power Station (The Chugoku Electric Power)

Development of Innovative Technology—Carbon dioxide Capture and Storage (CCS) Technology

CCS is a technology for capturing carbon dioxide given off in the combustion of fossil fuels at electric power plants and other facilities before it is emitted into the atmosphere and storing it deep underground. It is positioned in Japan and other countries as an innovative technology that is effective as a global warming countermeasure. However, there are many issues related to its actual implementation, so FEPC-related companies are promoting CCS technology development while actively cooperating in large-scale verification experiments led by the government in order to overcome the issues involved and clarify latent ones.

Carbon dioxide Capture and Utilization (CCU), a technology in which separated and recovered CO₂ is considered a resource and reused in chemicals, fuel, and minerals, is also being researched as a potentially important method in reducing the amount of CO₂ emitted. The Chugoku Electric Power Company has developed environmentally-friendly concrete (product name “CO₂-SUICOM”) that uses special cement additions that harden in reaction to CO₂ in addition to other common materials.

Notes: Values listed for heat efficiency are gross thermal efficiency values: a weighted average of the heat efficiency of coal, oil, and gas (lower heating value standard). Subject facilities are those of operators whose main business is selling electricity to third parties.

Subject facilities are those of operators whose main business is selling electricity to third parties.

Mikuni Solar Power Station

Wind Power

Annual average growth rate 26%

6,000 GWh

0 1,000 2,000 3,000 4,000 5,000 6,000

Solar

Wind

Small and medium sized hydro

Geothermal

Biomass

Feed-in tariff system

Source: METI

Comparison of Thermal Power Plant Efficiency in Japan and Other Countries

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## Demand-side Efforts for CO2 Reduction

Along with working to promote further use of hot water supply systems (EcoCute) with CO2 refrigerant heat pumps, which significantly reduce CO2 emissions compared to conventional water heaters, the industry is actively working to promote more widespread use of high-efficiency commercial air conditioners and other appliances that utilize heat pump technology.

EcoCute heats water by transferring the thermal energy in air, which is freely available, to water by means of refrigerants. 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.

If the heat demand for the consumer division (households and commercial divisions) and industrial divisions currently being fulfilled through boilers can be met with heat pumps, CO2 emissions in 2030 are estimated to be reduced by 21.74 million t-CO2/year compared to 2015 levels.

### Trends in EcoCute Units Shipped

<table>
<thead>
<tr>
<th>Year</th>
<th>Units Shipped</th>
<th>Cumulative Units Shipped</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>2,000</td>
<td>4,000</td>
</tr>
<tr>
<td>2005</td>
<td>3,000</td>
<td>13,000</td>
</tr>
<tr>
<td>2007</td>
<td>4,000</td>
<td>27,000</td>
</tr>
<tr>
<td>2009</td>
<td>5,000</td>
<td>57,000</td>
</tr>
<tr>
<td>2011</td>
<td>6,000</td>
<td>117,000</td>
</tr>
</tbody>
</table>

Source: The Japan Refrigeration and Air Conditioning Industry Association

### Energy Obtained for Hot Water Supply

<table>
<thead>
<tr>
<th>Component</th>
<th>Energy Obtained (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolysis</td>
<td>1</td>
</tr>
<tr>
<td>Atmospheric Heat</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
</tr>
</tbody>
</table>

### Exterior Effects for CO2 Reduction

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 for the purchase of equipment such as generators.

### Overseas Offices

Please feel free to contact your nearest office:

- **Washington, D.C.**
  - The Federation of Electric Power Companies of Japan, Washington Office
    - Established in 1994
    - The 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.
    - Tel: (202) 466-6783 Fax: (202) 466-6758
    - Established in 1994

- **Tokyo Electric Power Company Holdings, Inc., Washington Office**
  - Tel: (202) 427-4780 Fax: (202) 427-4810
  - Established in 1979

- **Chubu Electric Power Co., Inc., Washington Office**
  - 1 Rockefeller Plaza, Suite 1228, Washington, D.C. 20006, U.S.A.
  - Tel: (202) 775-1980 Fax: (202) 551-0524
  - Established in 1982

- **Chubu Electric Power Co., Inc., New York Office**
  - 1 Rockefeller Plaza, Suite 1418, New York, NY 10020 U.S.A.
  - Tel: (212) 726-8122 Fax: (212) 263-8914
  - Established in 2017

- **Tokyo Electric Power Company Holdings, Inc., London Office**
  - Unit 4, Level A, Tower 2, Evolution Plaza, No.1 East Chang, An Avenue, Dong Cheng District, Beijing 100736, CHINA
  - Tel: (010) 8504-7771 Fax: (010) 8518-7770
  - Established in 1992

- **Tokyo Electric Power Company Holdings, Inc., Paris Office**
  - 2121 K Street, N.W., Suite 910, Washington, D.C. 20037, U.S.A.
  - Tel: (202) 457-0790 Fax: (202) 457-0810
  - Established in 1978

- **Tokyo Electric Power Company Holdings, Inc., London Office**
  - 2121 K Street, N.W., Suite 910, Washington, D.C. 20037, U.S.A.
  - Tel: (202) 457-0790 Fax: (202) 457-0810
  - Established in 1978

- **Tokyo Electric Power Company Holdings, Inc., Paris Office**
  - 2121 K Street, N.W., Suite 910, Washington, D.C. 20037, U.S.A.
  - Tel: (202) 457-0790 Fax: (202) 457-0810
  - Established in 1978

- **Tokyo Electric Power Company Holdings, Inc., Jakarta Office**
  - 18th Floor, Summitmas I Jl Jend Sudirman Kav 61-62 Jakarta 12190, INDONESIA
  - Tel: (021) 2751-0048 Fax: (021) 2751-0047
  - Established in 2016

- **Tokyo Electric Power Company Holdings, Inc., Bangkok Office**
  - 13-15 Boulevard de la Madeleine, 75001 Paris, FRANCE
  - Tel: (02) 014-2520 Fax: (02) 014-2521
  - Established in 2016

- **The Kansai Electric Power Co., Inc., New York Office**
  - 1 Rockefeller Plaza, Suite 1418, New York, NY 10020 U.S.A.
  - Tel: (212) 726-8122 Fax: (212) 263-8914
  - Established in 2017

- **The Kansai Electric Power Co., Inc., London Office**
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  - Established in 1978

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  - Established in 2016

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  - Tel: (021) 2751-0048 Fax: (021) 2751-0047
  - Established in 2016

- **The Kansai Electric Power Co., Inc., Beijing Office**
  - 2nd Floor, RENMIN TOWER AT EMQUARTIER, 689 Sukhumvit Rd, Khlong Tan Nuea, Yodfa, Bangkok, 10110, THAILAND
  - Tel: (66) 2265-7710 Fax: (66) 2265-7720
  - Established in 2016

- **The Kansai Electric Power Co., Inc., Jakarta Office**
  - 18th Floor, Summitmas I Jl Jend Sudirman Kav 61-62 Jakarta 12190, INDONESIA
  - Tel: (021) 2751-0048 Fax: (021) 2751-0047
  - Established in 2016

- **The Kansai Electric Power Co., Inc., Jakarta Office**
  - 18th Floor, Summitmas I Jl Jend Sudirman Kav 61-62 Jakarta 12190, INDONESIA
  - Tel: (021) 2751-0048 Fax: (021) 2751-0047
  - Established in 2016
# Location of Power Stations

## Major Power Plants

Here is a list and map of the country's major power plants:

### Principal Thermal Power Plants (1,500MW 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>Nanko</td>
<td>Kansai</td>
<td>1,800</td>
<td>LNG</td>
</tr>
<tr>
<td>Maizuru</td>
<td>Kansai</td>
<td>1,600</td>
<td>Coal</td>
</tr>
<tr>
<td>Horinouchi</td>
<td>Chubu</td>
<td>1,507.4</td>
<td>LNG</td>
</tr>
<tr>
<td>Shi Oita</td>
<td>Kyushu</td>
<td>2,304</td>
<td>LNG</td>
</tr>
<tr>
<td>Shi Kokura</td>
<td>Kyushu</td>
<td>1,800</td>
<td>LNG</td>
</tr>
<tr>
<td>Tsukenanawari</td>
<td>J-Power</td>
<td>2,100</td>
<td>Coal</td>
</tr>
<tr>
<td>Matsuura</td>
<td>J-Power</td>
<td>2,000</td>
<td>Coal</td>
</tr>
<tr>
<td>Shinsui</td>
<td>TamaJP</td>
<td>2,000</td>
<td>Coal</td>
</tr>
<tr>
<td>Nakoso</td>
<td>JobanJP</td>
<td>1,625</td>
<td>Heavy, oil, coal</td>
</tr>
</tbody>
</table>

### Nuclear Power Plants

#### In Operation

<table>
<thead>
<tr>
<th>Name of Plant</th>
<th>Unit Number</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
<th>Reactor</th>
<th>Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomari</td>
<td>1</td>
<td>Hokkaido</td>
<td>579</td>
<td>PWR</td>
<td>1985</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>570</td>
<td>PWR</td>
<td>1991</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>912</td>
<td>PWR</td>
<td>2009</td>
</tr>
<tr>
<td>Higashi Onari</td>
<td>1</td>
<td>Tottori</td>
<td>1,100</td>
<td>BWR</td>
<td>2006</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>825</td>
<td>BWR</td>
<td>2006</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>825</td>
<td>BWR</td>
<td>2006</td>
</tr>
<tr>
<td>Kashima</td>
<td>1</td>
<td>Tokyo</td>
<td>1,100</td>
<td>BWR</td>
<td>1985</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>1,100</td>
<td>BWR</td>
<td>1995</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1,100</td>
<td>BWR</td>
<td>1995</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>1,100</td>
<td>BWR</td>
<td>1995</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1,100</td>
<td>BWR</td>
<td>1995</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>1,100</td>
<td>BWR</td>
<td>1995</td>
</tr>
<tr>
<td>Hirakawa</td>
<td>3</td>
<td>Chubu</td>
<td>1,100</td>
<td>BWR</td>
<td>1987</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>1,100</td>
<td>BWR</td>
<td>1987</td>
</tr>
<tr>
<td>Shika</td>
<td>1</td>
<td>Hokkaido</td>
<td>540</td>
<td>BWR</td>
<td>1993</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>1,200</td>
<td>BWR</td>
<td>2006</td>
</tr>
<tr>
<td>Shinshu</td>
<td>3</td>
<td>Kansai</td>
<td>626</td>
<td>PWR</td>
<td>1976</td>
</tr>
<tr>
<td>Takahama</td>
<td>1</td>
<td>Kansai</td>
<td>826</td>
<td>PWR</td>
<td>1974</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>826</td>
<td>PWR</td>
<td>1974</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td>870</td>
<td>PWR</td>
<td>1985</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>870</td>
<td>PWR</td>
<td>1985</td>
</tr>
<tr>
<td>Ohi</td>
<td>3</td>
<td>Kansai</td>
<td>1,180</td>
<td>PWR</td>
<td>1991</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>1,180</td>
<td>PWR</td>
<td>1992</td>
</tr>
<tr>
<td>Shimane</td>
<td>2</td>
<td>Chugoku</td>
<td>820</td>
<td>PWR</td>
<td>1989</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td>820</td>
<td>PWR</td>
<td>1989</td>
</tr>
<tr>
<td>Hitachi</td>
<td>3</td>
<td>Shikoku</td>
<td>890</td>
<td>PWR</td>
<td>1994</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>890</td>
<td>PWR</td>
<td>1994</td>
</tr>
<tr>
<td>Sendai</td>
<td>3</td>
<td>Kashiwara</td>
<td>1,180</td>
<td>PWR</td>
<td>1997</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>1,180</td>
<td>PWR</td>
<td>1997</td>
</tr>
<tr>
<td>Tokai Daima</td>
<td>1</td>
<td>Japan Atomic Power Co.</td>
<td>1,100</td>
<td>BWR</td>
<td>1976</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>1,100</td>
<td>BWR</td>
<td>1976</td>
</tr>
<tr>
<td>Tecumseh</td>
<td>2</td>
<td>Japan Atomic Power Co.</td>
<td>1,160</td>
<td>PWR</td>
<td>1987</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td>1,160</td>
<td>PWR</td>
<td>1987</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>10,000</strong></td>
</tr>
</tbody>
</table>

#### Under Construction (Estimated start)

<table>
<thead>
<tr>
<th>Name of Plant</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higashi Onari</td>
<td>Tottori</td>
<td>1,385</td>
</tr>
<tr>
<td>Shimane</td>
<td>Chugoku</td>
<td>1,373</td>
</tr>
<tr>
<td>Ohi</td>
<td>Kashiwara</td>
<td>1,383</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>4,141</strong></td>
</tr>
</tbody>
</table>

#### Preparing for Construction (Estimated start)

<table>
<thead>
<tr>
<th>Name of Plant</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higashi Onari</td>
<td>Tottori</td>
<td>1,385</td>
</tr>
<tr>
<td>Shimane</td>
<td>Chugoku</td>
<td>1,373</td>
</tr>
<tr>
<td>Ohi</td>
<td>Kashiwara</td>
<td>1,383</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>4,141</strong></td>
</tr>
</tbody>
</table>

#### End of Operation

- Higashi Onari (2019.2)
- Shimane (2019.2)
- Ohi (2019.2)
- Takahama (2019.2)
- Sendai (2019.2)
- Tokai Daima (2019.2)
- Kokura (2019.2)

### Principal Hydroelectric Power Plants (400MW 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>Koyu</td>
<td>Japan Atomic Power Co.</td>
<td>650</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Hamahiko</td>
<td>Kansai</td>
<td>600</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Gakuma</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Otsu</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Ohkawa</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Shikawa</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Komatsu</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Takeno</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Murakami</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Hida</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Nagata</td>
<td>Kansai</td>
<td>500</td>
<td>Pumped Storage</td>
</tr>
</tbody>
</table>

The Federation of Electric Power Companies

Close cooperation among electric utilities is essential to effectively supply Japan’s electricity. 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.

Organization of FEPC

Chairman
Satoru Katsuno

Vice Chairman
Yutaka Kanai

Vice Chairman
Hiroya Harada

Deputy Secretary General
Satoshi Ohmori

Head of Nuclear Waste Final Repository Promotion Headquarters
Sasumra Tsukiyama

Executive Secretary General
Yoshishito Tomoika

Senior Managing Director
Head of Fukushima Support Headquarters
Shigenobu Shimizu

Senior Managing Director
Deputy Secretary General
Hiroya Harada

Senior Managing Director
Deputy Secretary General
Yoshishito Tomoika

Board of Directors

Business Addresses

The Federation of Electric Power Companies (FEPC)

Koishikawakakuen, 1-3-2, Otemachi, Chiyoda-ku, Tokyo 100-8116, Japan
Tel: (03) 5221-1440 URL: http://www.fepc.or.jp

Hokkaido Electric Power Co., Inc.
2-4, Higashi 1-chome, Odori, Chuo-ku, Sapporo, Hokkaido 060-8677, Japan
Tel: (011) 251-1111 URL: http://www.hepco.co.jp

Tohoku Electric Power Co., Inc.
7-7-1 Honcho, Aoba-ku, Sendai, Miyagi 980-8770, Japan
Tel: (022) 225-2111 URL: http://www.tohoku-epco.co.jp

Tokyo Electric Power Company Holdings, Inc.
1-1-3, Uchisencho, Chiyoda-ku, Tokyo 100-8061, Japan
Tel: (03) 6373-1111 URL: http://www.tepco.co.jp

Chubu Electric Power Co., Inc.
1, Higashi-cho, Higashiyama-ku, Nagoya 461-8680, Japan
Tel: (052) 951-8211 URL: http://www.chuden.co.jp

Hokuriku Electric Power Co., Inc.
15-1, Shikishima-cho, Toyama-shi, Toyama 930-8608, Japan
Tel: (076) 441-2511 URL: http://www.hrkdun.co.jp

The Kansai Electric Power Co., Inc.
5-6-16, Nakanocho, Kita-ku, Osaka, 535-8270, Japan
Tel: (06) 4441-8821 URL: http://www.KEPCO.co.jp

The Chugoku Electric Power Co., Inc.
8-33, Komatsuno, Naka-ku, Hiroshima-shi, Hiroshima 730-8701, Japan
Tel: (082) 241-0211 URL: http://www.emerga.co.jp

Shikoku Electric Power Co., Inc.
2-5, Marunouchi, Takamatsu-shi, Kagawa 760-8573, Japan
Tel: (087) 821-5001 URL: http://www.yonem.net

Kyuushu Electric Power Co., Inc.
2-1-82, Watarabe-dori, Chuo-ku, Fukuoka 810-8770, Japan
Tel: (092) 761-1031 URL: http://www.kyuden.co.jp

The Okinawa Electric Power Co., Inc.
2-1, Makinomori 5-chome, Ubogane, Okinawa 901-2092, Japan
Tel: (098) 877-2541 URL: http://www.okiden.co.jp

Electric Power Development Co., Ltd. (J-Power)
6-151, Ginza, Chuo-ku, Tokyo 104-0025, Japan
Tel: (03) 5346-2211 URL: http://www.j-power.co.jp

The Japan Atomic Power Company (JAPC)
5-2-1, Ueji, Toto-ku, Tokyo 110-0005, Japan
Tel: (03) 4371-7400 URL: http://www.japc.co.jp

Japan Nuclear Fuel Limited (JNFL)
8-108, Aso Chitose, Aso Okushiri, Kokkai, Kaimitsu-gun, Aomori Prefecture 039-3212, Japan
Tel: (0171) 71-2000 URL: https://www.jnfl.co.jp

Japan Atomic Energy Agency (JAEA)
75-1, Furuisashibara, Tokio-mura, Naka-gun, Barakko 319-1184, Japan
Tel: (029) 382-1122 URL: https://www.jaea.go.jp

Central Research Institute of Electric Power Industry (CRIEPI)
4-33, Komachi, Naka-ku, Hiroshima, 730-8511, Japan
Tel: (082) 241-0211 URL: https://www.criepi.denken.or.jp

Japan Electric Power Information Center, Inc. (JEPIC)
3-6-16, Nakanoshima, Kita-ku, Osaka, 530-8270, Japan
Tel: (03) 6373-1111 URL: http://www.jepic.or.jp

Japanese Electric Power Information Center, Inc. (JEPIC)
2-5-1, Higashi-shincho, Higashiyama-ku, Nagoya 461-8680, Japan
Tel: (052) 951-8211 URL: http://www.chuden.co.jp

World Association of Nuclear Operators Tokyo Centre (WANO-TC)
6F, Uchigahara Bldg., 2-11-5, Uchigahara, Minato, Tokyo 108-0023, Japan
Tel: (03) 6722-5900 URL: https://www.wano.info

Atomic Energy Association (ATEA)
Koishikawakakuen, 1-3-2, Otemachi, Chiyoda-ku, Tokyo 100-8116, Japan
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