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 gradually found broader applications as a power source for household and industrial lighting because of its safety and cleanliness, and subsequently 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, a policy to implement three-phase reforms of the electric power system was adopted in 2013.

In 2015, the Organization for Cross-regional Coordination of Transmission Operators, JAPAN (OCTOCO) was established in the first phase of reform, in 2016, new entry into the electricity retail market was fully liberalized in the second phase, and in 2020, the transmission / distribution sector was legally unbundled in the third phase.

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 2000, 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 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.

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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, its energy security 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.

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.

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

Dependence on Imported Energy Sources by Major Countries (2017)

Source: IEA "World Energy Balances 2019 Edition"

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

Energy self-sufficiency rate:

- Only 12% at 2018
- Target: About 24%, surpassing the pre-earthquake level of about 20%

Electricity cost:

- Electricity rates have risen since the earthquake.
- The surcharge for purchasing renewable energy in FY2020 is 2.4 trillion yen.
- Target: Bring it down from the present level

Greenhouse gas emissions:

- Due to NPP shutdowns and the increase of thermal power generation, the CO2 emissions (from energy sources) in FY2013 were the worst ever.
- Target: 26% decrease compared to FY2013

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

<table>
<thead>
<tr>
<th>Electric power demand</th>
<th>Power source mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total (FY2013)</td>
<td>(FY2020)</td>
</tr>
<tr>
<td>Electric power 966.5 billion kWh</td>
<td>Electric power 996.8 billion kWh</td>
</tr>
<tr>
<td>Nuclear power: 17%</td>
<td>Nuclear power: 19%</td>
</tr>
<tr>
<td>LNG: 22%</td>
<td>Liquefied Natural Gas: 27%</td>
</tr>
<tr>
<td>Coal: 22%</td>
<td>Coal: 26%</td>
</tr>
<tr>
<td>Oil: 28%</td>
<td>Oil: 31%</td>
</tr>
</tbody>
</table>

Values are approximate.

Source: METI “Long-term Energy Supply and Demand Outlook”
Nuclear Safety & Market Liberalization

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 Japan 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 initiative of the nuclear industry become established practices, a new organization, the Atomic Energy Association (ATENA), was established. This organization 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 February 2021, electric power companies have applied for a review of conformance with the new regulatory requirements for 27 units out of their 16 power stations. Sixteen units have passed the review and nine of them have restarted commercial operation.

Establishment of an Emergency Response Force (ERF) at Hamaoka Nuclear Power Station

In July 2014, Chubu Electric Power established its Emergency Response Force (ERF) at Hamaoka Nuclear Power Station (HNP) in Japan. This ERF is increasing the number of personnel in ERF to have them be stationed on site at all hours of the day, every day of the week.

In 2018, so that these autonomous and continuous measures based on the results of the inspections.

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 liberalisation 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.

Overview of the Electricity System Reform

The following revisions to the Electricity Business Act related to the reforms of the electric power system were passed into law in November 2013.

Phase 1: Enforced in April 2015
1. Establishment of the “Organization for Cross-regional Coordination of Transmission Operators, JAPAN” (Enhancement of nationwide grid operation)
2. Full liberalization of entry to electricity retail business

Phase 2: Enforced in April 2016
1. Full liberalization of entry to electricity retail business
2. Abolishment of wholesale regulations
3. Implementation of the legal unbundling of the electricity transmission and distribution department (for ensuring further neutrality)
4. Abolishment of the retail price regulations

The New Electricity Supply System (from April 2020)

Column

Generation

Transmission and Distribution Utilities

Customer

Ex-PPS

Newcomers
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.

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 also has 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.

Electric Power Sources

Hydroelectric and nuclear power provides base load supply, while coal and LNG are major power sources for mid-range load supply. Oil-fired and pumped-storage hydroelectric power respond to peak demand fluctuation and contribute to the constant, stable supply of electricity.

Optimal Combination of Power Sources

<table>
<thead>
<tr>
<th>Power Source Type</th>
<th>Peak Load Supply</th>
<th>Mid-range Load Supply</th>
<th>Base Load Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydroelectric</td>
<td></td>
<td></td>
<td>Hydroelectric (Pumped-storage)</td>
</tr>
<tr>
<td>Thermal Power</td>
<td></td>
<td></td>
<td>Hydroelectric (Regulating Pumps) and Reservoir Type</td>
</tr>
<tr>
<td>Nuclear</td>
<td></td>
<td></td>
<td>Hydroelectric (Induction) and Geothermal</td>
</tr>
</tbody>
</table>

(Example) Combination of Power Sources

Okuma Hydroelectric Power Station (Pumped-storage)

Kawasaki Thermal Power Station (LNG Combined-cycle)

Ohma Nuclear Power Station (ABWR, Under Construction)

Takami Hydroelectric Power Station

Yoshinaura Thermal Power Station (LNG-Fired)

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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 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 conserves uranium resources and 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 reprocessed plutonium in the form of MOX fuel—as soon as possible.

In the past, Japan has relied on countries such as the UK, US, 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's spent fuel reprocessing plant passed the Nuclear Regulation Authority's conformance review in July 2020 and the plant is scheduled to be completed in the first half of FY2022.

In addition, JNFL engages in uranium enrichment, temporary storage of vitrified waste, and disposal of low-level radioactive waste. It has also been working on constructing a MOX fuel fabrication plant which also passed the Nuclear Regulation Authority's conformance review in December 2020 and the plant is scheduled to be completed in the first half of FY2024.

Electric utilities regard nuclear power as an important power source for Japan from viewpoints such as ensuring 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 December 16, 2020)

<table>
<thead>
<tr>
<th>Site</th>
<th>Spent fuel reprocessing plant</th>
<th>Spent fuel storage center</th>
<th>Vitrified waste disposal center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>Location</td>
<td>Storage capacity (ton-U)</td>
<td>Storage capacity (ton-U)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(in operation)</td>
<td>(in operation)</td>
</tr>
<tr>
<td>Kashiwazaki</td>
<td>Kitakami, Iwate Prefecture</td>
<td>2,880</td>
<td>1,830</td>
</tr>
<tr>
<td>Komaki</td>
<td>Kashiwazaki, Iwate Prefecture</td>
<td>800</td>
<td>400</td>
</tr>
<tr>
<td>Site</td>
<td>Spent fuel fabrication plant</td>
<td>Low-level radioactive waste disposal center</td>
<td></td>
</tr>
<tr>
<td>Site</td>
<td>Location</td>
<td>Storage capacity (ton-U)</td>
<td></td>
</tr>
<tr>
<td>Site</td>
<td>Kashiwazaki, Aomori Prefecture</td>
<td>1,500</td>
<td></td>
</tr>
</tbody>
</table>

Status of MOX Fuel Utilization

The electric power industry in Japan intends to introduce MOX fuel in 16 to 18 nuclear reactors by the end of February 2022. The New Plutonium Utilization Program, which is the new plan for the utilization of nuclear materials that Japan proposed at the latter half of the 2010s, is expected to be completed by the end of February 2022. The electric power industry in Japan intends to introduce MOX fuel in the future.

The Peaceful Use of Nuclear Energy

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 non-proliferation 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.

The Nuclear Regulation Authority has 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 option of processing no plutonium reserves without specified purposes and use 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 plutonium* 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.

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

The New Plutonium Utilization Program published in December 2020 aims to introduce MOX fuel in at least 12 reactors by FY2023.

The Energy Minister Meeting Meeting 520 Ministerial Meeting of Energy Transitions and Global Environment for Sustainable Growth was held in Kanazawa, Nagano in June 2019. The energy minister reached an agreement on establishing the "International Roundtable on Final Disposal of High-Level Radioactive Waste" for the first time in order to realize the final disposal of high-level radioactive waste which is a common concern for all countries that make use of nuclear power generation.

A report was published in August 2020 following this Roundtable which addressed the international community's role in geological disposal, dialogue with stakeholders, the decision-making process, and international cooperation in technological development.
Measures by the Electric Utility Industry to Suppress CO₂ Emissions

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. This sets in motion an international framework for tackling climate change spanning all countries including major greenhouse emitting countries.

In July 2015, the Japanese Government announced its “Intended Nationally Determined Contributions (INDC),” with the objective of reducing greenhouse gas emissions in 2030 by 26% from 2013 levels. In May 2016, in accordance with INDC, “the Electric Power Council for a Low-Carbon Society (ELCS)” was founded to facilitate efforts toward this goal (a membership of 62 companies as of February 2021).

According to the Action Plan, an end-user CO₂ emission factor of about 0.37 kg 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 more economically achievable best available technologies (BATs) in the construction of new thermal power plants. 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.

International efforts - Assisting developing countries to reduce carbon emissions through participation and cooperation with overseas ventures

- Expanding the use of non-fossil energy sources
- Improving the efficiency of power facilities
- Providing energy conservation and CO₂ emission reduction services
- Energy saving
- Efforts by electric power industry as users

Development of innovative technologies

- R&D for use of nuclear power
- Thermal power technology to reduce the environmental load
- Countermasures for large amount introduction of renewable energy
- Development of technologies on the efficient use of energy

CO₂ emissions is a major challenge for the industry.

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+3Es).

In July 2015, 35 electricity utility companies jointly constructed a voluntary framework 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 62 companies as of February 2021).

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Decarbonization of Energy on the Supply-side

Promoting nuclear power generation while assuring 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. 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 using digital technologies.

Currently operating state-of-the-art gas turbine combined cycle power plants have achieved the world’s highest level of 62% (LHV) in thermal efficiency by, for example, raising the combustion temperature at the gas turbines (JERA’s Nishi-Nagoya Thermal Power Station Unit 7-1 has achieved the world’s highest thermal efficiency of 63.08% (LHV) as of March 2018).

As to the conventional coal-fired power plants, the adoption of enhanced steam conditions (temperature and pressure) is being promoted to improve thermal efficiency. Presently, ultra-supercritical (USC) thermal power generation with the main steam temperature of 600°C is commercially available. Moreover, research and development of Integrated coal Gasification Combined Cycle (IGCC) has been conducted, in which gasified coal is used in combination with gas turbines and steam turbines to generate electricity. Joban Joint Power’s Nanako Power Station Unit 10 started operation as Japan’s first commercial IGCC plant in June 2013. Low carbonization initiatives continue to progress steadily—a large-scale IGCC plant is being constructed and preparation for a demonstration project of Integrated Coal Gasification Fuel Cell Combined Cycle (IGFC) that combined fuel batteries with IGCC is underway in Osakakamijima of Hiroshima Prefecture.

Coal-fired thermal power, as a cost-effective power source, serves a central role in base load power. Government discussions on phasing out inefficient coal-fired thermal power need to consider the viewpoint of S+3Es including the perspectives of stable supply and the impact on the regional economy.

International efforts - Assisting developing countries to reduce carbon emissions through participation and cooperation with overseas ventures

- Expanding the use of non-fossil energy sources
- Using nuclear power with safety as a major premise
- Using renewable energies
- Improving the efficiency of thermal power
- Providing energy conservation and CO₂ emission reduction services in electricity sector
- Promoting high-efficiency electrical devices to enhance the efficient use of electricity
- PR activities and providing information on energy-saving and CO₂ reduction
- Introducing smart meters for the efficient use of electricity
- Efforts in office-use energy saving and the use of company-owned vehicles

Efforts by electric power industry as users

- Providing energy conservation and CO₂ emission reduction services in electricity retail field
- Promoting high-efficiency electrical devices to enhance the efficient use of electricity
- PR activities and providing information on energy-saving and CO₂ reduction
- Introducing smart meters for the efficient use of electricity
- Efforts in office-use energy saving and the use of company-owned vehicles

International efforts - Assisting developing countries to reduce carbon emissions through participation and cooperation with overseas ventures

- Low carbonization on a global scale through development and introduction of electric technology
- R&D for use of nuclear power
- Thermal power technology to reduce the environmental load
- Countermasures for large amount introduction of renewable energy
- Development of technologies on the efficient use of energy

Note: (1) Based on total CO₂ emissions from all energy consumed in energy activities, transportation, heating, plant operation and manufacturing, etc. (2) The figures of nuclear power generation are calculated including the carbonization of spent fuel, use of MOL, feed and the disposal of high level radioactive waste.

Source: Report of the Central Research Institute of Electric Power Industry, etc.
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 FIT electricity, under the policy of “maximizing the amount of renewable energy to be introduced 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 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. In March 2017, the Organization for Cross-regional Coordination of Transmission Operators, JAPAN (OCCTO) significantly shifted the approach taken toward electricity network operation and facility configuration by presenting a direction where “maximum use would be made of existing electricity networks to comprehensively minimize long-term electricity source and distribution costs while continuing to meet electric source connection needs through expanded adoption of renewable energies and other measures.” Given this new policy, discussions are being held on measures on flexibly utilizing existing transmission lines’ capacity to enable connection under certain conditions. Measures that have been approved in discussion will be implemented sequentially. In June 2020, the Act for Establishing Energy Supply Resilience (Act on the Partial Revision of the Electricity Business Act and Other Acts for Establishing Resilient and Sustainable Electricity Supply Systems) was passed into law. Starting in FY2022, the FIP system (electricity is bought back at a premium on the market price) will be introduced, in addition to the existing FIT system.

Renewable energy operators will be engaging in market transactions under the FIP system which is expected to encourage generating behavior that reflects market price fluctuations. The FIP system will be adopted for “competitive power sources” such as utility photovoltaic power and wind power, while FIT system will continue to be used for “regional vitalization power sources” such as small-scale photovoltaic power and biomass.

Sharing Japan’s Top-level Power Generation Technologies with the World

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.
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 division currently produces three units of thermal energy.

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 division currently produces three units of thermal energy.

Heat pumps, which significantly reduce CO2 emissions compared to 2015 levels. CO2 emissions in 2030 are estimated to be reduced by 21.74 million t-CO2/year compared to 2015 levels.

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 for the purchase of equipment such as generators.

Overseas Offices

Please feel free to contact your nearest office.
Major Power Plants

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

Principal Thermal Power Plants (1,000MW or greater) as of March 31, 2020

<table>
<thead>
<tr>
<th>Name of Plant</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tomin</strong></td>
<td>Hokkaido</td>
<td>1,650</td>
<td>Coal</td>
</tr>
<tr>
<td><strong>Higashigawa</strong></td>
<td>Tohoku</td>
<td>4,810</td>
<td>Heavy, crude oil, LNG</td>
</tr>
<tr>
<td><strong>Harunomichi</strong></td>
<td>Toyama</td>
<td>2,000</td>
<td>Coal</td>
</tr>
<tr>
<td><strong>Nishihara</strong></td>
<td>Tohoku</td>
<td>1,800</td>
<td>Coal</td>
</tr>
<tr>
<td><strong>Toyama Shinko</strong></td>
<td>Hiroshima</td>
<td>1,164.7</td>
<td>Heavy, crude oil, coal, LNG</td>
</tr>
<tr>
<td><strong>Himeji No.2</strong></td>
<td>Kansai</td>
<td>4,119</td>
<td>LNG</td>
</tr>
<tr>
<td><strong>Sakai</strong></td>
<td>Kansai</td>
<td>2,000</td>
<td>LNG</td>
</tr>
<tr>
<td><strong>Gobo</strong></td>
<td>Kansai</td>
<td>1,800</td>
<td>Heavy, crude oil</td>
</tr>
<tr>
<td><strong>Nariko</strong></td>
<td>Kansai</td>
<td>1,800</td>
<td>LNG</td>
</tr>
<tr>
<td><strong>Mazuka</strong></td>
<td>Kansai</td>
<td>1,800</td>
<td>Coal</td>
</tr>
<tr>
<td><strong>Himeji No.1</strong></td>
<td>Kansai</td>
<td>1,207.4</td>
<td>LNG</td>
</tr>
<tr>
<td><strong>Shin Oita</strong></td>
<td>Kyushu</td>
<td>2,825</td>
<td>LNG</td>
</tr>
<tr>
<td><strong>Shin Kokura</strong></td>
<td>Kyushu</td>
<td>1,800</td>
<td>LNG</td>
</tr>
<tr>
<td><strong>Tachibana</strong></td>
<td>Power</td>
<td>2,100</td>
<td>Coal</td>
</tr>
<tr>
<td><strong>Matsumura</strong></td>
<td>Power</td>
<td>2,000</td>
<td>Coal</td>
</tr>
<tr>
<td><strong>Shinchi</strong></td>
<td>Soma JP</td>
<td>2,000</td>
<td>Coal, biomass</td>
</tr>
<tr>
<td><strong>Nakoso</strong></td>
<td>Joban JP</td>
<td>1,700</td>
<td>Heavy oil, coal</td>
</tr>
</tbody>
</table>

**Nuclear Power Plants**

- **Tomin**
- **Higashigawa**
- **Kanagawa**
- **Kochi**
- **Shiga**
- **Shikoku**
- **Mie**
- **Takashima**
- **Oita**
- **Shimane**
- **Wakayama**
- **Yamaguchi**
- **Sendai**
- **Tokyo No.2**

**Total Nuclear Power Stations** 34 Units 31,000MW

**Under Construction**

- **Higashigawa**
- **Shimane**
- **Oita**

**Total Under Construction** 3 Units 4,141MW

**Preparing for Construction**

- **Higashigawa**
- **Hokkaido**
- **Hokkaido**
- **Hokkaido**
- **Mitsubishi**
- **Kumamoto**
- **Sendai**
- **Sendai**

**Total Preparing for Construction** 8 Units 11,562MW

**Others**

- **Fujin**
- **Fujin**
- **Fujin**
- **Fujin**
- **Fujin**
- **Fujin**
- **Fujin**

**Total** 24 Units 11,742MW

Note: JERA = Japan electrical knob. OPEC = Organization of the Petroleum Exporting Countries.
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**: Kazuhiro Ikebe
- **Vice Chairman**: Yutaka Kanai
- **Vice Chairman**: Shigenobu Shimizu
- **Vice Chairman**: Housekihatsu Support Secretary General Satoshi Omori
- **Director**: Tsunehiro Tomioka
- **Director**: Osamu Okamura
- **Secretary General**: Atsushi Soda
- **Deputy Secretary General**: Daisuke Shimizu

**General Affairs**
- General Planning
- Public Relations

**Business**
- Business
- Sitop, Power Generation & Environment

**Nuclear Power**
- Nuclear Power
- Information Systems and Telecommunications
- Research & Development
- Washington Office

**Utilizing 80% recycled paper pulp**
The Federation of Electric Power Companies of Japan
Keidanren-kaikan,
1-3-2, Otemachi, Chiyoda-ku,
Tokyo 100-8118, Japan
https://www.fepc.or.jp/english/