History of Japan's Electric Utility Industry

Electricity was first used in Japan on March 25, 1878 at the Institute of Technology in Toranomon, Tokyo when an arc lamp was switched on in commemoration of the opening of the Central Telegraph Office. In those days, electricity was still unfamiliar and unknown 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 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 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, the policy to implement three-phase reforms of the electric power system was adopted.
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 20-22%, 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

<table>
<thead>
<tr>
<th>Energy self-sufficiency rate:</th>
<th>Only 6% at 2014</th>
</tr>
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<tbody>
<tr>
<td>Target:</td>
<td>Target:</td>
</tr>
<tr>
<td>About 25%, surpassing the pre-earthquake level of about 20%</td>
<td>Bring it down from the present level*</td>
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<table>
<thead>
<tr>
<th>Greenhouse gas emissions:</th>
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<tbody>
<tr>
<td>Due to NPP shutdowns and the increase of thermal power generation, the CO₂ emissions (from energy sources) in FY2013 were the worst ever.</td>
</tr>
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<table>
<thead>
<tr>
<th>Electric power demand</th>
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<tbody>
<tr>
<td>Through energy efficiency and conservation, CO₂ emissions 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.</td>
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<table>
<thead>
<tr>
<th>Power source mix</th>
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</thead>
<tbody>
<tr>
<td>Nuclear power: 17% to 18%</td>
</tr>
<tr>
<td>Lignite: 22%</td>
</tr>
<tr>
<td>Lignite: 27%</td>
</tr>
<tr>
<td>Coal: 22%</td>
</tr>
<tr>
<td>Coal: 26%</td>
</tr>
<tr>
<td>Oil: 7%</td>
</tr>
<tr>
<td>Gas: 7%</td>
</tr>
</tbody>
</table>

*Values are approximate. Source: METI “Long-term Energy Supply and Demand Outlook”
Nuclear Safety & Market Liberalization

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 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 October 2018, 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.

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

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 that 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.

The New Electricity Supply System (from April 2016)

Surveillance

Japan Electric Power Exchange

Utilities

Power Generation

Transmission, Distribution & Grid Control

Minister of Economy, Trade and Industry

Organization for Cross-regional Coordination of Transmission Operators (OCCTO)

Surveillance

Electricity and Gas Market Surveillance Commission

Surveillance

Marketing & Sales

Electric Retail Companies (ex-PPS)

Marketing & Sales

Electric Retail Companies (Newcomers)

Customers

Competition in Wholesale Market

Competition in Retail Market

Column

Overview of the Reforms of the Electric Power System

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)

Phase 2: Enforced in April 2016

(2) Full deregulation of entry into the electricity retail sector

(3) Abolishment of wholesale regulations

Phase 3: Should be implemented in April 2020

(4) Implementation of the legal unbundling of the electricity transmission and distribution department (for ensuring further neutrality)

(5) Abolishment of the retail price regulations

Column

Start of full operation of Mihama Nuclear Emergency Assistance Center in December 2016

- When an nuclear accident occurs, the center swiftly assembles an emergency dispatch team, transports personnel and equipment to the operator struck by disaster, and cooperates with the operator to deal with the nuclear accident at high radiation dose.
- During normal times, the center intensively deploys and manages rationalized controlled robots, etc., and implements operating training for nuclear operator personnel.

Column

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Column

Underground structure plate

Earthquake

Installation within Types

Plane crash, etc.

Smaller scale facility

Power source vehicle

Build seawalls or necessary, enforcing the highest possible tsunami

Tsunami

Boring

Trench survey

Freshwater

Specified safety facility

Power source

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.
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 are also developing pumped-storage power generation plants to meet peak demand. The share of pumped-storage generation facilities of the total hydroelectric power capacity in Japan is growing year by year.

**Thermal Power**

Initially, coal was the dominant fuel for thermal power generation in Japan, but it later lost that place to oil. Today, a diverse range of fuels including coal, oil, and LNG are used for the important generating role that thermal power plants play. In particular, 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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Legend:
- Base Load Supply
- Mid-range Load Supply
- Peak Load Supply
- Hydroelectric (Pumped-storage) Type
- Hydroelectric (Regulating Pondage and Reservoir Type)
- Oil
- LNG and Other Gas
- Coal
- Nuclear
- Hydroelectric (Inflow type) and Geothermal

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.
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 as a homegrown energy source. The benefits of a closed nuclear fuel cycle 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 October 2018)

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Name</th>
<th>Location</th>
<th>Capacity</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium Mine</td>
<td>Kamikita-gun, Aomori Prefecture</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Refinery Plant</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>MOX Fuel Fabrication Plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Storage capacity: 3,000 ton-U</td>
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<tr>
<td>Start of construction: 1997</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Completion of construction: 2007</td>
<td></td>
<td></td>
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<tr>
<td>Uranium enrichment plant</td>
<td></td>
<td></td>
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<tr>
<td>Storage capacity: 1,050 ton-SWU/year</td>
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<tr>
<td>Start of construction: 1992</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Completion of construction: 1997</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Low-level radioactive waste storage center</td>
<td></td>
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<tr>
<td>Storage capacity: 600,000m³ (equivalent to 20,000 to 40,000 canisters)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start of construction: 1991</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Completion of construction: 1997</td>
<td></td>
<td></td>
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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 nonproliferation standards. Since 1955, the domestic laws of Japan require that all nuclear activities, including commercial activities, be conducted only for peacefull 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.

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-authoritaul corporation (the spent fuel reprocessing organization) which, as a principal business entity, conducts the reprocessing business both appropriately and efficiently, and establishing an authoriall 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. Furthermore, the supplemental regulation to the legislation renews the policy of possessing no plutonium reserves without specified purposes. Also, according to the bill, the Governmental instructs the nuclear operators to conduct reprocessing business while upholding this policy, and if an implementing body should make reprocessing plans that go against this policy, the Minister of Economy, Trade and Industry can withhold approval of such plans.

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 8 units have received permission to introduce MOX fuel and have gained the understanding of the local municipalities. 4 units have restarted operation using MOX fuel thus far.
Economic efficiency and Environmental conservation, the mix, seeking to simultaneously achieve Energy security, Economic efficiency and Environmental conservation, under the major premises of Safety (5+3EA).

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 43 companies as of the end of October 2018).

According to the Action Plan, an end-user CO2 emission factor of about 0.37kg CO2/kWh will be targeted in light of the Governments 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 and CO2 reduction services on both the supply and demand sides.

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 (5+3EA).

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 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 plan for Global Warming Countermeasures was adopted. Emissions of carbon dioxide (CO2), a major cause of global warming, are closely related to energy utilization in economic activities and daily life, and so the reduction of CO2 emissions is a major challenge for the industry.

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 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. (Chubu Electric Power Co.’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 the Integrated coal Gasification Combined Cycle (IGCC) are being conducted, in which gasified coal will be used in combination with gas turbines and steam turbines to generate electricity.
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 flexibly utilizing existing transmission lines’ capacity to enable connection under certain conditions.

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.
Environmental Conservation

Atmospheric heat pumps, which significantly reduce CO₂ emissions water supply systems (EcoCute) with CO₂ refrigerant being fulfilled through boilers can be met with heat pumps, and commercial divisions) and industrial division currently produces three units of thermal energy. Refrigerants. With a single unit of electric energy for heat in air, which is freely available, to water by means of that utilize heat pump technology.

If the heat demand for the consumer division (households and commercial divisions) and industrial division 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.

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 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.

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.

WASHINGTON, D.C.

The Federation of Electric Power Companies of Japan, Washington Office

The Federation’s Washington Office was established in January 1994. Its principal objectives are to study U.S. energy policies and to exchange information with U.S. energy opinion leaders in order to promote a greater understanding of the Japanese electric power industry.

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881 17th Street, N.W., Suite 628, Washington, D.C. 20006, U.S.A.
Tel: (202) 775-1969 Fax: (202) 531-9256
Established in 1982

London

The Kansai Electric Power Co., Inc., New York Office

1 Rockefeller Plaza, Suite 4151, New York, NY 10020 U.S.A.
Tel: (212) 726-9707 Fax: (212) 265-4018
Established in 1990

Tokyo Electric Power Company Holdings, Inc., London Office

4th Floor, Multiplaza, 14-18 Holborn, London, EC1N 2LE U.K.
Tel: (020) 7831-2859 Fax: (020) 7831-2860
Established in 1990

Chubu Electric Power Co., Inc., London Office

Hot Water Supply

Energy Obtained for Hot Water Supply

<table>
<thead>
<tr>
<th>Year</th>
<th>Cumulative Units Shipped</th>
<th>Units Shipped in fiscal year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>2002</td>
<td>2,000</td>
<td>1,000</td>
</tr>
<tr>
<td>2003</td>
<td>3,000</td>
<td>1,000</td>
</tr>
<tr>
<td>2004</td>
<td>4,000</td>
<td>1,000</td>
</tr>
<tr>
<td>2005</td>
<td>5,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>

Source: The Japan Refrigeration and Air Conditioning Industry Association
**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>Nankoku</td>
<td>Kansai</td>
<td>1,300</td>
<td>LNG</td>
</tr>
<tr>
<td>Makino</td>
<td>Kansai</td>
<td>1,900</td>
<td>Coal</td>
</tr>
<tr>
<td>Hijiyama Daini</td>
<td>Kansai</td>
<td>1,507.4</td>
<td>LNG</td>
</tr>
<tr>
<td>Shin Oita</td>
<td>Kyushu</td>
<td>2,304</td>
<td>LNG</td>
</tr>
<tr>
<td>Shin Kokura</td>
<td>Kyushu</td>
<td>1,800</td>
<td>LNG</td>
</tr>
<tr>
<td>Tachibana-wan</td>
<td>J-Power</td>
<td>2,100</td>
<td>Coal</td>
</tr>
<tr>
<td>Mutsuura</td>
<td>J-Power</td>
<td>2,000</td>
<td>Coal</td>
</tr>
<tr>
<td>Shichiken</td>
<td>Soma</td>
<td>2,000</td>
<td>Coal</td>
</tr>
<tr>
<td>Nakoso</td>
<td>Jiban</td>
<td>1,625</td>
<td>Heavy oil, coal</td>
</tr>
</tbody>
</table>

**Location of Power Stations**

1. Tomakomai | Hokkaido | 1,650 | Coal |
2. Higashi Nagoa | Toyako | 5,149 | Heavy, crude oil, LNG, natural gas |
3. Hanamachi | Toyako | 2,000 | Coal |
4. Itaka | Toyako | 1,633 | Heavy, crude, light oil |
5. Kashima | Toyako | 5,660 | Heavy, crude oil, city gas |
6. Futsu | Toyako | 5,040 | LNG |
7. Horo | Toyako | 4,400 | Heavy, crude oil, coal |
8. Chiba | Toyako | 4,380 | LNG |
9. Anegasaki | Toyako | 3,600 | Heavy, crude oil, LNG, LPG, NGL |
10. Sodegaura | Toyako | 3,600 | LNG |
11. Yokohama | Toyako | 3,460 | Heavy, crude oil, LNG |
12. Kawasaki | Tokyo | 3,370 | LNG |
13. Hachikita | Tokyo | 2,000 | Coal |
14. Higashi Oigawa | Toyako | 2,000 | LNG |
15. Gai | Toyako | 1,886 | LNG |
16. Kawaoka | Chiba | 4,802 | LNG |
17. Hakkan | Chiba | 4,100 | Coal |
18. Chita | Chiba | 3,966 | Heavy, crude oil, LNG |
19. Shin Nagoya | Chiba | 3,058 | LNG |
20. Jiotta | Chiba | 2,380 | LNG |
21. Atsugi | Chiba | 1,900 | Heavy, crude oil |
22. Chita Daini | Chiba | 1,708 | LNG |
23. Toya Park | Hikoshiki | 1,500 | Heavy, crude oil, coal |
24. Hijiyama | Kansai | 4,091.5 | LNG |
25. Kanazawa | Kansai | 2,100 | Heavy, crude oil |
26. Sakaiko | Kansai | 2,000 | LNG |
27. Gujo | Kansai | 1,800 | Heavy, crude oil |

**Nuclear Power Plants**

<table>
<thead>
<tr>
<th>Name of Plant</th>
<th>Company</th>
<th>Installed Capacity (MW)</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomin</td>
<td>Hokkaido</td>
<td>579</td>
<td>PWR (60H)</td>
</tr>
<tr>
<td>Makino</td>
<td>Kansai</td>
<td>879</td>
<td>PWR (60H)</td>
</tr>
<tr>
<td>Oita</td>
<td>Kyushu</td>
<td>912</td>
<td>BWR (60H)</td>
</tr>
<tr>
<td>Higashi Daini</td>
<td>Toyako</td>
<td>1,100</td>
<td>BWR (60H)</td>
</tr>
<tr>
<td>Chubu</td>
<td>Toyako</td>
<td>825</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Kusatsu</td>
<td>Toyako</td>
<td>930</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Suzuka</td>
<td>Toyako</td>
<td>1,100</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Fukushima Daini</td>
<td>Tokyo</td>
<td>1,100</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Kashima</td>
<td>Tokyo</td>
<td>1,100</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Hamazaki</td>
<td>Chubu</td>
<td>1,100</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Hama</td>
<td>Chubu</td>
<td>1,100</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Shikura</td>
<td>Chubu</td>
<td>1,100</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Michima</td>
<td>Kansai</td>
<td>826</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Takahama</td>
<td>Kansai</td>
<td>826</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Ohi</td>
<td>Chubu</td>
<td>870</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Onahama</td>
<td>Chubu</td>
<td>1,180</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Shimane</td>
<td>Chubu</td>
<td>1,180</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Rokkasho</td>
<td>Chubu</td>
<td>870</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Genkai</td>
<td>Kyushu</td>
<td>559</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Sendai</td>
<td>Kyushu</td>
<td>1,180</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Todoroki Daini</td>
<td>JAP</td>
<td>1,100</td>
<td>BWR (50H)</td>
</tr>
<tr>
<td>Tsukuba</td>
<td>JAP</td>
<td>1,100</td>
<td>BWR (50H)</td>
</tr>
</tbody>
</table>

**Principal Hydroelectric Power Plants (400MW 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>Fukushima</td>
<td>Kansai</td>
<td>357</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Daichi</td>
<td>Chubu</td>
<td>1,385</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Shimane</td>
<td>Chubu</td>
<td>1,373</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Ohta</td>
<td>Chubu</td>
<td>1,384</td>
<td>Pumped Storage</td>
</tr>
<tr>
<td>Total 15 Units</td>
<td>3,153MW</td>
<td>Pumped Storage</td>
<td></td>
</tr>
</tbody>
</table>

**Pumped Storage**

- **Higashi Daini** | Chubu | 1,385 | Pumped Storage |
- **Shimane** | Chubu | 1,373 | Pumped Storage |
- **Ohta** | Chubu | 1,384 | Pumped Storage |

**Principal Type**

- **Hokkaido**
- **Kansai**
- **Chubu**
- **Kyushu**

**End of Operation**

- **Kamioka**
- **Hokkai**
- **Miyazaki**
- **Shikoku**
- **Chugoku**
- **Kansai**
- **Kanto**
- **Tohoku**
- **Hokuriku**

**Note:**
- **APWR:** Advanced Pressurized Water Reactor
- **BWR:** Boiling Water Reactor
- **压水堆:** Advanced Pressurized Water Reactor
- **沸水堆:** Advanced Boiling Water Reactor
- **沸水圧水:** Pressed Boiling Water Reactor
- **沸水圧水:** Advanced Pressurized Water Reactor
- **沸水圧水:** Advanced Boiling Water Reactor

**Source:**
- **Japan Atomic Energy Agency**
- **Japan Power Corporation**
- **Japan Electric Power Company**

**End of Operation**

- **Kamioka**
- **Hokkai**
- **Miyazaki**
- **Shikoku**
- **Chugoku**
- **Kansai**
- **Kanto**
- **Tohoku**
- **Hokuriku**

**Note:**
- **APWR:** Advanced Pressurized Water Reactor
- **BWR:** Boiling Water Reactor
- **Pressurized Water Reactor:** Advanced Pressurized Water Reactor
- **Advanced Boiling Water Reactor:** Pressed Boiling Water Reactor
- **Advanced Pressurized Water Reactor:** Pressed Boiling Water Reactor
- **Advanced Boiling Water Reactor:** Pressed Boiling Water Reactor
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.

Board of Directors

Organization of FEPC

Business Addresses

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World Association of Nuclear Operators Tokyo Centre (WANO-TC)
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Tel: (03) 6722-9500  URL: http://www.wano.info

Atomic Energy Association (ATENA)
Koigakobashi, 1-3-2, Otemachi, Chiyoda-ku, Tokyo 100-8118, Japan
Tel: (03) 5877-3880  URL: http://www.atena-jp.jp