

Energy Generation in Japan



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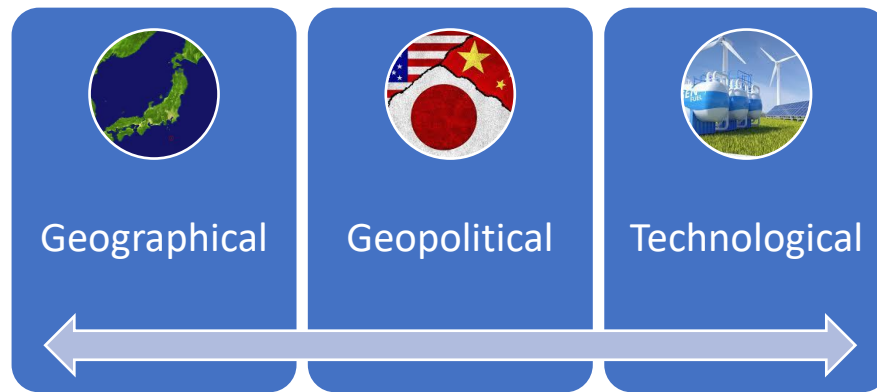
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Energy Economy of Japan

Japan's energy sector is a complex ecosystem that spans geographical, geopolitical, and technological perspectives. The country is highly dependent on energy imports, and the government strives to achieve energy security and sustainability.



I. Geographical Perspective

- Japan is an archipelago in the Pacific Ocean consisting of four main islands and many smaller ones. Despite having limited natural resources, Japan has managed to develop one of the largest economies in the world.
- However, sustaining this growth has resulted in a heavy reliance on energy imports from the Middle East, Southeast Asia, and Australia. These countries are essential in meeting Japan's energy needs, and any disruption in supply could significantly impact the economy.
- Following the Fukushima disaster in 2011, Japan has been moving away from nuclear power. The disaster had far-reaching consequences for Japan's energy policy, emphasising renewable energy sources like wind, solar, and hydropower.
- The government has set a target of generating at least 22-24% of its energy from renewable sources by 2030.
- However, due to geography, Japan's renewable energy sector faces unique challenges. The country's limited land availability and high seismic activity make developing large-scale renewable energy projects difficult.
- Nonetheless, Japan has made significant progress in developing renewable energy. The country has one of the largest solar power markets in the world,

ranked 4th globally with its solar capacity increasing from 3.62 GW in 2010 to 74.19 GW in 2021.

- Wind power is being developed in various coastal areas.
- Additionally, Japan has a long history of hydro power, and new projects are being developed to harness the country's abundant water resources.

With continued investment and innovation, Japan has the potential to become a leader in renewable energy development, despite the many obstacles it faces.

II. Geopolitical Perspective

- Japan's energy security is a multifaceted issue significantly impacted by its relationships with other countries. While the country has historically relied heavily on the Middle East for oil imports, recent efforts have been made to diversify its energy sources and suppliers to mitigate this risk. In addition to boosting its use of renewable energy, Japan has also been exploring alternative sources of fossil fuels, such as shale gas and liquefied natural gas.
- Moreover, Japan has been actively involved in various international initiatives to promote energy security and sustainability. For instance, it has been a member of the Clean Energy Ministerial since its launch in 2010. This initiative brings together countries worldwide to encourage the adoption of clean energy technologies and practices.
- Japan has also been a member of the International Energy Agency since 1974, which works to ensure reliable, affordable, and clean energy for its member countries.

Despite these efforts, however, Japan remains susceptible to fluctuations in global energy markets and geopolitical tensions that can impact its energy supply. Consequently, the country is still pursuing various strategies to enhance its energy security, including domestic energy production and energy conservation measures.

III. Technological Perspective

- Japan is renowned for being a pioneer in technological innovation, with a rich tradition in this field. In addition, its expertise in energy-related research and

development has been widely recognized. The country is making significant progress in improving and enhancing renewable energy technologies, such as solar panels and wind turbines, to make them more efficient and reliable.

- Japan is also the home of some of the world's largest energy companies, including TEPCO, JXTG, and Chubu Electric Power. These companies constantly invest in new technologies and explore innovative business models to adapt to the rapidly changing energy landscape.

In summary, Japan's energy sector is a complex ecosystem that requires a multidimensional approach to ensure its sustainability and security. The country's geography, geopolitics, and technology are all important factors that significantly impact its energy system.

By leveraging its strengths in innovation and collaborating with other countries, Japan can successfully navigate these challenges and create a more robust and sustainable energy system.

Energy Goals Transformation

Japan's energy goals have significantly changed since the early 1900s, reflecting the country's historical, cultural, and economic development. Japan is an island nation with limited natural resources, which has influenced its energy choices and policies over time.

- In the early 1900s, Japan depended heavily on coal for its energy needs, with the coal industry symbolising modernisation and progress. However, the heavy reliance on coal had negative impacts on the environment and public health, resulting in air pollution, acid rain, and respiratory diseases.
- Following World War II, Japan shifted its focus to oil to meet its growing energy needs. This shift was driven by Japan's rapid economic growth and industrialisation, which increased the country's demand for energy. However, the reliance on oil made Japan vulnerable to price shocks and supply disruptions, as seen during the oil crisis of the 1960s and 1970s.

- In response to the oil crisis, Japan started investing heavily in nuclear power plants. Nuclear energy provided a reliable and stable source of power for Japan's industries, which were vital to the country's economic growth and development
- Japan's energy transitions have been influenced by many factors, including economic, environmental, social, and cultural. The Fukushima disaster of 2011 served as a turning point that highlighted the importance of public trust and participation in energy decision-making.
- As a result, Japan has been promoting citizen participation in energy policy-making and investing in energy-efficient technologies and smart grids to reduce their reliance on traditional energy sources.
- One of the most significant changes in Japan's energy goals has been the country's shift towards renewable energy sources. Japan has set a target of generating 24% of its energy from renewable sources by 2030, with solar, wind, and hydropower being the primary sources of focus. In 2019 renewables contributed 18.6% of total electricity generation- 184.4TWh
- The investments toward smart grids and energy-efficient technologies have been driven by the desire to reduce the country's reliance on traditional energy sources, such as coal, oil, and nuclear energy.



In conclusion, Japan's energy transitions have been shaped by many factors, including economic, environmental, social, and cultural. The country has undergone significant changes in its energy goals, shifting from coal to oil to nuclear energy and now to renewable energy sources.

Nuclear Power Plants

- Establishing a nuclear power plant in Japan is estimated at around 1 trillion yen (\$9.2 billion). This is a significant amount of money, but it is essential to consider

the benefits of nuclear power. Nuclear power plants have a longer lifespan than other power plants, which can save money in the long term.

- Nuclear power accounts for about 30% of Japan's electricity generation. According to the World Nuclear Association, nuclear power plants in Japan have prevented the emission of approximately 2.2 billion tonnes of carbon dioxide since 1970. Additionally, the cost of operations is high due to the strict safety regulations in place after the Fukushima disaster, but these regulations are in place to protect the health and safety of the public.
- Some of the most famous nuclear power plants in Japan include the Kashiwazaki-Kariwa Nuclear Power Plant, which is located in Niigata Prefecture and has a total of seven reactors with a combined capacity of 8,212 MW. This makes it the largest nuclear power plant in the world by net electrical power rating. Another notable nuclear power plant is the Genkai Nuclear Power Plant, located in Saga Prefecture, which has a total of four reactors with a combined capacity of 3,783 MW. The Onagawa Nuclear Power Plant, located in Miyagi Prefecture, has three reactors with a combined capacity of 2,174 MW, making it an important part of the electricity grid in north-eastern Japan.
- The Fukushima nuclear disaster, which occurred on March 11, 2011, was a catastrophic event that severely impacted Japan. The earthquake that triggered the disaster was one of the most powerful ever recorded, measuring 9.0 on the Richter scale. The subsequent tsunami that struck the north-eastern coast of Japan reached heights of up to 40 meters, causing widespread destruction.
- The disaster's human toll was immense, with a total of 15,894 confirmed deaths and 2,539 missing persons. Many lives were lost due to the tsunami, which swept away entire communities, and the subsequent meltdowns and explosions at the Fukushima Daiichi nuclear power plant. The disaster forced and evacuation of approximately 160,000 people due to the release of radioactive materials.



- The environmental impact of the disaster was also significant. The radioactive materials released from the damaged nuclear reactors contaminated an estimated 20,000 square kilometres of land, resulting in the need to remove topsoil and demolish over 1,000 buildings to mitigate the spread of radiation. The process of decontamination has been complex and time-consuming, with ongoing challenges in effectively reducing the spread of radiation and restoring the affected areas.
- The estimated total cost, including compensation to victims, decontamination efforts, and the decommissioning of the Fukushima Daiichi nuclear power plant, is projected to exceed 21.5 trillion yen (approximately 200 billion USD). This has significantly strained Japan's economy, with declining exports, loss of consumer confidence, and increased government spending to address the aftermath of the disaster.
- The Fukushima disaster also had far-reaching implications for Japan's agriculture and tourism industries. Many agricultural products from the region were contaminated with radioactive materials, leading to consumer concerns and restrictions on their sale and export. The tourism industry in the affected region suffered a significant blow, with a sharp decline in visitors due to safety concerns and negative perceptions about radiation risks.
- In addition to the immediate impacts, the Fukushima disaster has had long-term social, psychological, and health effects on the affected communities. The fear and anxiety caused by the disaster, including concerns about radiation exposure and its potential health effects, have profoundly impacted the mental and emotional well-being of the affected population.
- As a result of the Fukushima disaster, Japan has implemented stricter regulations and safety standards for nuclear power plants, including increased seismic and tsunami resilience requirements. The incident has also prompted global discussions about nuclear safety and the need for robust safety measures in the operation of nuclear power plants worldwide.

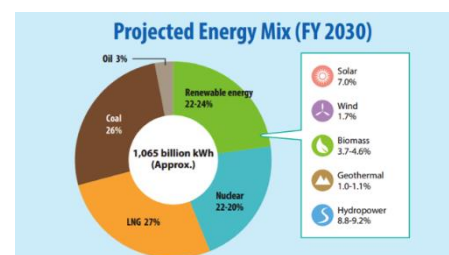
In conclusion, the Fukushima nuclear disaster of 2011 had severe and far-reaching impacts on Japan, including loss of life, displacement of people, environmental contamination, economic costs, and long-term social and psychological effects. It

serves as a stark reminder of the risks associated with nuclear energy and the need for stringent safety measures in the operation of nuclear power plants.

Thermal Power Plants

- Thermal power plants are a crucial component of Japan's energy mix, accounting for approximately 40% of the country's electricity generation. Japan has a total of 90 thermal power plants, with some of the most significant plants including the Takasago Thermal Power Station, the Hekinan Thermal Power Station, and the Tomari Thermal Power Station.
- The Takasago Thermal Power Station, located in Hyogo Prefecture, has a total capacity of 2,407 MW, making it one of the largest thermal power plants in Japan.
- The Hekinan Thermal Power Station, located in Aichi Prefecture, has a total capacity of 3,000 MW, making it one of the largest thermal power plants in the world. It is a crucial part of the electricity grid in Japan, providing power to millions of people every day.
- The Tomari Thermal Power Station, located in Hokkaido, has a total capacity of 1,800 MW and is a vital source of electricity for the northern part of Japan.
- The cost of establishing a thermal power plant in Japan is estimated to be around 200-400 billion yen (\$1.8-3.7 billion), and the cost of operations is also high due to the need for imported fuel. However, the Japanese government has been investing in developing more efficient and environmentally friendly thermal power plants to reduce the country's reliance on fossil fuels.
- The Yokosuka Thermal Power Station, located in Kanagawa Prefecture, has a natural gas-fired combined cycle system that increases its thermal efficiency to over 60%, making it one of Japan's most efficient thermal power plants.

The transition to renewable energy sources is a long-term process, and thermal power plants will continue to play a vital role in Japan's energy mix for the foreseeable future.



Shortfalls in Japan's Energy Goals

A. Nuclear Power

- Japan's energy policy has significantly changed since the Fukushima nuclear disaster in 2011. One of the key goals is to reduce the country's reliance on nuclear power and eventually phase it out by 2040. However, despite these efforts, nuclear power still accounts for a significant portion of Japan's energy mix, with a share of 6.2% in 2019.
- This represents a decline from its peak of 29% in 2010, but the reduction has not been sufficient to meet the country's ambitious targets. Japan is pursuing various strategies to achieve its energy goals beyond simply reducing its nuclear capacity.
- Japan is investing heavily in renewable energy sources such as solar and wind power. Japan is also exploring the use of hydrogen as an alternative fuel source and has launched several pilot projects to test its feasibility. Additionally, Japan is implementing energy efficiency measures in various sectors to reduce overall demand.
- Despite these efforts, there are challenges that Japan must overcome to achieve its energy goals. For instance, renewable energy sources are not yet cost-competitive with conventional fuels, and the country's ageing energy infrastructure needs significant upgrades to accommodate new technologies.

B. Renewable Energy

- Japan has set a major goal to increase its use of renewable energy sources to 22-24% of its total energy supply by 2030. This is part of Japan's commitment to reducing its carbon footprint and promoting sustainable development. However, as of 2019, renewable energy only accounted for 18% of the country's total energy mix.

- Japan has invested heavily in solar power in recent years, and in 2013, the country installed more solar power capacity than any other country. This is a promising development in Japan's renewable energy sector, but solar power only accounts for 7% of Japan's total energy mix. To increase the use of solar power, Japan needs to address several challenges, such as the lack of available space for large-scale solar farms and the high costs of installation.



- Wind power is another area where Japan needs to catch up to its goals. The country aimed to install 10 GW of offshore wind by 2020, but as of 2019, only 0.04 GW had been installed. This is a major setback for Japan's renewable energy sector, but it is not an insurmountable challenge. Japan needs to increase government support for offshore wind power, reduce the costs of installation, and find more offshore sites for wind farms.



With these measures in place, Japan can make significant progress towards its renewable energy goals and become a model for sustainable development worldwide.

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