

# COUNTRY ANALYSIS BRIEFS

## Japan

Last Updated: Jun. 4, 2012

### Background

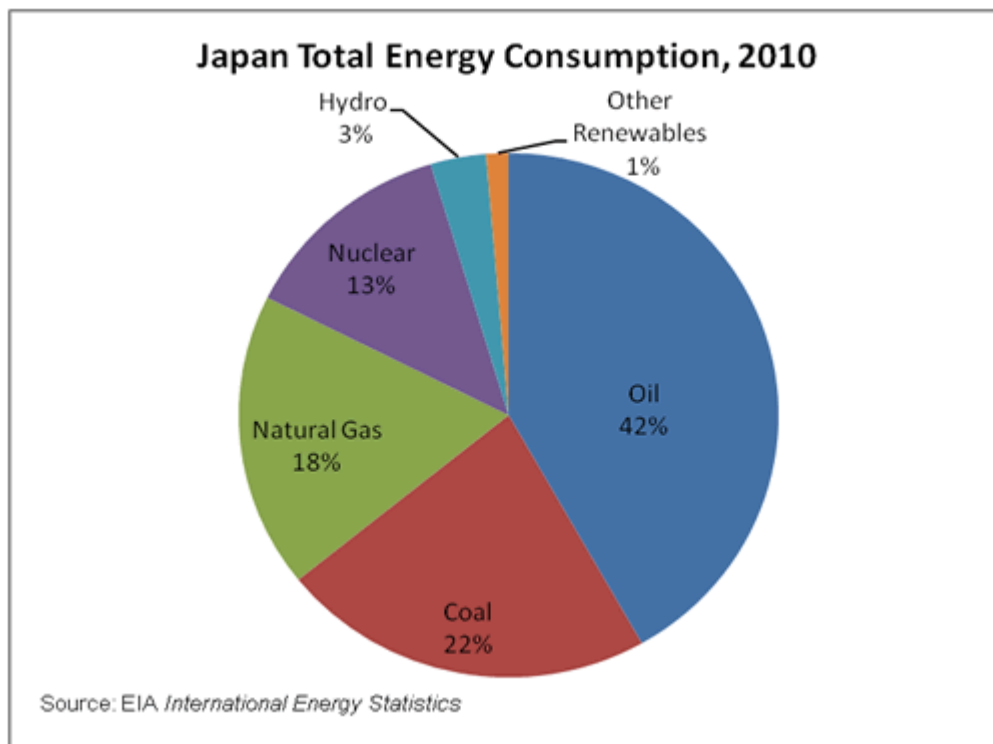
**Japan is the world's largest importer of LNG, second largest importer of coal and the third largest net importer of oil.**

Japan has few domestic energy resources and is only 16 percent energy self-sufficient. It is the third largest oil consumer in the world behind the United States and China and the third-largest net importer of crude oil. It is the world's largest importer of liquefied natural gas (LNG) and second largest importer of coal. In light of the country's lack of sufficient domestic hydrocarbon resources, Japanese energy companies have actively pursued participation in upstream oil and natural gas projects overseas and provide engineering, construction, financial, and project management services for energy projects around the world. Japan is one of the major exporters of energy-sector capital equipment, and has a strong energy research and development (R&D) program supported by the government, which pursues energy efficiency measures domestically in order to increase the country's energy security and reduce carbon dioxide emissions.

On March 11, 2011, a 9.0 magnitude earthquake struck off the coast of Sendai, Japan, triggering a large tsunami. The earthquake and ensuing damage resulted in an immediate shutdown of 12,000 MW of electric generating capacity at four nuclear power stations. Other energy infrastructure such as electrical grid, refineries, and gas and oil-fired power plants were also affected by the earthquake, though some of these facilities were restored. Between the 2011 earthquake and May 2012, Japan lost all of its nuclear capacity due to scheduled maintenance and the challenge facilities face in gaining government approvals to return to operation. Japan is substituting the loss of nuclear fuel for the power sector with additional natural gas, low-sulfur crude oil, and fuel oil.



In the wake of the Fukushima nuclear incident, Japan's energy fuel mix likely will change as natural gas, oil, and renewable energy take larger slices of the market share and supplant some of the nuclear fuel. Oil is the largest energy resource of fuel consumption in Japan, although its share of total energy consumption has declined from about 80 percent in the 1970s to 42 percent in 2010. Coal continues to account for a significant share of total energy consumption, although natural gas is increasingly important as a fuel source and is currently the preferred fuel-of-choice for the shortfall in nuclear capacity. Before the 2011 earthquake, Japan was the third largest consumer of nuclear power in the world, after the US and France, and nuclear power accounted for about 13 percent of total energy in 2010. Hydroelectric power and renewable energy comprise a relatively small percentage of total energy consumption in the country.



## Oil

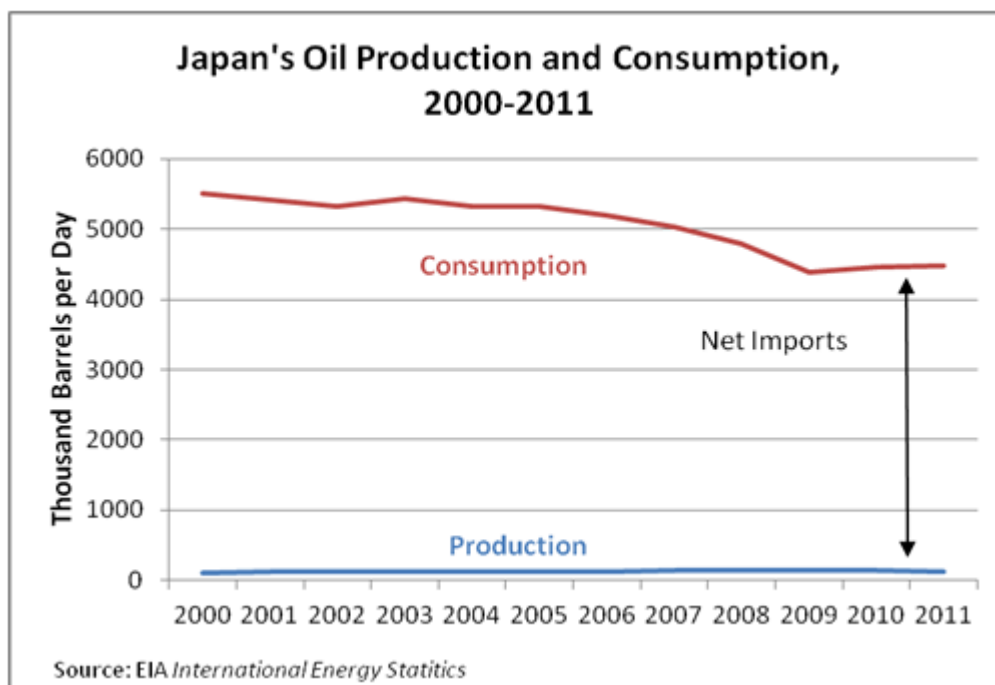
**Japan relied on oil imports to meet about 42 percent of its energy needs in 2010.**

Japan has very limited domestic oil reserves, amounting to 44 million barrels as of January 2012, according to the Oil and Gas Journal (OGJ), down from the 58 million barrels reported by OGJ in 2007. Japan's domestic oil reserves are concentrated primarily along the country's western coastline. Offshore areas surrounding Japan, such as the East China Sea, also contain oil and gas deposits; however, development of these zones is held up by competing territorial claims with China. While a preliminary accord was reached between the two governments in May 2008 over two fields - Chunxiao/Shirakaba and Longjing/Asunaro - in September 2010, Japan urged China to implement the agreement as tensions rose over the contested area. (See [East China Sea](#) country analysis brief.)

Consequently, Japan relies heavily on imports to meet its consumption needs. Japan maintains government-controlled oil stocks to ensure against a supply interruption. Total strategic oil stocks in Japan were 589 million barrels at the end of December 2011, with 55 percent being government stocks and 45 percent commercial stocks.

Japan consumed an estimated 4.5 million barrels per day (bbl/d) of oil in 2011, making it the third largest petroleum consumer in the world, behind the United States and China. However, oil demand in Japan has declined overall since 2000 by nearly 20 percent. This decline stems from structural factors, such as fuel substitution, an aging population, and government-mandated energy efficiency targets. In addition to the shift to natural gas in the industrial sector, fuel substitution is occurring in the residential sector as high prices have decreased demand for kerosene in home heating. Japan consumes most of its oil in the transportation and industrial sectors. Japan is also highly dependent on naphtha and low sulfur fuel oil imports. Demand for naphtha is falling as ethylene production is gradually being displaced by petrochemical production in other Asian countries. However, demand for low-sulfur fuel oil is increasing as it replaces nuclear electric power generation.

Japan's oil consumption rose slightly in 2011 by 30,000 bbl/d over 2010 due to some post-disaster reconstruction works and substitution of crude oil and low sulfur fuel oil for the suspended nuclear power after the Fukushima incident. EIA assumes that net total oil consumption will rise by another 80,000 bbl/d in 2012 if no nuclear capacity comes back online.



The Japanese government's policy has emphasized increased energy conservation and efficiency. The government generally aims to reduce the share of oil consumed in its primary energy mix as well as the share of oil used in the transportation sector. Oil as a percentage of total primary energy demand has fallen from roughly 80 percent of the energy mix in the 1970s to about 42 percent in 2010, made possible by increased energy efficiency and the expanded use of nuclear power and natural gas. Among the large developed world economies, Japan has one of the lowest energy intensities, as high levels of investment in R&D of energy technology since the 1970s has substantially increased energy efficiency.

### Sector Organization

Although Japan is a minor oil producing country, it has a robust oil sector comprised of various state-run, private, and foreign companies. Until 2004, Japan's oil sector was dominated by the Japan National Oil Corporation (JNOC), which was formed by the Japanese government in 1967 and charged with promoting oil exploration and production domestically and overseas. In 2004, JNOC's profitable business units were spun off into new companies in order to introduce greater competition into Japan's energy sector. Many of JNOC's activities were taken over by the Japan Oil, Gas and Metals National Corporation (JOGMEC), a state-run enterprise charged with aiding Japanese companies involved in exploration and production overseas and promoting commodity stockpiling domestically. New companies were formed, of which the two largest are Inpex, now Japan's largest oil and gas company, and the Japan Petroleum Exploration Company (Japex).

Private Japanese firms dominate the country's large and competitive downstream sector, as foreign companies have historically faced regulatory restrictions. But over the last several years, these regulations have been eased, which has led to increased competition in the petroleum-refining sector. Chevron, BP, Shell, and BHP Billiton are among the foreign energy companies involved in providing products and services to the Japanese market as well as being joint venture (JV) partners in many of Japan's overseas projects.

### Domestic Production and Exploration

In 2011, Japan's total oil production was roughly 130,000 bbl/d, of which only 5,000 bbl/d was crude oil. The vast majority of Japan's oil production comes in the form of refinery gain, resulting from the country's large petroleum refining sector. Japan has 148 producing oil wells in over 11 fields, according to the *Oil and Gas Journal* (OGJ).

### Overseas Exploration and Production

Japanese oil companies have sought participation in exploration and production projects overseas with government backing because of the country's lack of domestic oil resources. The government's 2006 energy strategy plan encourages Japanese companies to increase energy exploration and development projects around the world to secure a stable supply of oil and natural gas. The Japan Bank for International Cooperation supports upstream companies by offering loans at favorable rates, thereby allowing Japanese companies to bid effectively for projects in key producing countries. Such financial support helps Japanese companies to purchase stakes in oil and gas fields around the world, reinforcing national supply security while guaranteeing their own financial stability. The government's goal is to import 40 percent of the country's total crude oil imports from Japanese-owned concessions by 2030, up from the current

estimated 19 percent. As a result of the 2011 earthquake and greater need for energy supplies, JOGMEC plans to increase spending more than \$1.12 billion in the fiscal year 2012. This is equivalent to nearly all of the company's upstream investments since its inception in 2004.

Japan's overseas oil projects are primarily located in the Middle East and Southeast Asia. Japanese oil companies involved in exploration and production projects overseas include: Inpex, Cosmo Oil, Idemitsu Kosan Co., Japan Energy Development Corporation, Japex, Mitsubishi, Mitsui, Nippon Oil, and others. Many of these companies are involved in small-scale projects that were originally set up by JNOC. However, many are involved in high-profile upstream projects involving major investments in overseas ventures in recent years.

Some of the major upstream projects that Japanese companies are involved in overseas are:

#### **Middle East and Africa**

- Kuwait and Saudi Arabia Neutral Zone: Khafji and Hout fields - Japanese-owned Arabian Oil Company (AOC) once held a 40 percent stake in exploration for the Khafji and Hout oil fields in Kuwait and the Neutral Zone. Subsequent concession expirations have left the AOC with a limited, technical role and a 100,000 bbl/d purchase contract from Khafji field until 2023.
- United Arab Emirates (UAE): Adma Block - Japan Oil Development Co. (JODCO), a wholly-owned subsidiary of Inpex, holds a 12 percent stake in 4 fields and a 40 percent stake in a fifth field. JODCO is involved in developing the fields, which began producing in 1982. Development is continuing to maintain and expand output. Additionally, offshore UAE and Qatar, Mubarraz and 2 other fields are 100 percent owned by the consortium of Nippon Oil, Cosmo Oil, Tokyo Electric, Chubu Electric, and Kansai Electric.
- Egypt: West Bakr Block - A joint venture between Inpex and Mitsui with 100 percent interest in exploration and development. Oil production began in 1980, and the contract extends to 2020.
- Algeria: El Ouar 1 and 2 Blocks - Inpex holds a 10 percent working interest in these onshore fields containing oil, gas, and condensates.
- Congo: 11 offshore oil fields - Inpex holds a 32 percent stake. Production began in 1975, and the contract was extended to 2023.

#### **Northern Europe**

- Norway: North Sea offshore - Idemitsu Kosan currently produces 28,000 barrels of oil equivalent per day (boe/d) from its interests in five producing fields in Norway's North Sea (Snorre, Tordis/Vigdis, Statfjord East, Sygna, Fram), and was awarded two exploration licenses in September 2009 in a JV with Osaka Gas for 2 additional blocks near currently producing Snorre and Fram fields.
- UK: North Sea offshore - Idemitsu Kosan acquired Petro Summit Investment UK from Sumitomo Corporation in November 2009, and is producing 5,000 boe/d of crude and natural gas from nine fields. It is also involved in exploration and development of four licensed blocks west of the Shetland Islands. Additionally, Nippon Oil has stakes ranging from 2 percent to 45 percent in several North Sea offshore fields and currently produces about 12,600 boe/d of hydrocarbons.

#### **Caspian Sea**

- Azerbaijan: Azeri-Chirag-Guneshli Project (ACG) - Inpex has a 10 percent stake in ACG, which is now producing an estimated 1 million bbl/d.
- Kazakhstan: North Caspian Sea project, Kashagan oil field - Inpex has a 7.56 percent stake. Initial production is projected at 450,000 bbl/d at end-2014. Peak production target is 1.5 million bbl/d by the end of the decade.

#### **Russia**

- Sakhalin-1 - The Sakhalin Oil and Gas development Company (SODECO), a consortium of public and private Japanese oil companies, holds a 30 percent interest. Sakhalin-1 oil production reached 250,000 bbl/d in February 2009.
- Sakhalin-II - Mitsui and Mitsubishi have a combined interest of 22.5 percent in the oil field.

#### **Asia**

- Indonesia: Offshore Mahakam Block and Attaka unit - Inpex has a 50 percent stake in each project and production-sharing contracts lasting to 2017 with the Indonesian government. Crude and condensate are shipped mainly to oil refineries and power utilities in Japan. Additionally, Nippon Oil and JOGMEC in JV own a 17 percent stake, currently under exploration and development, in the Berau Block integrated area.
- Australia: Van Gogh and Ravensworth oil fields - Inpex has a 47.5 percent interest in Van

Gogh, which started up in first quarter 2010 with a 150,000 bbl/d capacity, and a 28.5 percent interest in neighboring Ravensworth, which started up in September 2010 as part of the 96,000 bbl/d Pyrenees project. Additionally, Nippon Oil has a 25 percent stake in the NW Shelf Mutineer and Exeter fields. Its net production is currently 1,500 barrels of oil equivalent per day (boe/d), and it also has five other fields in various stages of development.

- Vietnam: Nam Rong/Doi Moi offshore oil fields - Idemitsu Kosan has a 15 percent stake in these fields, which began production February 2010 at 20,000 bbl/d; Idemitsu's portion is 1,500 bbl/d. Idemitsu, Nippon Oil and Teikoku Oil, hold interests in two other Vietnamese offshore fields currently under exploration.
- Papua New Guinea: A consortium of Nippon Oil, Mitsubishi, and the Japanese government own interests in various fields under exploration and development including onshore blocks at Kutubu and Moran.

### The Americas

- Brazil: Frade block, Northern Campos Basin - a joint venture of Inpex, JOGMEC, and Sojitz Corp hold 18.3 percent interest in this offshore block. Production began in 2009; peak production of 79,000 bbl/d was reached in 2011.
- Canada: Alberta oil sands syncrude project - Nippon Oil has a 5 percent stake. Nippon's share was 14,000 bbl/d in 2009.
- Canada: Athabasca oil sands project, Alberta - Japex is involved in this project, its share in 2007 production was 7,000 bbl/d.

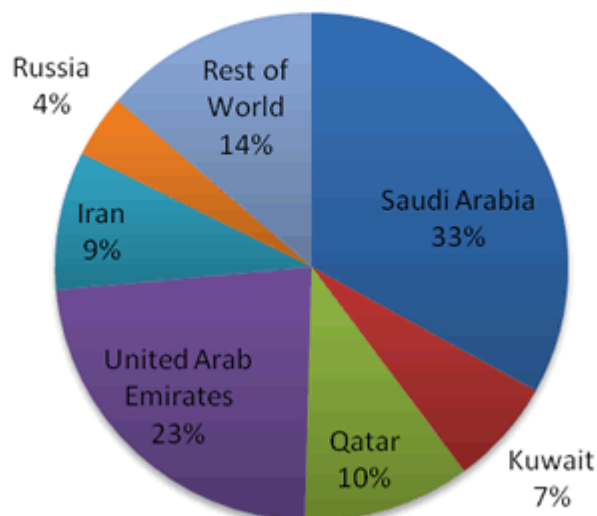
### Imports

Japan was the third-largest net importer of total oil in the world after the United States and China in 2011, having imported around 4.3 million bbl/d. After the Fukushima incident, Japan has been increasing imports of crude oil for direct burn in power plants. The country is primarily dependent on the Middle East for its crude oil imports, as roughly 87 percent of Japanese crude oil imports originate from the region, up from 70 percent in the mid-1980s. Saudi Arabia is the largest source of imports, making up 33 percent of the import portfolio or about 1.1 million bbl/d of crude oil, and UAE, Qatar, and Iran are other sizeable sources of oil to Japan.

Japan reduced imports from Iran during 2011 in light of current and impending US and EU sanctions against Iran, and Japanese refiners are seeking replacements from other Middle Eastern suppliers. Japanese imports from Iran were 313,000 bbl/d in 2011, down 11.7 percent from 2010, according to the Ministry of Economy, Trade and Industry (METI).

Also, Japan is currently looking towards Russia, Southeast Asia, and Africa to geographically diversify its oil imports. As of mid-2011, Japan is substituting some of the lost nuclear fuel for power with low sulfur, heavy crudes for direct burn in power plants from sources in West Africa (Gabon) and Southeast Asia (Vietnam, Indonesia, and Malaysia).

**Japan's Crude Oil Imports by Source, 2011**



Source: Global Trade Atlas, Japanese Government

For a consumer of its size, Japan has a relatively limited domestic pipeline transmission system. Crude oil and petroleum products are delivered to consumers mainly by coastal tankers and tank trucks, as well as railroad tankers and pipelines.

Russia's Transneft, backed by the Russian government, is building the Eastern Siberia-Pacific Ocean pipeline (ESPO), a 2,900 mile pipeline from Taishet, Siberia to Nakhodka on the Pacific Ocean, to export Russian oil to the energy hubs of the Asia-Pacific region. In September 2010, the first section of the pipeline, running from Eastern Siberia to China's northeastern frontier, was completed with a capacity of 600,000 bbl/d. The remainder of the pipeline, scheduled to be finished by 2013, is expected to transport up to 1.6 million bbl/d, about one-third of Russia's current oil exports, to China, Japan, and South Korea.

### Downstream/Refining

According to OGJ, Japan had 4.7 million bbl/d of oil refining capacity at 30 facilities as of December 2011, and has the second-largest refining capacity in the Asia-Pacific region after China. JX Nippon is the largest oil refinery company in Japan and operates seven refineries with 1.42 million bbl/d of capacity. In recent years, the refining sector in Japan has been characterized by overcapacity since domestic petroleum product consumption has declined due to the contraction in industrial output and the decline in transportation fuel demand because of mandatory blending with ethanol. As a result, Japan scaled back refining capacity by 560,000 bbl/d between 2000 and 2010. In addition to declining domestic demand, Japanese refiners now must compete with new state-of-the-art refineries in emerging Asian markets. For example, JX Nippon aims to shut down 600,000 bbl/d of capacity between 2008 and 2015. Currently, private refiners in Japan are required to maintain petroleum product stocks equivalent to at least 70 days of consumption, which imposes large additional costs to these companies. This regulation was relaxed to 67 days after the Fukushima incident.

The Japanese government is seeking to promote operational efficiency, and in 2010, METI announced an ordinance that would raise the cracking to crude distillation capacity ratio that refiners had to meet by March 2014 from 10 percent to 13 percent or higher. This ordinance is intended to increase refinery competitiveness within the country and will likely lead to refinery closures if implemented. FACTS Global Energy anticipates that if the ordinance is implemented, it could remove an additional 600,000 to 800,000 bbl/d of refining capacity as companies rationalize their expenditures. Announced closures along with the METI legislation could lower refining capacity by a total of 1.3 million bbl/d by 2014.

The March 2011 earthquake in Northeastern Japan caused an immediate shutdown of 6 refineries with 1.4 million bbl/d or about 30 percent of the total current capacity. However, the country ramped up imports of refined products, particularly low sulfur fuel oil, in order to offset shortfalls in fuel supply for power generation until refineries were restored. In 2011, fuel oil imports surged to 102,000 bbl/d, rising from 58,000 bbl/d in 2010 while crude refining was down by 5.6 percent to 3.4 million bbl/d in 2011. As of May 2012, only 100,000 bbl/d of refining capacity remains offline from part of Cosmo Oil's Chiba refinery.

## Natural Gas

According to OGJ, Japan had 738 billion cubic feet (Bcf) of proven natural gas reserves as of January 2012. Natural gas proven reserves have declined since 2007, when they measured 1.4 trillion cubic feet (Tcf). Most natural gas fields are located along the western coastline.

### Sector Organization

Inpex and other companies created from the former Japan National Oil Company are the primary actors in Japan's domestic natural gas sector, as in the oil sector. Inpex, Mitsubishi, Mitsui, and various other Japanese companies are actively involved in domestic as well as overseas natural gas exploration and production. Osaka Gas, Tokyo Gas, and Toho Gas are Japan's largest retail natural gas companies, with a combined share of about 75 percent of the retail market. Japanese retail gas and electric companies are participating directly in overseas upstream LNG projects to assure reliability of supply.

Although Japan is a large natural gas consumer, it has a relatively limited domestic natural gas pipeline transmission system for a consumer of its size. This is partly due to geographical constraints posed by the country's mountainous terrain, but it is also the result of previous regulations that limited investment in the sector. Reforms enacted in 1995 and 1999 helped open the sector to greater competition and a number of new private companies have entered the industry since the reforms.

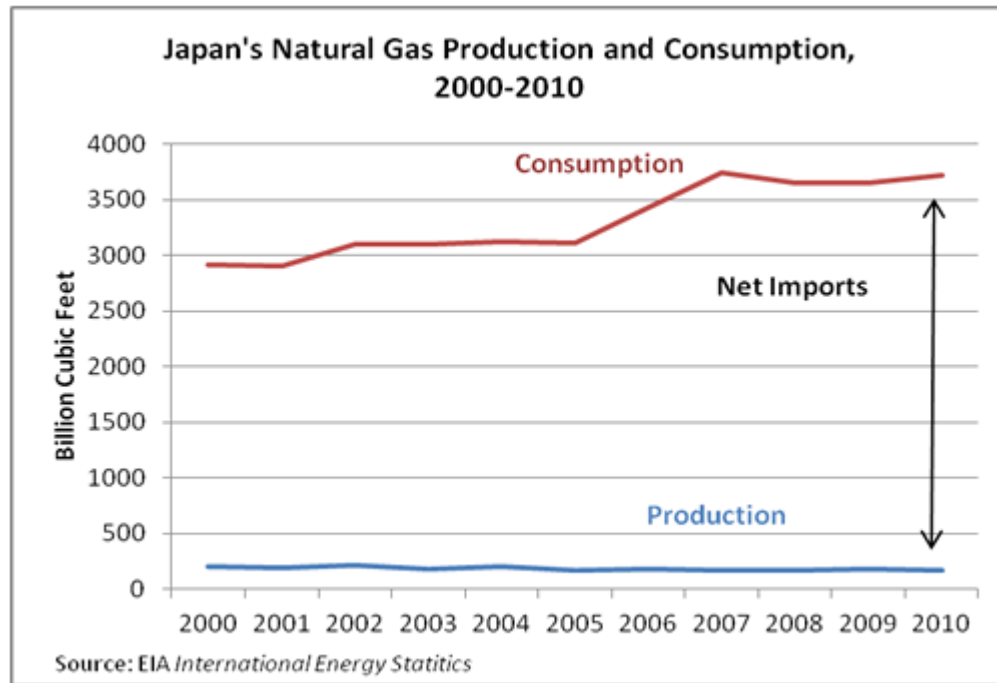
### Production and Exploration

Japan produced 174 Bcf of natural gas in 2010. Japan's largest natural gas field is the Minami-Nagaoka on the western coast of Honshu, which produces about 40 percent of Japan's domestic gas. Exploration and development are still ongoing at the field which Inpex discovered in 1979. The gas produced is transported via an 808-mile pipeline network that stretches across the region surrounding the Tokyo metropolitan area. Inpex is building an LNG terminal with a 73 Bcf/y

***Japan relies on LNG imports for virtually all of its natural gas demand and is the world's largest LNG importer.***

capacity at Naoetsu port in Joetsu City which will connect its domestic pipeline infrastructure with its overseas assets by 2014. Japex has been involved in locating new domestic reserves in the Niigata, Akita, and Hokkaido regions of Japan, targeting structures near existing oil and gas fields.

Japanese companies are using innovative methods to produce hydrocarbons and discovered methane hydrates off the country's east coast. Japan estimates about 40 Tcf of methane hydrates may exist and hopes to begin production by 2018. The high cost of such developments could push back production plans.



### Liquefied Natural Gas Imports

Because of its limited natural gas resources, Japan must rely on imports to meet its natural gas needs. Japan began importing LNG from Alaska in 1969, making it a pioneer in the global LNG trade. Due to environmental concerns, the Japanese government has encouraged natural gas consumption in the country. Japan is the world's largest LNG importer, holding about 33 percent of the global market in 2011.

In 2010, Japan consumed about 3.7 Tcf of natural gas, importing over 3.4 Tcf of LNG by tanker. As a result of the March 2011 earthquake, Japan's LNG imports rose 12 percent in 2011 to 3.8 Tcf, according to some industry sources. IHS CERA estimated that total natural gas imports increased by a monthly average of 18 percent annually from April 2011 through February 2012 compared with the pre-earthquake increases of 4 percent year-on-year between January and March 2011. LNG consumption by the electric utilities rose by 20 percent annually to a record-high of 2.4 Bcf in 2011.

Japan has 32 operating LNG import terminals with a total gas send-out capacity of 8.7 Tcf/y, well in excess of demand in order to ensure flexibility. The majority of LNG terminals is located in the main population centers of Tokyo, Osaka, and Nagoya, near major urban and manufacturing hubs, and is owned by local power companies, either alone or in partnership with gas companies. These same companies own much of Japan's LNG tanker fleet. Five new terminals are under construction and anticipated to come online by 2015 and could add between 200 to 300 Bcf/y of capacity.

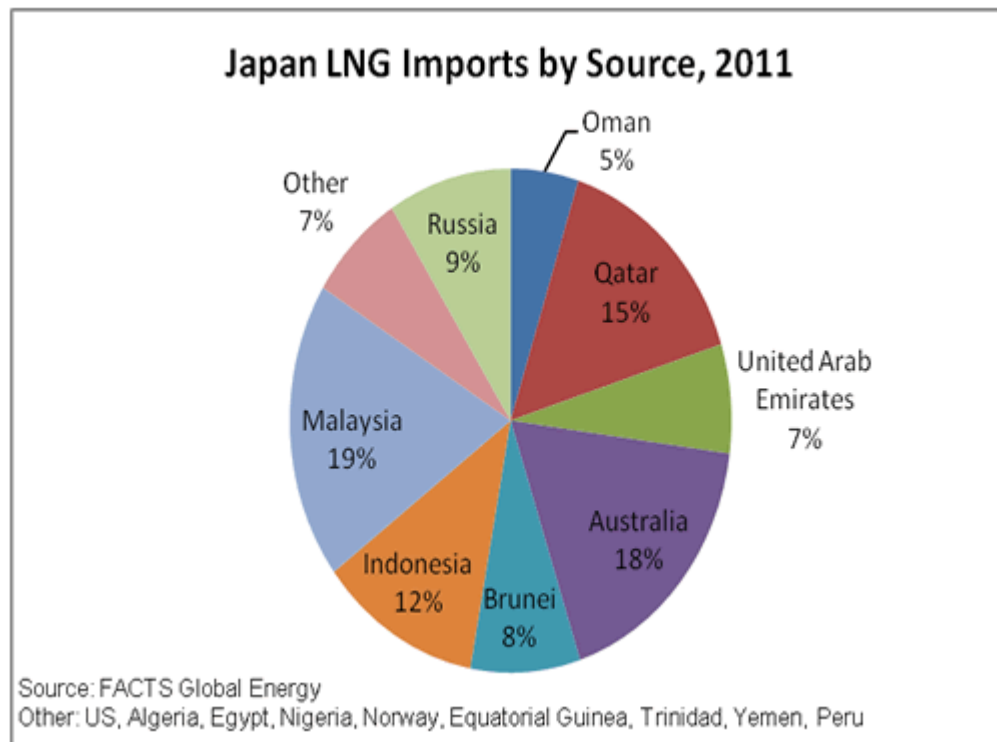
Several factors favor the use of LNG over other fossil fuels and other sources to replace nuclear energy after the 2011 earthquake. Current government carbon-abatement policies and the government's pledge to lower GHG emissions support natural gas as the cleanest fossil fuel to replace capacity. Also, gas remains cheaper than oil in contrast to the aftermath of the last major earthquake in 2007, after which fuel oil made the biggest gains from incremental demand. Destruction of coal-fired electric capacity was widespread in the area affected by the earthquake, allowing for gas to compete with coal on a cost-basis. However, Japan's higher gas demand for power and a tighter LNG global supply market over the past year has led to an overall increase in short term prices from \$9/MMBtu before the crisis to over \$16/MMBtu at the end of 2011.

After the Fukushima incident, Japan is replacing lost nuclear capacity with more short-term and spot cargo LNG which made up about 20 percent of total LNG imports in 2011. Most of Japan's

LNG import infrastructure was not damaged by the earthquake since a majority of these facilities are located in the south and west of the country, away from the earthquake's epicenter. The Shinminato LNG terminal, owned by Sendai Gas, was the only plant closed in March 2011, though the facility was brought back online as of December 2011. Therefore, Japan is able to rely on LNG as a key source of fuel after the accident. Industry analysts project LNG imports could range from 4.1 Bcf/y to 4.5 Bcf/y in 2012, depending on whether any nuclear facilities return to operation.

Most of Japan's LNG imports originate from regional suppliers in Southeast Asia, although the country has a fairly balanced portfolio with no one supplier having a market share greater than roughly 20 percent. Japan's top five gas suppliers make up 73 percent of the market share. After the March 2011 disaster, several suppliers from Qatar, Russia, Malaysia and Indonesia exported cargoes to Japan through swaps and diverted cargoes. Qatar, the world's largest supplier of flexible LNG, overtook Indonesia as the third largest supplier to Japan in 2011 and provided most of the additional imports needed after the earthquake under short-term agreements. Japanese utility companies signed agreements with QatarGas at the end of 2011 to secure longer term LNG supply.

Japan began importing LNG from Russia's Sakhalin terminal in 2009, and the two countries are discussing ways to increase gas imports to Japan via a proposed pipeline or more LNG shipments. Additional supplies to Japan could stem from other new projects in Papua New Guinea or North America in the long term. Reportedly, Japan is negotiating with US exporters for additional supply, though negotiations depend on approval of export licenses by the US and the ability of the Japanese infrastructure to accept gas that is leaner in calorific value. Japanese electric and gas companies and trading houses have signed contracts with various large LNG projects in Australia, most significantly the Chevron-led Gorgon project, which will provide up to 2 Bcf/d of LNG to Asian markets by 2014. In 2012, Mitsui and Mitsubishi purchased a 15 percent stake in Australia's Browse LNG project that will supply at least 1.6 Bcf/d of natural gas from the Browse Basin in Western Australia.



Japanese regulations permit individual utilities and natural gas distribution companies to sign LNG supply contracts with foreign sources, in addition to directly importing spot cargoes. The largest LNG supply agreements are held by Tokyo Gas, Osaka Gas, Toho Gas, Chubu Electric and TEPCO, primarily with countries in Southeast Asia and the Middle East. Many of Japan's existing LNG contracts date from the 1970s and 1980s, and are set to expire over the next decade forcing Japan to renegotiate term contracts or locate shorter term supply. Some industry analysts suggest that this is driving Japanese firms' interest in acquiring equity stakes in foreign liquefaction projects, in an effort to guarantee future supply.

The power sector is the largest consumer of LNG, holding 66 percent of generation in 2011, according to FACTS Global Energy. City gas demand makes up the remaining 34 percent of generation and consists primarily of industrial, residential and commercial sectors. TEPCO is the largest electric utility and gas importer, holding 44 percent of the power generation market. Tokyo



Gas makes up over a third of the city gas share and is the second largest LNG importer.

### Overseas Exploration and Production

Japanese companies have actively sought participation in natural gas exploration and production projects abroad. Some of the major overseas upstream projects that Japan is involved in are:

#### Australia

- Ichthys Project, Browse Basin, Western Australia - Inpex holds a 73-percent stake in this offshore LNG project, slated to come online in 2017. It is expected to produce 400 Bcf/y of LNG, most of which is reportedly intended for export to Japan.
- Mimia Project, Browse Basin - Inpex has a 76-percent stake. In 2008, Inpex announced that it made a new natural gas discovery in the Mimia-1 well, WA-344-P block. Total owns 24 percent. The companies are considering linking the development of the Mimia field to the adjacent Ichthys project.
- Pluto LNG Project - Tokyo Gas and Kansai Electric each acquired a 5-percent stake in Woodside's Pluto LNG project and signed a deal for 182 Bcf/y of LNG for 15 years. The first train came online in early 2012, with estimated new capacity of 200 Bcf/y of LNG.
- Timor Sea Joint Petroleum Development Area, including Bayu-Undan gas field - Inpex, Tokyo Gas, and TEPCO combined own 20 percent. An LNG sales agreement was signed for annual supply of 146 Bcf/y, and the first shipment was in 2006.
- Darwin LNG Terminal - Inpex, TEPCO, and Tokyo Gas hold a combined 20.5 percent stake in the 170 Bcf/y Darwin LNG terminal, which came online in 2006. TEPCO and Tokyo Gas have contracts totaling 146 Bcf/y for 17 years.

#### Russia

- Sakhalin-II - Mitsui and Mitsubishi hold stakes of 22.5 percent combined. Although Shell was originally the main operator of Sakhalin-II, in April 2007 Gazprom became the majority shareholder, and the holdings of Shell, Mitsui, and Mitsubishi were reduced to 27.5, 12.5, and 10 percent respectively. In June 2008, the Japan Bank for International Cooperation (JBIC) and a consortium of international commercial banks pledged \$5.3 billion in project financing. Sakhalin II went online in February 2009. At its peak, Sakhalin-II is expected to produce 468 Bcf/y, and approximately 60 percent of the project's LNG will be sold to Japan.
- Vladivostok LNG terminal - In July 2010, Japan and Russia signed a preliminary agreement to build an LNG terminal with liquefaction capacity of 244 Bcf/y by 2017.

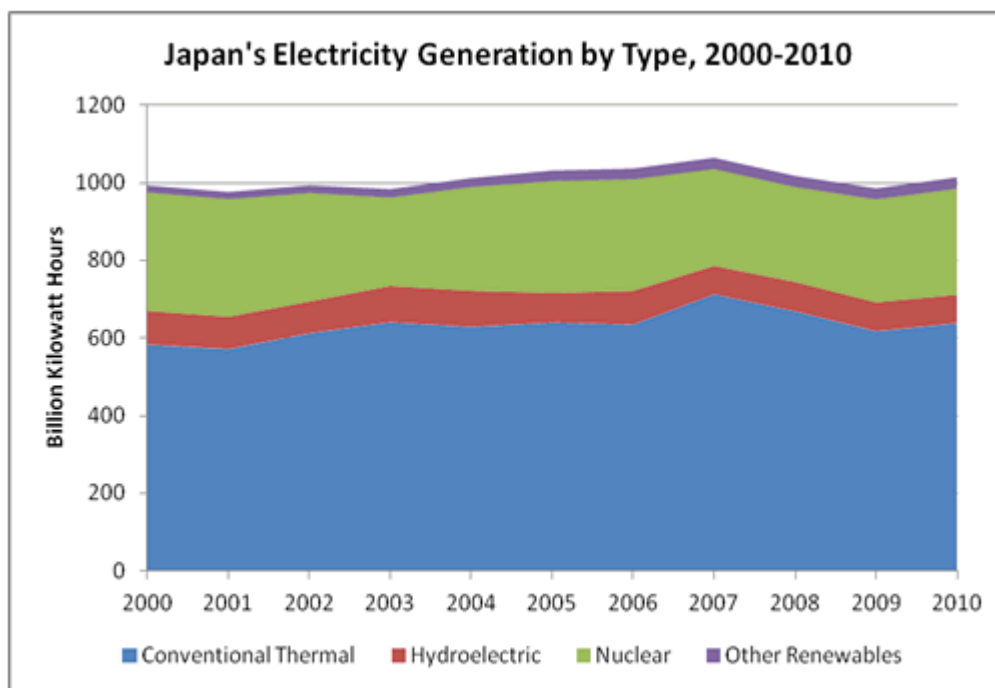
#### Indonesia

- Masela Block, Abadi gas field, Timor Sea - Inpex holds a 100-percent stake in this field, with an estimated 10 Tcf of natural reserves. Inpex is planning to build a floating LNG plant with a 220 Bcf/y capacity, and the project is expected to be online and shipping 150-250 Bcf/y of LNG to Japan and elsewhere by 2016.
- Senoro LNG plant, Sulawesi - Mitsubishi holds 45 percent equity. The Senoro gas field is estimated to hold 1.5 Tcf of reserves. Mitsubishi is building a 97 Bcf/y LNG plant and will be the sole buyer of LNG from the plant, scheduled to come onstream in 2014.
- Mahakam Block and Attaka Unit, Offshore Kalimantan Island - Inpex and Total each hold 50 percent equity. These fields began producing in 1972. Most of the natural gas is sent to Indonesia's Bontang liquefaction plant before being shipped to Japan. Inpex has a 20-year production contract through 2017 and is currently negotiating to extend it further.
- Berau Block, Tangguh LNG Project, Papua Province - A joint venture between Inpex and Mitsubishi has a 22.9-percent interest in the Berau Block and a 16.5-percent interest in the Tangguh Project. Reserves are estimated at 14.4 Tcf. The first cargo of LNG was shipped in July 2009. China, South Korea, and North America have long-term sales agreements for the 363 Bcf/y of production.
- North Belut gas field, South Natuna Sea - Inpex has a 35-percent interest in this project, which is led by ConocoPhillips. The field came online December 2009 at 97 Bcf/y, and the gas is shipped to Malaysia under contract.

### Electricity

Japan had 282 gigawatts (GW) of total installed electricity generating capacity, the third largest in the world behind the United States and China, in 2010. However, after the damage to facilities by the March 2011 earthquake, IHS Global Insight estimates capacity fell to around 243 GW in mid-2011. From the 1 Terawatt hour (TWh) of electric power that Japan generated in 2010, 63 percent of which came from conventional thermal fuels, 27 percent from nuclear sources, 7 percent from hydroelectric sources, and 3 percent from other renewable sources. According to the IEA, the share of thermal generation rose to 186 TWh or 73 percent of total generation in the first quarter of 2012, the highest on record as LNG and oil supplanted some nuclear power.

***Japan was the world's third largest producer of nuclear power after the US and France before the Fukushima Daiichi nuclear power plant accident in March 2011.***



Although Japan accounts for the most electricity consumption in OECD Asia, it has one of the lowest electricity demand growth rates in the region, projected at an average of 0.7 percent from 2007 through 2018 by the Federation of Electric Power Companies of Japan. The damage to homes and industries by the earthquake and energy conservation efforts lowered power demand by 4.7 percent in 2011. In 2010, total generation was over 1 Terawatt-hour and has remained at about the same level for over a decade. Power demand could drop again in 2012 depending on how quickly reconstruction efforts unfold and if nuclear power is renewed. The fuel portfolio for power generation is expected to shift as some nuclear facilities remain permanently offline after the Fukushima disaster.

The Japanese government and electric utilities have taken several steps to ensure power supply meets demand following the Fukushima crisis. Some of these measures for thermal power stations include restoring some of the disaster-affected plants, relaxed regulations on inspections of the stations, and restarting mothballed oil-fueled stations. Also, the government promoted power restraints for consumers in the disaster-affected areas throughout 2011, invoking a 15-percent power reduction on all consumer groups. The Energy and Environment Council concluded that the government would need to request voluntary power saving efforts of 10 percent and 5 percent, respectively, from end users of Kansai Electric Power Company (KEPCO) and Kyushu Electric Power Company during the summer of 2012. Also, the government requested that four western service areas with surplus capacity to cut electricity consumption by five percent in order to transfer power to the northeastern power areas with electricity deficits.

The Japanese government, under the new Prime Minister Yoshihiko Noda, began to officially discuss the new energy policy in October of 2011, to address safety measures and the future of nuclear energy following the March 11 earthquake and tsunami and revise the Basic Energy Plan created in 2010. The 2010 Energy Plan calls for at least 12 new nuclear reactors to be constructed by 2020 and the nuclear share of the electricity sector to increase to over a 50-percent share by 2030 as the country attempts to reduce GHG emissions. However, the Fukushima catastrophe created greater public concerns and revealed potential dangers of an aggressive nuclear policy. Currently, experts on an advisory panel to the government are in disagreement over the amount of nuclear fuel mix with proposals ranging from zero to 35 percent by 2030. The revised energy policy is slated to take effect in the second half of 2012 and increase the role of LNG, oil, and renewable fuels following the government's assessment of energy security for the country's power sector.

Current policy is that nuclear power plants can be effectively used, contingent on effective regulations imposed for safety measures. It favors bringing back online some reactors suspended for maintenance, inspection and installation of safety measures in 2012, though aged reactors should be decommissioned.

### Sector Organization

Japan's electricity industry is dominated by 10 privately-owned, integrated power companies that act as regional monopolies, accounting for about 85 percent of the country's total installed generating capacity. The remainder is generated by industrial facilities. The largest power company is the Tokyo Electric Power Company (TEPCO), which accounts for 27 percent of total

power generation in the country. These companies also control the country's regional transmission and distribution infrastructure. Japan's electricity policies are managed by the Agency for Natural Resources and Environment, part of METI.

Other significant operators in the electricity market are the Japan Atomic Power Company, the first Japanese company to build a nuclear reactor in 1960, which operates four nuclear power plants with 2.6 GW total and sells electricity to the local power companies, and the Electric Power Development Company (J-Power), formerly a state-owned enterprise that was privatized in 2004. J-Power operates 16 GW of hydroelectric and thermal power plants. It has also been involved in consulting services for electricity production and environmental protection in 63 countries, mainly in the developing world, since 1960.

## Electricity Generation

### *Conventional Thermal*

Japan had about 182 GW of installed conventional thermal electric generating capacity in 2009 and electricity generation was 637 TWh in 2010. According to Japan Electric Power Information Center, there are currently 61 major thermal power plants, and 6 more are under construction: 3 using LNG and 3 using coal for generation. The country's aging oil-fired power plants are used primarily as extra capacity to meet peak demand, and less than 10 percent of total electricity produced was oil-generated in 2010. Coal and natural gas comprised 25 percent and 27 percent of total power supply, respectively.

Coal, typically used as a base load source for power generation, remains an important fuel source and accounted for 43 percent of fossil fuel-fired generation in 2011, according to the International Energy Agency. Domestic coal production came to an end in 2002 and Japan imported 207 million short tons in 2010, mainly from Australia. However, new, clean coal technologies are being pursued in the power sector in efforts to meet environmental targets. As of mid-2011, Japan had 43 GW of coal-fired capacity according to IHS Global Insight. Several coal-fired plants experienced significant damage following the 2011 earthquake since they were located near Fukushima. Because of this factor, coal was not used as a substitute for nuclear power and actually experienced a negative growth in 2011.

The number of natural gas-fired power stations is increasing in Japan, and roughly 26 percent of electricity was natural gas-fired in 2010. LNG accounted for 43 percent of the fossil fuel mix in 2011, rising from 37 percent in 2010. Capacity utilization in gas-fired power facilities is close to 80 percent, so increasing LNG use in the short term is limited. The government has plans to construct more gas-fired power generators, and currently, there are three proposed gas-fired power plants with 3.4 GW of capacity scheduled to come online by 2016. The lead-time on greenfield plants is about 7 to 10 years mainly due to environmental permitting. However, TEPCO and Tohoku Electric Power, utilities that suffered damage to their gas-fired plants in the earthquake zone, were temporarily exempted from these environmental requirements.

Before the 2011 earthquake, Japanese utilities began removing oil-fired generation capacity due to higher operational costs. Unlike the more constricted capacity at gas-fired facilities, capacity utilization at oil-fired facilities is less than 50 percent. Therefore, power generators have more room to increase burn of crude oil and fuel oil than natural gas in the short term. Some utilities plan to bring back mothballed facilities to compensate for lost nuclear power. Kansai Electric Power proposed restarting 2.4 GW of power at 5 units by summer 2012. Chugoku Electric and Shikoku Electric plan to resume nearly 600 MW of power generation. Total oil-fired capacity was 60 GW, mostly crude oil direct burn, by mid-2011.

Japanese electric utilities are burning more fuel oil and direct crude to make up for lost nuclear generation. Consumption of fuel oil and crude oil in power sector were estimated at 210,000 bbl/d and 178,000 bbl/d, respectively, in 2011. Incremental demand for both fuel oil and crude oil for power ranged between 130,000 bbl/d and 145,000 bbl/d in 2011. FACTS Global Energy forecasts that these figures could increase by 19 percent for fuel oil to 252,000 bbl/d and 29 percent for crude oil to 230,000 bbl/d in 2012 assuming a few nuclear facilities are brought online. In the first quarter of 2012 as nuclear capacity dwindled to zero, monthly demand growth for fuel oil and direct crude oil burn was over 3 times higher on an annual basis. If no nuclear

facilities are brought online in 2012, incremental oil demand for power could be over 250,000 bbl/d on the whole.

### *Nuclear*

Before the Fukushima accident, Japan ranked as the third-largest nuclear power generator in the world behind the United States and France. However, the country has gradually lost all of its nuclear generation capacity as its facilities have been removed from service due to earthquake damage or for regular maintenance. General maintenance standards in Japan require facilities to come offline every 13 months for inspections. The last reactor went offline in May 2012, and for the first time in over 40 years, Japan has no nuclear generation. The average nuclear utilization rate dropped from 68 percent in 2010 to 38 percent in 2011.

Following the Fukushima accident, the Japanese government required facilities to pass two phases of stress tests issued by the Nuclear Industrial Safety Authority (NISA) as well as local government approval. As of May 2012, only two idled reactors, Ohi No. 3 and 4, passed the stress tests and approvals by both NISA and the Nuclear Safety Commission (NSC), but the facilities must receive authorization by local government and the Prime Minister. Serious public concerns about bringing nuclear reactors back into operation may cause local governments to challenge any federal approval. Some industry sources predict Japan will resume operation of a few reactors by the end of summer 2012; however, Prime Minister Noda has delayed the approval of the facilities until stricter safety standards are drafted by the government. Several factors ranging from public safety to energy security and economic impacts contribute to the debate on re-commissioning the facilities.

Over 10 GW of nuclear capacity at the Fukushima, Onagawa, and Tokai facilities ceased operations immediately following the earthquake and tsunami, and some of the reactors are permanently damaged from emergency seawater pumping efforts and not scheduled to be brought back online. The government officially decommissioned four reactors with a capacity of 3 GW at the Fukushima Daiichi nuclear plant in April 2012. Also, Japan recently reported that it would decommission any ageing reactors older than 40 years to improve safety. Ultimately, this proposed law contributes to a long-term decline in nuclear capacity. Below is a snapshot of Japan's key nuclear facilities including those affected by the 2011 earthquake.

Japan currently has 50 nuclear reactors with a total installed generating capacity of 46 GW, down from 54 reactors with 49 GW of capacity in 2010. EIA estimates that Japan produced 274 TWh of nuclear-generated electricity in 2010. In its policy plans from 2010, the government intended to increase nuclear's share of total electricity generation from 24 percent in 2008 to 40 percent by 2017 and to 50 percent by 2030, according to the Ministry of Economy, Trade and Industry. However, the March 2011 Fukushima nuclear plant incident will likely shift Japan's focus on nuclear energy growth and affect the government's energy fuel mix targets.

Japan has a full fuel cycle setup, including enrichment and reprocessing of used fuel for recycling. Japan has promoted nuclear electricity over the years as a means of diversifying its energy sources and reducing carbon emissions, emphasizing safety and reliability. The World Nuclear Association reports there are currently two nuclear plants with 2.7 GW of capacity under construction and originally scheduled to be online by 2014. According to the Federation of Electric Power Companies in Japan, nuclear power has made a great contribution to Japan's energy security by reducing its energy imports requirement by approximately 440 MMbbl/d per year and, because nuclear energy emits no CO<sub>2</sub>, it reduces Japan's CO<sub>2</sub> emissions by about 14 percent per year.



Source: Global Insight

#### *Hydro and Other Renewables*

Japan had installed hydroelectric generating capacity of 48 GW in 2009, accounting for about 16 percent of total electricity capacity. About half of this capacity is pumped storage with another 5 GW scheduled to come online by 2020. Like nuclear power, hydropower is a source for baseload generation in Japan because of the low generation costs and stable supply. Hydroelectric generation was 73 TWh in 2010, making up about 7 percent of total net generation. The Japanese government has been promoting small hydropower projects to serve local communities through subsidies and by simplifying procedures.

Wind, solar, and tidal power are being actively pursued in the country and installed capacity from these sources has increased in recent years to about 4.6 GW in 2009, up from 0.8 GW in 2004. However, they continue to account for a relatively small share of generation at this time.

As part of the revised energy policy plan, Japan is trying to encourage a greater use of renewable energy, from sources such as solar, wind, geothermal, hydropower, and biomass, for power generation. Non-nuclear renewable energy made up about 4 percent of Japan's total energy consumption and about 2 percent of the country's electricity generation in 2010. The Japanese legislature approved an act, scheduled to be official in July 2012, compelling electric utilities to purchase electricity generated by renewable fuel sources, except for nuclear, at fixed feed-in tariff prices. The costs are to be shared by government subsidies and the end users, though details of the act, particularly the tariff price, are not entirely defined.

## Links

### EIA Links

[EIA - Country Information on Japan](#)

### U.S. Government

[CIA World Factbook](#)

[Library of Congress Country Study on Japan](#)

[U.S. Embassy in Tokyo](#)

[U.S. State Department Background Notes on Japan](#)

## Foreign Government Agencies

[Japanese Agency for Natural Resources and Energy](#)

[Japanese Ministry of Economy, Trade and Industry](#)

[Japanese Ministry of Foreign Affairs](#)

## Oil and Natural Gas

[Cosmo Oil](#)

[Idemitsu Kosan Co., Ltd.](#)

[Inpex Corporation](#)

[Japan Oil, Gas and Metals National Corporation \(JOGMEC\)](#)

[Japan Petroleum Exploration Co., Ltd. \(Japex\)](#)

[Mitsui Oil Exploration Co., Ltd.](#)

[Nippon Oil Corporation](#)

[Chubu Electric Power](#)

[Electric Power Development Company \(J-Power\)](#)

[Federation of Electric Power Companies \(FEPC\)](#)

[Japan Atomic Power Company \(JAPC\)](#)

[Kansai Electric Power](#)

[Nuclear Safety Commission of Japan](#)

[Tokyo Electric Power Company \(TEPCO\)](#)

## Sources

Asia Pulse

BMI Asia Pacific Oil and Gas Insights

Business Monitor International

FACTS Global Energy

Federation of Electric Power Companies of Japan

Chevron Corp.

Idemitsu Kosan

IHS Global Insight

Inpex

Institute of Energy Economics , Japan

IntelAsia

International Energy Agency

International Oil Daily

Japan Atomic Power Co.

Japan Electric Power Development Co.

Japex

LNGpedia.com

Nippon Oil

Oil & Gas Journal

PFC Energy

Platts Oilgram News

Reuters

RTT News

Sakhalin Energy Corp.

TendersInfo

Upstream

U.S. Energy Information Administration

World Gas Intelligence

## Contact Info

[cabs@eia.gov](mailto:cabs@eia.gov)

(202)586-8800

[cabs@eia.gov](mailto:cabs@eia.gov)