SAMPLE REPORT: JAPAN

April 2020—(The data in the sample report may not be the latest data available in the service).
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Overview

Despite Fukushima, nuclear will remain a key pillar of the energy supply. Faced with volatile energy prices, the latest energy policy has made supply security, cost reduction, the environment, and safety the top priorities.

Ten vertically integrated private companies account for around two thirds of the power production. JXTG Nippon Oil & Energy is the largest oil company, accounting for 50% of gasoline sales. Tokyo Gas and Osaka Gas account for 70% of the gas supply.

Crude oil imports are decreasing since 2000. LNG imports, which are declining rapidly since 2014, represent around one third of the world’s trade. Japan is the third largest importer of coal. The country ranks second in the world for solar PV capacity (62 GW in 2019). Solar PV now has the same share as nuclear in the power mix (7%).

The price of electricity in industry is still high in comparison to other OECD countries.

Energy consumption is decreasing and in 2019 was 16% lower than in 2010. The share of oil in the energy mix has been decreasing since 1990. The energy intensity to the GDP has been decreasing at a very rapid pace of 4%/year since 2010.

The country is facing pressure to reach its 2030 CO₂ emissions and power mix targets, leading to tighter regulations for coal projects and the development of projects using CCS. The gas import capacity is expected to increase since the Government is encouraging fuel switching to gas.
**Table 1: Economic Indicators**

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<td><strong>Population</strong></td>
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<td>%/year</td>
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<tr>
<td>%/year</td>
<td>3.1</td>
<td>-0.68</td>
<td>-0.72</td>
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<tr>
<td>lc/$</td>
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<td>108</td>
<td>87.8</td>
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**Energy security**

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<td><strong>Energy independence rate</strong></td>
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<tr>
<td><strong>Share of oil imported(+) exported(-)</strong></td>
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**Energy efficiency**

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<td><strong>Total consumption/GDP</strong></td>
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<td></td>
<td>0.109</td>
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<td>0.082</td>
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<td>4.9</td>
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<td><strong>Efficiency of thermal power plants</strong></td>
<td>%</td>
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<td></td>
<td>41.0</td>
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**CO2 emissions**

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<tr>
<td>kCO2/$15p</td>
<td>0.258</td>
<td>0.245</td>
<td>0.226</td>
<td>0.211</td>
<td>0.203</td>
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<td><strong>CO2 emissions/capita</strong></td>
<td>tCO2/cap.</td>
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<td></td>
<td>8.4</td>
<td>8.9</td>
<td>8.6</td>
<td>8.8</td>
<td>8.5</td>
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* at purchasing power parity

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Institutions and energy policy

Despite Fukushima, nuclear will remain a key pillar of the energy supply.

Faced with volatile energy prices, the latest energy policy has made supply security, cost reduction, the environment, and safety the top priorities.

The METI, Ministry of Economy, Trade and Industry, is in charge of the energy sector through ANRE, Agency for Natural Resources and Energy. ANRE has three departments: the Energy Conservation and Renewable Energy Department, the Natural Resources and Fuel Department, and the Electricity and Gas Industry Department.

EGC, Electricity and Gas Market Surveillance Commission, has been implemented in 2015 to strengthen the monitoring of both markets.

The latest Strategic Energy Plan of Japan (2018) by METI’s expert committee stipulates the main goals of the country’s energy policy, based on the Basic Act on Energy Policy. It designates nuclear as an important long-term electricity source both for domestic security of supply and for environmental commitments. It also forecasts renewables as major energy sources in the future, with an emphasis on advancing the development of energy storage and hydrogen. The committee recommended phasing-out and replacing inefficient coal-fired power plants with gas power plants.

Electricity

ESCI, Electric Power System Council of Japan, regulates the electricity sector.

Under the Policy on the Electricity System Reform, the deregulation of the retail market was launched in 2016 and the residential sector was open to competition. In 2018, METI announced the procedure that customers have to follow for switching electricity retailers. The unbundling of the power transmission and distribution activities is planned for April 2020. This market opening reform ends the monopoly of the ten regional electricity companies and aims to boost competition and lower prices, which are among the highest in the world. Utilities have long been
opposed to such a move, but the Fukushima accident has weakened their lobbying power.

In February 2020, the government adopted a bill to revise the electricity business law, which intends to secure power in times of disaster. One of the aims is to force power companies to develop contingency plans on working with other utilities, local governments, and the Self-Defence Forces.

An Organization for Cross-regional Coordination of Transmission Operators (OCCTO) was set up in 2015 to aggregate and evaluate the electricity supply plans from various companies, to oversee the cross-regional operation of supply/demand and the network, and to draw up the rules of the network code and power bidding.

Since the full opening of the retail residential electricity market, the number of electricity retailers has ballooned from the 10 vertically integrated utilities to about 400 companies. Non-power utility retailers are soon expected to account for more than 10% of Japan’s electricity consumption. However, former regional monopolies still generate most of the power, while new retail companies must purchase power from higher-cost plants such as gas-fired power plants. In 2016, the METI announced that it plans to implement a baseload power market to improve competition by ensuring equal access to cheap power supplies for new retail companies. This new scheme is planned to start during the FY 2019-2020.

Nuclear target: 20-22% of power mix in 2030

Nuclear

Following the Fukushima nuclear accident in 2011, a new nuclear regulatory agency, the Nuclear Regulation Authority (NRA), was created in 2012. It issued new nuclear safety rules that took effect in 2013. Since then, only 7 reactors have cleared NRA inspections and resumed operations.

In 2013, Japan created an authority, IRID, International Research Institute for Nuclear Decommissioning, dedicated to the dismantling of four Fukushima nuclear units. It will be in charge of conceiving new technologies and processes to clean up the site, including withdrawing spent fuel.

The latest Energy White Paper (Annual Report on Energy based on the Strategic Energy Plan), which was approved by the Cabinet in June 2019,

---

3 FY: Fiscal Years starting in April.
The 4th Strategic Energy Plan introduced full competition in the gas retail business in 2017

Energy efficiency target:
30% of energy savings by 2030 compared to 2006

explains the progress that Japan has made in reconstruction efforts in Fukushima Prefecture since 2011. The objective is a share of 20-22% of nuclear in the 2030 power mix.

Oil

Due to the lack of domestic resources, the energy policy incentivises companies to pursue overseas exploration projects in order to secure the supply.

Gas

The retail gas market was fully liberalised in 2017. The opening of the market took place in several phases: first for customers consuming more than 217 mcm/year in 1994 and, after several revisions, the threshold was lowered to 0.1 mcm/year in 2007. In 1999 the law also introduced third party access to the gas transmission networks.

Gas transmission and distribution networks operated by the three largest gas suppliers, namely Tokyo Gas, Osaka Gas and Toho Gas, will be transferred to companies that will become legally separated in 2022, in order to open access to new entrants.

In 2014, Japan launched its LNG Futures market on the Japan OTC Exchange (JOE) to bring more transparency to the spot deals and to lower the price of LNG.

Energy efficiency

The Energy Efficiency Policy is governed by the Energy Conservation Law (Rational Use of Energy Act, 1979), which was last amended in 2013.

In 2006, the New National Energy Strategy, including the Energy Conservation Frontrunner Plan, set the target to improve energy efficiency by at least 30% by 2030 compared to 2006.

Energy efficiency standards, known as the “top-runner programme”, have existed since 1998. They currently concern about 32 products and types of equipment, including household and commercial electrical appliances, lamps, road vehicles, heating and cooking appliances and industrial electric equipment (e.g. motors, transformers), with up to 3 updates for some of them. For passenger cars, the 2015 target represented an increase of about 24% in average fuel efficiency compared to 2004 levels. The vehicle efficiency targets are generally set at 5-year intervals, with the
government targeting an average passenger car fleet fuel economy of 20.3 km/l by 2020, a 24% increase from 2009 levels and a 19.6% increase from the 2015 actual results.

In industry, and in the commercial sector since 2008, large companies are obliged to name an “energy manager” who is responsible for the implementation of an energy plan and who has to report statistics to the METI.

In 2015, the METI announced plans to invest US$779m to finance the implementation of energy efficiency devices, such as LED lamps or high-efficiency boilers by SMEs and industries. In 2016, the government introduced new energy efficiency benchmarks and standards for existing and new thermal power plants and revised the calculation method for energy efficiency evaluation to promote the effective utilization of waste heat.

Renewables

In the government’s latest Energy White Paper (2019), renewables are recognized as a major energy source for Japan’s future. The plan aims to raise the share of renewables in the power mix to 22-24% (including hydropower) in 2030, with plans to make renewables Japan’s main power source by 2050.

Feed-in tariffs (FiTs) were introduced for solar PV in 2009 (for surplus electricity production only) and were extended to other renewables in 2011. The scheme is reviewed at least every three years. FiTs for solar PV were removed in February 2020 for large scale projects (>250 kW) and replaced by a tendering program initiated by the METI.

In 2012-2013, FiTs were among the highest in the world (twice the level of Germany and over three times that of China for solar). In 2016, the government revised the Act on Special Measures for Renewable Energy, which includes changes in FiTs, as the existing FiTs favoured solar PV.

The FiTs for non-residential solar PV systems >10 kW have been reduced several times since 2013 to reflect declining costs and increasing utilization rates of solar facilities. In February 2020, the METI set solar PV FiT for FY 2020-2021 at Yen 21/kWh (US$19c/kWh) for solar PV systems below 10 kW, at Yen 13/kWh (US$12c/kWh) for projects between 10 and 50 kW, and at Yen 12/kWh (US$11c/kWh) for projects between 50 and 250 kW.
To boost offshore wind development, the METI introduced a specific FiT for offshore wind in 2014. The FiT for offshore wind and small-scale wind will remain at Yen 36/kWh (US$32c/kWh) and Yen 55/kWh (US$50c/kWh), respectively, until FY 2019, while the FiT for large-scale (>20 kW) onshore wind will decrease from Yen 20/kWh (US$18c/kWh) in FY 2018 to Yen 19/kWh (US$17c/kWh) in FY 2019. The FiT for repowering wind projects will decrease from Yen 17/kWh (US$16c/kWh) in FY 2018 to Yen 16/kWh (US$14c/kWh).

FiTs for geothermal facilities are set for 15 years at US$28.2c/kWh (>15 MW) and at US$43.4c/kWh (<15 MW).

FiTs for small and medium hydropower are set at US$35c/kWh <200 kW), US$30c/kWh (between 200 kW and 1 MW), and US$25c/kWh (>1 MW), respectively, for 20 years (from 2015).

For biomass projects above 2 MW, the Yen 24/kWh (US$22c/kWh) tariff will progressively fall to Yen 21/kWh (US$19c/kWh) from 1 September 2017 to FY 2019, while smaller installations will benefit from a tariff of Yen 24/kWh (US$22c/kWh).

**CO₂**

Japan aims to reduce GHG emissions to 1.04 GtCO₂eq by FY 2030, which is 26% below FY 2013 (NDC). In 2016, the country ratified the Paris Agreement on climate change.

GHG emissions dropped by 3.6% in FY 2019 for a fifth straight year and by 12% from FY 2013 to FY 2019.

The long-term goal, announced in June 2019 in the long-term growth strategy under the Paris Agreement, is to become carbon neutral in 2050.

CO₂ emissions from energy combustion peaked in 2013 following the closure of nuclear reactors, but have since declined regularly (-2.4%/year).

**GRAPH 1: CO₂-ENERGY EMISSIONS (MtCO₂)**
Emission trading scheme

The Government announced in 2012 its intention to introduce a national compulsory emissions trading scheme for large CO\textsubscript{2} emitting companies. However, in the face of strong opposition from industries, the government scrapped the proposal and instead introduced a CO\textsubscript{2} tax.

In 2010, the Tokyo Metropolitan Government launched a mandatory cap-and-trade scheme to reduce its GHG emissions by 25\% by 2020 and 30\% by 2030 (compared with 2000). Over the first period (FY2010-2014), a 25\% emission reduction was achieved. For the second period (FY2015-2019), the reduction target was set at 15-17\%. Finally, for the third compliance period (FY2020-2024), facilities are expected to reduce emissions by 25\% or 27\% depending on their category.

Carbon taxes

A CO\textsubscript{2} tax called “Tax for Climate Change Mitigation” and known as the “GW Tax” was introduced in 2012 and was last increased in 2016 to JPY 289/tCO\textsubscript{2} (US$2.7/tCO\textsubscript{2}).
Energy companies

Ten vertically integrated private companies account for around two thirds of the power production.

JXTG Nippon Oil & Energy is the largest oil company, accounting for 50% of gasoline sales.

Tokyo Gas and Osaka Gas account for 70% of the gas supply.

Electricity

The electricity sector is dominated by 10 regional, private companies (the “Ten EPCOS”), vertically integrated and grouped together in the Federation of Electric Power Companies (FEPC), and by J-Power. The EPCOs’ monopoly in their region ended in 2016. The Ten EPCOS account for around 2/3 of the electricity produced with the three largest - TEPCO, Kansai and Chubu - representing 38% of the installed capacity and about 49% of sales of the Ten EPCOS.

TEPCO (Tokyo EPCO) currently has a capacity of around 64 GW (13 GW of nuclear, 29 GW of LNG/LPG, 3.2 GW of coal, 9 GW of oil, and 10 GW of hydro, end of FY 2018). Prior to the Fukushima accident in 2011, its nuclear capacity was 17.3 GW. The 6 Fukushima Daiichi nuclear reactors have now been permanently closed. TEPCO power generation has decreased significantly, from 264 TWh in 2010 to 191 TWh in FY2018, and its sales dropped to 230 TWh from 293 TWh in 2010 (FY2018). TEPCO accounted for 24% of the national electricity sales in 2018. Following TEPCO’s nationalisation in 2012, the Nuclear Damage Compensation and Decommissioning Facilitation Corporation is now the company’s main shareholder with a 54.74% stake. TEPCO plans to develop over 5 GW in 23 countries. Together with JXTG, TEPCO plans to enter the hydrogen business by developing one of the world’s largest production sites by mid-2020.

In April 2019, TEPCO and Chubu Electric integrated their domestic thermal power generation business into JERA (68 GW of coal and gas-fired capacity in Japan and 9 GW overseas), which then became the country’s largest thermal power producer. JERA announced its plan to invest 70% of
its budget for the next seven years on renewables and LNG power projects, targeting 5 GW of renewable capacity by 2025.

**Kansai EPCO** has a capacity of 34 GW and sales of 115 TWh (FY 2018). Kansai has 4 operational nuclear power facilities (3.9 GW), and 3 mothballed (2.3 GW). The company restarted operations at several nuclear reactors: Takahama 3 & 4 in 2017 and Ohi 3 & 4 in April and June 2018.

**Chubu EPCO** has a capacity of 33 GW and sales of 123 TWh (FY2018).

The other companies are, in order of importance: Kyushu (30 GW, 72 TWh of sales), Tohoku (17 GW, 69 TWh of sales), Chugoku (12 GW, 61 TWh of sales), Hokuriku (8 GW, 30 TWh of sales), Hokkaido (8 GW, 25.5 TWh of sales), Shikoku (7 GW, 28 TWh of sales), and Okinawa (2.1 GW, 7.4 TWh of sales) (FY2018).

**J-Power** (also called EPDC) has a domestic capacity of 17 GW (including affiliated companies), made up of 8.3 GW thermal, 8.6 GW hydro, and 0.4 GW of wind (April 2018) and a capacity abroad of 7 GW (of which, 3.3 GW in Thailand). Total Sales in FY 2017 were 63 TWh. It was privatised in 2004 through the sale by the State of 83% of its capital.

**Japan Nuclear Fuel Ltd (JNFL)** is a private venture led by the nation's ten electric utilities to develop a "closed" nuclear fuel cycle.

Nuclear Fuel Industries Ltd. has been Japan’s sole producer of nuclear fuel since 1972. Since 2018, it is a subsidiary of Toshiba Energy Systems.

### Oil

Around thirty Japanese companies produce oil abroad and import it into Japan. **JOGMEC**, Japan Oil, Gas and Metals National Corporation, supports the oil and gas companies in conducting oil and gas E&P overseas and offshore Japan. In 2016, the parliament adopted a bill allowing JOGMEC to invest in foreign oil and gas companies. This should help Japan compete for global energy assets and improve its energy supply. JOGMEC manages the national level petroleum stockpiling. JOGMEC has developed several projects since 2016, including an onshore oil sand project in Canada, an exploration project in the Krasnoyarsk region of Russia and LNG projects in Australia (Itchys and Wheatstone).

**JAPEX**, Japan Petroleum Exploration Co, develops E&P oil projects (including natural gas or other energy resources) abroad and in Japan.
To reduce costs, refineries are moving towards mergers and acquisitions.

**JXTG Nippon Oil & Energy** is the largest oil group, with a refining capacity of nearly 2 mb/d in Japan; it controls half of the gasoline market and operates more than 14 000 retail outlets in the country. The company was created in 2017 from the merger between JX Nippon Oil & Energy and Tonen/General (3 refineries with a total capacity of 0.5 mb/d).

**Idemitsu Kosan** is the second largest oil refining company (0.9 mb/d), controlling around 30% of the refining market. In 2015, it acquired a 33.24% stake in Showa Shell Sekiyu (6 refineries). The integration of their key businesses was completed in April 2019, when the two companies swap shares for the 68.75% not owned by Idemitsu.

The remaining large refiner is **Cosmo Oil** (3 refineries with a total capacity of 0.5 mb/d).

**Gas**

Three companies account for more than 80% of the gas supply: **Tokyo Gas** (15.1 bcm of sales in FY 2019), **Osaka Gas** (8.6 bcm in FY 2018), and **Toho Gas** (3.8 bcm in FY 2018). There are around 200 gas companies, 85% of which are private; they are grouped together in **JGA**, Japan Gas Association.

**Inpex** (MITI 18.96%, JAPEX 7.32%, Master Trust Bank of Japan 4.45%) develops LNG projects abroad. Inpex has a total LNG capacity of around 7 Mt/year, spread over 4 plants: Itchys LNG (operator, stake of 66.24%), Prelude FLNG (17.5%) and Darwin LNG (11.38%) in Australia, and Tangguh LNG in Indonesia (7.8%). In Indonesia, it is developing the Masela Abadi LNG project (stake of 65%).

**JERA Global Market** was set up in April 2019 for LNG trading and optimisation (JERA 66.67% and EDFT-EDF Trading 33.33%). Through this transaction, JERA has access to 15 European LNG terminals and 6 European gas hubs.

Tokyo Gas and Kansai Electric signed a strategic cooperation agreement in 2016 to jointly source LNG on global markets. The two companies will cooperate on LNG imports, especially from the Pluto LNG project in Australia, as both have 15-year LNG import deals with that project (1.5 Mt/year for Tokyo Gas and 1.75 Mt/year for Kansai Electric), as well as from the Cove Point LNG project (20-year supply agreement for 1.4 Mt/year for Tokyo Gas and 0.8 Mt/year for Kansai Electric).
Energy supply

Crude oil imports are decreasing since 2000. LNG imports, which are declining rapidly since 2014, represent around one-third of the world’s trade. Japan is the third largest importer of coal. The country ranks second in the world for solar PV capacity (62 GW in 2019). Solar PV now has the same share as nuclear in the power mix (7%).

Resources

Japan has limited hydrocarbon resources (around 7 Mt of oil and 27 bcm of gas end of 2019). ANRE estimates that the economically exploitable potential of renewable energies amounts to 38-64 Mtoe/year (including 10-21 Mtoe of solar and 7-10 Mtoe of waste); the technical potential is estimated at 127 Mtoe/year. According to the Japan Wind Power Association (JWPA), Japan has good wind power potential, with average wind speeds of 6.5 m/s (onshore) and 7 m/s (up to 30 km offshore and less than 200m sea depth). Geothermal potential is estimated at 1.6-2.6 GW.

Electricity

The electricity capacity is 336 GW, including 194 GW thermal, 59 GW of solar and wind (over 93% of solar), 50 GW of hydroelectricity, and 32 GW of nuclear energy (of which only 9 GW in operation) (end of 2019).

Following the Fukushima accident, all undamaged nuclear reactors were placed offline for safety controls. Before the accident, there were 54 reactors spread over 17 plants. As of April 2020, 7 of the 42 operable reactors have been restarted: Sendai-2 by Kyushu Electric (846 MW) in 2015; Takahama-3&4 in 2017 by Kansai Electric (830 MW each); Ohi-3&4 by Kansai Electric (1 127 MW each), and Genkai-3&4 by Kyushu Electric (1 127 MW each) in 2018. Two reactors that had been restarted, Ikata-3 by Shikoku Electric Power (846 MW, restarted in 2016) and Sendai-1 by Kyushu Electric (846 MW, restarted in 2015), were shut down in December 2019 and March 2020, respectively, due to non-compliance with the new regulations on back-up safety measures. The NRA approved
Around 6 GW of gas capacity have been added to the network since 2011. The latest units commissioned are: the first Nishi Nagoya CCGT unit in 2017, the second 1 150 MW CCGT at Nishi Nagoya 7 in 2018 by Chubu Electric, Ishikariwan Shinko-1 (569 MW) in February 2019 by Hokkaido Electric, and Kobe Steel-1 (624 MW) in mid-2019 by Kocalco.

At the end of 2019, Japan had a PV capacity of nearly 62 GW (second in the world, behind China). PV capacity additions have averaged 8.3 GW/year since 2015.

Wind power is less developed (only 3.7 GW in 2019).

GRAPH 2: INSTALLED ELECTRIC CAPACITY BY SOURCE (2019, %)

Power production has been decreasing since 2011 (-1.6%/year on average and -3.4% in 2019) to 1 013 TWh (from a peak of 1171 TWh in 2010).

The share of nuclear dropped from 25% in 2010 to 9% in 2011 and 1% in 2015; it recovered to 9% in 2019. The decrease in nuclear has benefited coal and gas, with shares reaching 32% and 34%, respectively, in 2019 (compared to 21% and 24%, respectively, in 2000). The share of solar PV has increased from 1% in 2013 to 7% in 2019.
4th largest oil importer, with 90% of the imports coming from Middle East

Oil

After the United States, China and India, Japan is the world’s fourth largest oil importer. Crude oil imports have been decreasing by 2%/year since 2000. Slower economic growth coupled with structural trends in the transport sector (shift to electric cars and reduced car use among young generations) and the gradual phaseout of oil-fired power plants are reducing the oil demand.

Supplies are diversified, but mainly come from the Middle East (around 90% in 2018-2019). Japan’s main suppliers are Saudi Arabia (around 40%) and the United Arab Emirates (25%).

The country has a refining capacity of 3.5 mb/d (end of 2019), spread over 22 refineries, 7 of which are over 200 000 bbl/d, representing nearly half
of the country’s capacity. In 2014, JX Nippon Oil & Energy closed its Muroran Refinery (180 000 bbl/d) to transform it into a petrochemical plant and Idemitsu Kosan closed its Tokuyama refinery (120 000 bbl/d).

Gas

Japan is the world’s largest LNG importer. Imports increased rapidly between 2010 and 2014 in order to compensate the drop in nuclear production and supply gas power plants. However, imports declined by 3.3%/year from 2014 to 2019, reaching 103 bcm in 2019. LNG imports represent almost one third of the world’s total LNG trade.

The main LNG suppliers are Australia, Malaysia and Qatar (37%, 12% and 12%, respectively, in 2018). Imports from Indonesia, initially Japan’s main supplier, only accounted for 6% in 2018 (33% in 2000).

Japan has secured a multitude of long-term LNG contracts totalling 123 bcm/year in 2019 (including Australia: 47 bcm/year, Malaysia and the United States: 14 bcm/year, and Qatar: 13 bcm/year). In 2019 and early 2020, Japan started 17 new contracts for a total plateau volume of 13 bcm/year, of which 74% from the US.

Japan has 41 operating LNG regasification terminals, with a total capacity of 280 bcm/year. The main recently commissioned terminals are Soma LNG (1.8 bcm/year) and Toyama-Shinko (0.5 bcm/year) in March 2018.

Coal

All the coal used in Japan is imported. Coal imports reached their highest level in 2013 with 196 Mt, due to the switch of Japan’s utilities to cheap coal for fuelling their power plants since the Fukushima accident, and have slightly decreased since (182 Mt in 2019).

In May 2018, METI announced its interest in eradicating destination restrictions on shipment contracts for thermal coal buyers.
The price of electricity in industry is still high in comparison to other OECD countries.

**Oil**

The average price was US$1.33/l for gasoline and US$1.16/l for diesel in 2019. Prices have followed international oil prices, declining between 2012 and 2016 and increasing slightly up to 2018. Japanese customers pay one of the highest gasoline prices in the Asia Pacific region, after Hong Kong and South Korea. Diesel prices are about 30% higher than in China.

**GRAPH 5: GASOLINE & DIESEL PRICES (US$/l)**

![Graph showing gasoline, diesel, and Brent prices from 2013 to 2019.]

**Electricity**

Despite reductions imposed by the METI, the price of electricity in industry is still high in comparison to other OECD countries (18% higher than in the EU in 2019), but closer for households (only 3% higher than in the EU). Prices were US$16.8c/kWh for industry and US$25.2c/kWh for households in 2019. Between 2007 and 2012 nominal prices soared by 68% for industry and 57% for households, but have since decreased by 13% in both sectors.
Electricity prices were 18% higher than the EU average for the industrial sector and largely similar for households in 2019.

Gas

Gas prices have been increasing since 2017 for households (9%/year), reaching US$11.74c/kWh in 2018, and since 2016 in industry (14%/year), amounting to US$4.60c/kWh in 2018. Over 2007-2012, the average gas price increased sharply, especially in the industrial sector (+80% between 2007 and 2011). Due to the fall of gas prices on the international markets, however, prices for households and especially for industry fell in 2016 (-4% and -20% respectively).
Energy consumption is decreasing and in 2019 was 16% lower than in 2010.

The share of oil in the energy mix has been decreasing since 1990.

The energy intensity to the GDP has been decreasing at a very rapid pace of 4%/year since 2010.

Energy consumption per capita decreased from 4.1 toe in 2000 to 3.3 toe in 2019 (close to the EU level). Electricity consumption per capita was around 7600 kWh in 2018 (almost 35% above the EU level).

Total energy consumption has been decreasing since 2010 (by 2%/year on average) to 421 Mtoe in 2019.

**GRAPH 8: CONSUMPTION TRENDS BY ENERGY SOURCE (Mtoe)**

The share of nuclear has declined post-Fukushima, benefitting coal and gas.
whereas the share of coal increased from 19% in 2000 to 23% in 2010 and 27% in 2019.

GRAPH 9: TOTAL CONSUMPTION MARKET SHARE BY ENERGY (2019, %)

420.9 Mtoe

*Including heat; Nuclear (1 TWh = 0.26 Mtoe), Hydroelectricity and wind (1 TWh = 0.086 Mtoe), Geothermal (1 TWh = 0.86 Mtoe)

The GDP energy intensity has been decreasing since 2010, at a rapid average pace of 4%/year.

The final energy mix has remained relatively stable over the last five years. The share of oil products in final consumption accounts for 48% (2019), followed by electricity (26%), coal (14%) and gas (9%).

GRAPH 10: FINAL CONSUMPTION MARKET SHARE BY SECTOR (2019, %)

299.4 Mtoe

Buildings (households and services) absorbed 31% of final consumption in 2019, followed by industry with 32%, transport (23%), and non-energy uses (14%).
Oil

Oil product consumption has been generally decreasing steadily since 1996, except between 2010 and 2012 when it increased, with the oil demand from power plants increasing by 80% to compensate for the closure of nuclear plants. It declined by 3.1%/year between 2012 and 2019 to reach 150 Mt in 2019, as utilities progressively switched to coal.

GRAPH 11: OIL CONSUMPTION (Mt)

Compared to other OECD countries, the oil consumption is more balanced among the different sectors: 43% is consumed in the transport sector, 32% in industry, 17% in buildings and 4% in power plants.

GRAPH 12: OIL CONSUMPTION BREAKDOWN BY SECTOR (2019, %)

* Including non energy uses
**Electricity**

Electricity consumption decreased generally between 2010 and 2018 (-1.1%/year), but dropped sharply in 2019 (-4.3%). Of that reduction, 20% is due to a cooler climate and a similar decline was seen in other sectors.

**GRAPH 13: ELECTRICITY CONSUMPTION (TWh)**

Industry accounts for 35% of electricity consumption, followed by services (33%) and households (28%).

**GRAPH 14: ELECTRICITY CONSUMPTION BREAKDOWN BY SECTOR (2019, %)**
Natural gas

Two thirds of natural gas are used for power generation. Gas consumption declined from 2016 to 2019 (-3.9%/year on average), after remaining almost stable from 2011 to 2016. Because of the closure of nuclear reactors, the consumption of natural gas increased very rapidly from 2005 to 2012 (+5.9%/year).

GRAPH 15: NATURAL GAS CONSUMPTION (bcm)

GRAPH 16: GAS CONSUMPTION BREAKDOWN BY SECTOR (2019, %)

* Including non energy uses
Coal

Coal consumption has been roughly stable since 2013 (187 Mt in 2019). It increased rapidly between 2000 and 2007 (3%/year) with most of the utilities switching to this cheap fuel.

Electricity production uses 61% of the coal consumed, and the remainder is consumed by industry, mainly by the iron and steel industry.

**GRAPH 17: COAL CONSUMPTION (Mt)**

**GRAPH 18: COAL CONSUMPTION BREAKDOWN BY SECTOR (2019, %)**

* Including non energy uses
The country is facing pressure to reach its 2030 CO₂ emissions and power mix targets, leading to tighter regulations for coal projects and the development of projects using CCS.

The gas import capacity is expected to increase since the Government is encouraging fuel switching to gas.

Using its Global Energy Forecasting Model POLES (baseline called Enerblue), Enerdata foresees the share of oil to account for 30% of the primary energy consumption by 2040, while the share of natural gas would be around 25% and the share of coal around 13%. The remainder (32%) would be covered by nuclear, renewables and biomass. METI plans to prioritize nuclear and renewables as major energy sources in Japan’s energy sector future.

Electricity

According to a revised version of the Basic Energy Plan (2018), Japan plans to reach a 20-22% share of nuclear power in the power mix in 2030, while renewables would account for 22-24%, coal for 26%, and gas for 27%. The plan will be revised every three years.

High safety-related costs and rising opposition to restarting existing nuclear plants have affected nuclear projects announced before 2011 and new nuclear commissioning remain hypothetical.

Five reactors are expected to restart: Tokai-2 (1060 MW) by Japco in 2022, and Onagawa-2 (796 MW) by Tohoku Electric Power (approved by NRA in February 2020), Mihama-3, and Takahama-1&2 (780 MW each) by Kansai Electric in July 2020, July 2021 and March 2021, respectively (postponed since safety works will take more time than expected). In 2017, two units at TEPCO’s Kashiwazaki-Kariwa passed safety inspections, but TEPCO has struggled to obtain approval from the local government to resume operations; these units are currently mothballed.

Two projects were under construction before Fukushima (J-Power’s Ohma and Chugoku Electric’s Shimane) and commissioning of Ohma (1 325 MW)
has now been shifted to 2024. Chugoku is seeking approval for safety inspections for Shimane 3 (1 325 MW), as the reactor’s construction work nears completion, but the start year is still unclear.

Seven nuclear reactors were planned on 4 sites before Fukushima: Kaminoseki 1&2 by Chugoku Electric (2x 1 320 MW), Higashi-Dori 1&2 by TEPCO (2x 1 320 MW), Tsuruga 3&4 by Japco (2x 1 500 MW), and Hamaoka 6 by Chubu (1 380 MW). The last three projects are currently frozen.

Several power utilities have decided to decommission their nuclear reactors due to the investments required to upgrade them to new safety standards: Kansai Electric (Ohi-1 and 2), Japan Atomic Power (Tsuruga-1), Kyushu Electric (Genkai-1 and 2), Chugoku Electric (Shimane-1), Kansai Electric (Mihama-1 and Mihama-2), Shikoku Electric (Ikata-1 and 2), TEPCO (Fukushima Daini-1, 2, 3 and 4), Tohoku Electric (Onagawa-1), JERA (Owase Mita-1, 2, 3, and Yokkaichi-3), and Shikoku Electric (Ikata-2). In addition, Kyushu Electric will stop Sendai 2 in May 2020. For security upgrades, Kansai Electric will temporarily suspend Takahama-3 and 4 units from mid-2020.

In September 2019, TEPCO submitted its plan for the decommissioning of the 4268 MW Fukushima Daini nuclear power plant, which was stopped in 2018. Moreover, TEPCO is also considering the decommissioning of the Kashiwazaki nuclear power plant (7 units and around 8 GW) and the facilities at the Fukushima Daiichi site (around 5 GW), mothballed since 2011.

In 2016, the METI again revised its costs projections related to Fukushima to Yen 21 500bn (US$188bn), which is twice as high as the initial estimates: decommissioning costs have soared from Yen 2 000bn to Yen 8 000bn (US$70bn), compensation payments to Yen 7 900bn (US$69bn) and the treatment and storage of contaminated soil to Yen 5 600bn (US$49bn). In terms of safety and security measures, costs have increased by US$4.5bn in 2018 compared to the previous year, reaching around US$40bn. Safety measures per reactor after implementation of post-Fukushima standards reach US$1.6bn.

Due to fierce criticism from environmental groups, the Government is considering tightening regulations on the approval of coal-fired power projects, so that only the most efficient technologies (including ultrasupercritical plants) would be approved.
Currently 6.5 GW of coal projects are under construction and nearly 3.5 GW of additional capacities are planned.

**JERA** is constructing the 650 MW Hitachinaka Kyodo unit, expected to be commissioned in 2020-2021, and the Taketoyo 1070 MW unit, expected for 2022.

Marubeni announced in 2018 its plans to halve its coal-fired capacity from 3 to 1.5 GW by 2030 and increase its renewable share from 10% to 20% in 2030.

**TEPCO** is building two 540 MW IGCC in partnership with Joban Joint Power and Mitsubishi through the two joint-ventures Nakoso IGCC Power GK and Hirono IGCC Power GK. The first power plant is being built in the Hirono area by 2021, the second one is being built within the premises of the Nakoso power plant by 2020.

**J-POWER** is constructing the 600 MW Takehara New 1 Ultra-supercritical plant which is expected to start in 2020, and which will burn up to 10% of wood.

**Chugoku Electric** aims to build a 1000 MW USC power plant, Misumi 2, which is expected to be commissioned in 2022.

**Kashima Power** is constructing the 645 MW Sumitomo Metals Kashima unit, which is expected to start in 2020.

Due to rising opposition, Kansai Electric and Marubeni delayed the construction of the 1300 MW Akita project, initially planned between 2023 and 2025, without specifying a new date.

Chiba Sodegaura Energy decided in February 2019 to scrap a 2 GW coal-fired project.

Several CCGT are under construction totalling 4.2 GW, of which 1.1 GW are to be commissioned by the end of 2020: Hokuriku Electric’s 425 MW Toyama Shinko CCGT and Kobe Steel-2 CCGT project (624 MW) expected in 2020, Ishikariwan Shinko 2-3 (1138 MW) by Hokkaido Electric (commissioning in stages over 2021-2028), and the Anegasaki conversion by Jera (1950 MW) in 2023.

In addition, planned projects represent 11 GW, including the 2 GW Chiba Sodegaura and the 2.3 GW Goi CCGT of JERA (supposed to start in 2024-2025).
Three pumped-storage projects are in the pipeline: the 1,880 MW Kannagawa-3 project being constructed by TEPCO and expected after 2032, the 200 MW Kyogoku-3 project by Hokkaido Electric (planned for 2023), and the 400 MW Kazunogawa-3 project by TEPCO (planned for 2024).

According to a study by the Ministry of Environment in 2015, solar power generation could increase to 78-128 TWh by 2030, out of a total renewable power generation of 241-257 TWh, depending on energy policies.

Over 1.5 GW of solar projects are under construction and plans are underway for additional projects of 956 MW. The main project under construction is the 258 MW Sakuto project, which will be commissioned in 2020 by Pacifico Energy.

Over 381 MW of wind projects are under construction and plans are underway for additional projects of nearly 3.6 GW.

In its wind power roadmap to 2050, JWPA expects onshore and offshore wind power capacities to reach 10 GW and 1 GW respectively by 2020, 27 GW and 9 GW by 2030, and 38 GW and 27 GW by 2050.

NEDO approved financial support through subsidies to two offshore wind projects in 2016: a project of 170 MW developed by Marubeni and Obayashi in the port of Noshiro by 2020, and another of 104 MW developed by Green Power Investment in the Ishikari Bay by 2022.

Several wind plants are under consideration: Softbank is moving ahead with plans for 250 MW Ibaraki offshore; Murakami City is bidding for 220 MW Iwafune (initially expected to start in 2025); and the 229 MW Hibikinada offshore is being planned.

The city of Kitakyushu (Kyushu Island) has selected the Hibiki consortium led by Kyuden Mirai (100% Kyushu Electric) and including J-Power, Hokutaku, Saibu Gas and engineering firm Kyudenko, to develop a Yen 175bn (US$1.5bn) offshore wind project near the port of Kitakyushu, with a capacity of 229 MW. Construction works are scheduled to begin in FY 2022.

Tohoku Electric and Renova (from Portugal) plan to develop a 700 MW offshore wind project off the coast of Yurihonjo City in Akita prefecture (Japan), as announced in March 2019. This project has been authorized and is expected to be commissioned in 2024.
In addition, TEPCO has started seabed surveys for a possible offshore wind project in Choshi (1 GW) in November 2018, together with the Danish power company Ørsted. The two companies signed an MoU in January 2019 to work jointly on offshore wind project in Japan. Early 2020, they decided to create the joint venture Choshi Offshore Wind Farm to jointly bid for this project.

In order to promote the development of offshore renewable power generation facilities, the Japanese government passed a new offshore wind power bill in December 2018.

Gas

To increase the LNG supply, several LNG regasification terminals are under development. LNG imports are expected to increase significantly to offset the potential reduction of nuclear power generation.

Hokkaido Electric is building the Ishikari-3 and 4 projects, expected in 2020, with 460000 m³ of storage capacity.

Tokyo Gas plans to build a second LNG storage tank by 2021 in Hitachi, for a total capacity of 2 bcm/year.

Tokyo Gas plans to install two new vaporisers and a new LNG storage tank at the Sodegaura LNG terminal by 2024 (2.4 bcm/year) and a new regasification unit (Niihama), expected to start in 2024.

Kansai Electric plans to commission the Wakayama regasification terminal in 2026, with 840000 m³ of storage capacity.

US company Freeport LNG and Sumitomo Corporation signed agreements in September 2018 to deliver 2.2 Mt/year of LNG under a 20-year contract starting in 2023.

Gas pipelines

Tokyo Gas, Japex and Nippon Steel & Sumikin Engineering completed a preliminary feasibility study for a 1 500 km gas pipeline project, which would import natural gas from Russia’s Sakhalin Island to Hokkaido and then on to the Tokyo metropolitan area. The pipeline, which would be 50 cm to 76 cm in diameter, would be brought onshore near Kashima Port in Ibaraki Prefecture and connected to Tokyo Gas’s pipeline network. It would cost up to around US$6.5bn and could transport 25 bcm/year.
Oil

The government expects oil product demand to drop by 1.7%/year through 2023.

The unconventional oil revolution in the U.S. has prompted the Japanese Government to promote policies that will increase the competitiveness of the Japanese petrochemical industry. The energy efficiency and production flexibility of the Japanese refineries need to be improved to enable competition with the new refineries in Asia.

As announced in July 2019, Japan’s largest oil refiner JXTG plans to decommission the 115 000 bbl/d refinery in October 2020.

CO₂ capture and storage

JGC Corporation has also received a contract from Japan CCS to construct the core facilities at a CO₂ capture and storage (CCS) technology demonstration project. The site for the demonstration project is located adjacent to an oil refinery in Tomakomai, Hokkaido, owned by Idemitsu Kosan. The lump-sum turnkey contract calls for the engineering, procurement, construction and commissioning work associated with carbon dioxide capture facilities with a yearly capacity of 200 000 t/year of CO₂, as well as compression, transportation and injection facilities. The value of the contract was not disclosed. Capture started with the pilot project in 2016 and ended in November 2019 when the target of 300 kt of CO₂ injection was reached.

Toshiba Energy Systems and Solutions has started construction on Japan’s first large-scale carbon capture project at its 50 MW Mikawa biomass power plant. The project is scheduled for commercial operations in 2020 and aims to capture more than 500 tCO₂/d.

Uranium

In previous years, Japan Oil, Gas and Metals National Corp. (JOGMEC) and Navoi Mining and Metallurgical Combinat (Uzbekistan) conducted joint exploration for uranium in Uzbekistan, with the aim of supplying Japan with nuclear fuel in the case of the restart of nuclear plants. In January 2020, Uzbekistan signed contracts with Itochu and Marubeni; these contracts are worth more than US$1 billion in total for the supply of uranium to Japan from 2023 to 2030.
### Table 2: Supply Indicators

#### Reserves*

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* On December 31st

#### Capacity*

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* On December 31st

#### Production

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<td>1</td>
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#### External trade*

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<td>Crude oil</td>
<td>Mt</td>
<td>203</td>
<td>218</td>
<td>181</td>
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<td>Oil products</td>
<td>Mt</td>
<td>54.0</td>
<td>46.6</td>
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<td>21.4</td>
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<td>Gas</td>
<td>bcm</td>
<td>49.6</td>
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<td>97.0</td>
<td>115</td>
<td>116</td>
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<td>Coal</td>
<td>Mt</td>
<td>105</td>
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<td>187</td>
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* Imports(+) exports(-) balance

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## Table 3: Demand Indicators

### Consumption per capita

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<tr>
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<tr>
<td>Total - toe</td>
<td>3.6</td>
<td>4.1</td>
<td>3.9</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>3.4</td>
<td>3.3</td>
</tr>
<tr>
<td>Electricity - kWh</td>
<td>6 272</td>
<td>7 777</td>
<td>8 209</td>
<td>7 587</td>
<td>7 599</td>
<td>7 725</td>
<td>7 581</td>
<td>7 261</td>
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### Consumption trends

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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total - %/year</td>
<td>6.7</td>
<td>2.0</td>
<td>5.5</td>
<td>-1.8</td>
<td>-1.1</td>
<td>1.1</td>
<td>-1.4</td>
<td>-1.6</td>
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<tr>
<td>Total with climatic corrections - %/year</td>
<td>n.a.</td>
<td>1.7</td>
<td>4.6</td>
<td>-1.6</td>
<td>-1.0</td>
<td>1.1</td>
<td>-2.3</td>
<td>-1.0</td>
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<tr>
<td>Gas - %/year</td>
<td>8.6</td>
<td>3.5</td>
<td>6.5</td>
<td>-6.0</td>
<td>1.5</td>
<td>-0.79</td>
<td>-4.4</td>
<td>-4.8</td>
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<td>Gas with climatic corrections - %/year</td>
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<td>1.9</td>
<td>-0.84</td>
<td>-4.9</td>
<td>-4.4</td>
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<td>Electricity - %/year</td>
<td>8.5</td>
<td>4.3</td>
<td>4.7</td>
<td>-2.4</td>
<td>0.04</td>
<td>1.5</td>
<td>-2.0</td>
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### Total consumption

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</tr>
</thead>
<tbody>
<tr>
<td>Total - Mtoe</td>
<td>440</td>
<td>520</td>
<td>503</td>
<td>434</td>
<td>429</td>
<td>434</td>
<td>428</td>
<td>421</td>
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</table>

### Final consumption

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<th></th>
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</thead>
<tbody>
<tr>
<td>Total - Mtoe</td>
<td>307</td>
<td>354</td>
<td>333</td>
<td>313</td>
<td>310</td>
<td>313</td>
<td>306</td>
<td>299</td>
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### By energy

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</thead>
<tbody>
<tr>
<td>Oil - %</td>
<td>58</td>
<td>57</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>41</td>
<td>41</td>
<td>39</td>
</tr>
<tr>
<td>Gas - %</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>9</td>
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<tr>
<td>Coal, lignite</td>
<td>15</td>
<td>12</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>14</td>
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<tr>
<td>Electricity</td>
<td>21</td>
<td>24</td>
<td>27</td>
<td>26</td>
<td>26</td>
<td>27</td>
<td>27</td>
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<td>Heat - %</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Biomass - %</td>
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<td>2</td>
<td>3</td>
<td>3</td>
<td>4</td>
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### By sector

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<tbody>
<tr>
<td>Industry - %</td>
<td>39</td>
<td>33</td>
<td>31</td>
<td>31</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Transport - %</td>
<td>22</td>
<td>24</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Households &amp; services - %</td>
<td>25</td>
<td>30</td>
<td>32</td>
<td>31</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>31</td>
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<tr>
<td>Non energy uses - %</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>14</td>
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<td>14</td>
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### Electricity consumption

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</thead>
<tbody>
<tr>
<td>Total - TWh</td>
<td>775</td>
<td>986</td>
<td>1 051</td>
<td>965</td>
<td>965</td>
<td>979</td>
<td>960</td>
<td>918</td>
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### Electricity consumption breakdown

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<tbody>
<tr>
<td>Industry - %</td>
<td>55</td>
<td>42</td>
<td>36</td>
<td>36</td>
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<td>Households - %</td>
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<td>Services - %</td>
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<td>33</td>
<td>33</td>
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</tbody>
</table>

---

* Nuclear (1TWh = 0.26 Mtoe), Hydroelectricity and wind (1 TWh = 0.086 Mtoe), Geothermal (1 TWh = 0.86 Mtoe)
### Table 4: Energy Balances

#### Total energy balance (Mtoe)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Imports</th>
<th>Exports</th>
<th>Aviation and marine bunkers</th>
<th>Stock Changes</th>
<th>Primary Supply</th>
<th>Final Consumption</th>
<th>Of which</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>76.2</td>
<td>383</td>
<td>5.08</td>
<td>10.0</td>
<td>-3.57</td>
<td>440</td>
<td>307</td>
<td>Industry</td>
</tr>
<tr>
<td>1990</td>
<td>107</td>
<td>435</td>
<td>6.33</td>
<td>11.9</td>
<td>-3.95</td>
<td>520</td>
<td>354</td>
<td>Transport</td>
</tr>
<tr>
<td>2000</td>
<td>103</td>
<td>428</td>
<td>17.9</td>
<td>10.1</td>
<td>0.14</td>
<td>503</td>
<td>333</td>
<td>Residential &amp; Services</td>
</tr>
<tr>
<td>2010</td>
<td>33.8</td>
<td>428</td>
<td>19.0</td>
<td>10.7</td>
<td>1.39</td>
<td>434</td>
<td>313</td>
<td>Non-Energy Uses</td>
</tr>
<tr>
<td>2015</td>
<td>36.7</td>
<td>421</td>
<td>19.2</td>
<td>11.2</td>
<td>1.76</td>
<td>429</td>
<td>310</td>
<td></td>
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<tr>
<td>2016</td>
<td>43.0</td>
<td>419</td>
<td>18.5</td>
<td>11.3</td>
<td>1.25</td>
<td>434</td>
<td>313</td>
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<tr>
<td>2017</td>
<td>52.0</td>
<td>406</td>
<td>18.9</td>
<td>11.8</td>
<td>0.19</td>
<td>428</td>
<td>306</td>
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<tr>
<td>2018</td>
<td>58.1</td>
<td>388</td>
<td>20.2</td>
<td>11.2</td>
<td>5.98</td>
<td>421</td>
<td>299</td>
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<tr>
<td>2019</td>
<td></td>
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<td></td>
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</table>

#### Detailed energy balance (Mtoe)

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<th>Year</th>
<th>Coal</th>
<th>Crude Oil</th>
<th>Oil Products</th>
<th>Natural Gas</th>
<th>Primary Elec.*</th>
<th>Elec.</th>
<th>Biomass</th>
<th>Total**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>0.58</td>
<td>0.42</td>
<td>2.32</td>
<td>39.9</td>
<td>14.5</td>
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<td>2000</td>
<td>0.90</td>
<td>1.71</td>
<td>38.9</td>
<td>87.9</td>
<td>1.33</td>
<td>388</td>
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<td></td>
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<tr>
<td>2010</td>
<td>11.2</td>
<td>111.2</td>
<td>9.37</td>
<td>19.2</td>
<td>6.26</td>
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<td></td>
<td></td>
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<tr>
<td>2015</td>
<td>113</td>
<td>111.2</td>
<td>9.37</td>
<td>19.2</td>
<td>6.26</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>113</td>
<td>111.2</td>
<td>9.37</td>
<td>19.2</td>
<td>6.26</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2017</td>
<td>113</td>
<td>111.2</td>
<td>9.37</td>
<td>19.2</td>
<td>6.26</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2018</td>
<td>113</td>
<td>111.2</td>
<td>9.37</td>
<td>19.2</td>
<td>6.26</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2019</td>
<td>113</td>
<td>111.2</td>
<td>9.37</td>
<td>19.2</td>
<td>6.26</td>
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* Nuclear (1 TWh = 0.26 Mtoe), Hydroelectricity and wind (1 TWh = 0.086 Mtoe), Geothermal (1 TWh = 0.86 Mtoe)

** Including heat

---

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Table 5: Power capacity development status*

<table>
<thead>
<tr>
<th>Energy</th>
<th>Under development (MW)</th>
<th>Share</th>
<th>Under construction (MW)</th>
<th>Share</th>
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</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>5 280</td>
<td>18.7%</td>
<td>2 650</td>
<td>15.1%</td>
</tr>
<tr>
<td>Thermal</td>
<td>15 394</td>
<td>54.6%</td>
<td>11 127</td>
<td>63.4%</td>
</tr>
<tr>
<td>Coal/Lignite</td>
<td>3 612</td>
<td>12.8%</td>
<td>6 557</td>
<td>37.3%</td>
</tr>
<tr>
<td>Gas</td>
<td>11 072</td>
<td>39.2%</td>
<td>4 154</td>
<td>23.7%</td>
</tr>
<tr>
<td>Oil</td>
<td>0</td>
<td>0.0%</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Biomass</td>
<td>710</td>
<td>2.5%</td>
<td>415</td>
<td>2.4%</td>
</tr>
<tr>
<td>Renewables (Excl. Biomass)</td>
<td>7 504</td>
<td>26.6%</td>
<td>3 787</td>
<td>21.6%</td>
</tr>
<tr>
<td>Hydro</td>
<td>617</td>
<td>2.1%</td>
<td>1 880</td>
<td>10.7%</td>
</tr>
<tr>
<td>Wind</td>
<td>3 656</td>
<td>12.9%</td>
<td>381</td>
<td>2.2%</td>
</tr>
<tr>
<td>Solar</td>
<td>2 991</td>
<td>10.6%</td>
<td>1 511</td>
<td>8.6%</td>
</tr>
<tr>
<td>Geothermal, Marine, etc</td>
<td>0</td>
<td>0.0%</td>
<td>15</td>
<td>0.1%</td>
</tr>
<tr>
<td>Total</td>
<td>28 178</td>
<td>100.0%</td>
<td>17 564</td>
<td>100.0%</td>
</tr>
<tr>
<td>of which carbon free tech</td>
<td>13 494</td>
<td>47.9%</td>
<td>6 852</td>
<td>39.0%</td>
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</table>

* The figures are aggregated capacities of large power projects under development and under construction at the date of update of the report. These figures do not include small distributed power generation projects.

Table 6: Gas infrastructures and contracts

### MAIN LNG PLANT PROJECTS

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<tr>
<th>Location</th>
<th>Name</th>
<th>Unit type</th>
<th>Operator</th>
<th>Status</th>
<th>Start year</th>
<th>Operational capacity (bcm/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ishikari</td>
<td>Ishikari 4</td>
<td>Regasification</td>
<td>Hokkaido Electric</td>
<td>Under construction</td>
<td>2020</td>
<td></td>
</tr>
<tr>
<td>Ishikari</td>
<td>Ishikari 3</td>
<td>Regasification</td>
<td>Hokkaido Electric</td>
<td>Under construction</td>
<td>2020</td>
<td></td>
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<tr>
<td>Hitachi</td>
<td>Hitachi expansion</td>
<td>Regasification</td>
<td>Tokyo Gas</td>
<td>Approved</td>
<td>2024</td>
<td></td>
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<tr>
<td>Sodegaura</td>
<td>Sodegaura (expansion)</td>
<td>Regasification</td>
<td>Tokyo Gas</td>
<td>Planned</td>
<td>2024</td>
<td></td>
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<tr>
<td>Niihama</td>
<td>Niihama LNG</td>
<td>Regasification</td>
<td>Kansai Electric</td>
<td>Planned</td>
<td>2026</td>
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*n.a.*: not available

### MAIN LNG CONTRACTS

<table>
<thead>
<tr>
<th>Importing company</th>
<th>Exporting country</th>
<th>Start year</th>
<th>End</th>
<th>Plateau volume (bcm/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chubu Electric</td>
<td>United States</td>
<td>2019</td>
<td>2039</td>
<td>3.0</td>
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<td>Osaka Gas</td>
<td>United States</td>
<td>2019</td>
<td>2039</td>
<td>3.0</td>
</tr>
<tr>
<td>JERA</td>
<td>Mozambique</td>
<td>2023</td>
<td>2040</td>
<td>1.1</td>
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<tr>
<td>Sumitomo</td>
<td>United States</td>
<td>2023</td>
<td>2043</td>
<td>3.0</td>
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<td>Tokyo Gas</td>
<td>Mozambique</td>
<td>2023</td>
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<td>1.8</td>
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*n.a.*: not available
## Abbreviation

### Oil
- **bbl**: barrels
- **bbl/d**: barrels per day
- **mb**: million barrels
- **mb/d**: million barrels per day
- **kb**: thousand barrels
- **kb/d**: thousands barrels per day
- **Gbl**: billion barrels
- **kboe**: thousand barrels of oil equivalent
- **Mboe**: million barrels of oil equivalent
- **Gboe**: billion barrels of oil equivalent
- **l**: liters
- **LPG**: Liquefied Petroleum Gas
- **NGL**: Natural Gas Liquids
- **E&P**: Exploration & Production

### Coal
- **kt**: thousands tonnes of oil equivalent
- **Mt**: million tonnes
- **IGCC**: integrated gasification combined cycle

### Economy
- **GDP**: Gross Domestic Product

### Natural gas
- **mcm**: million cubic meters
- **bcm**: billion cubic meters
- **mcm/year**: million cubic meters per year
- **bcm/year**: billion cubic meters per year
- **LNG**: Liquefied Natural Gas
- **GCV**: Gross Calorific Value

### Electricity
- **kW**: Kilowatt
- **kWp**: Kilowatt-peak
- **MW**: Megawatt
- **GW**: Gigawatt
- **kWh**: Kilowatt hour
- **MWh**: Megawatt hour
- **TWh**: Terawatt hour
- **GWh**: Gigawatt hour
- **CCGT**: combined cycle gas turbine
- **IPP**: Independent Power Producer
- **CHP**: Combined Heat and Power
- **PPA**: Power Purchase Agreement
- **T&D**: Transmission & Distribution
- **kV**: kilo volt
- **HVDC**: High Voltage Direct Current
- **UHV**: Ultra High Voltage
- **UHVDC**: Ultra High Voltage Direct Current
- **FIT**: Feed-In Tariff
CO₂  
MtCO₂  million tonnes of carbon dioxide  
gCO₂  grammes of carbon dioxide  
tCO₂/cap  tonnes of carbon dioxide per capita  
CO₂eq  CO₂ equivalent  
kg  kilogrammes  
CCS  carbon capture and storage  
ETS  Emission Trading Scheme  
GHG  Greenhouse Gases  
INDC  Intended Nationally Determined Contribution  
NDC  Nationally Determined Contribution  
EUA  European Union emission Allowances  

Energy Efficiency  
NEEAP  National Energy Efficiency Action Plan  
EED  Energy Efficiency Directive  

Uranium  
$/lb  dollar per pound  
Mlb  million pounds  

Infrastructures  
km  kilometers  
HOA  Head of Agreements  
MoU  Memorandum of Understanding  
LOI  Letter of Intent  
FEED  Front-End Engineering Design  

Projections  
BAU  Business as Usual  
FID  Final Investment Decision  
EPC  Engineering, Procurement, Construction  
EPCC  Engineering, Procurement, Construction and Commissioning  
BOO  Build-Own-Operate  
BOOT  Build-Own-Operate-Transfer  
BOT  Build-Own-Transfer  
O&M  Operation and Maintenance  
TSO  Transmission System Operator  
TYNDP  Ten-Year Network Development Plan  

Production

Energy production always corresponds to gross domestic production. It consists of primary and secondary gross production, except for natural gas for which production corresponds to marketed production.

Gross power generation

Gross production of electricity includes the public production (production of private and public electricity utilities) and the autoproducers, by any type of power plants (including cogeneration).

Trade

Balance of trade

The trade balance is the difference between exports and imports. The balance of a net exporter appears as a negative value (-).

Imports

Imports are the quantities of energy products imported from abroad into the national territory, deductions being made for quantities simply in transit destined for other countries and those quantities which are processed within the national boundaries on behalf of another country.

Exports

Exports are the quantities of energy product exported from the national territory to foreign countries, deductions being made for products simply in transit and quantities processed on behalf of other countries. For reasons of accounting conformity, exports appear with a negative sign (-) in the energy balance.

Consumption

Total energy consumption

Total energy consumption, for each energy product, is the sum of total production, balance of trade, aviation and marine bunkers, and stock variations.

Final consumption

Final consumption is the difference between total consumption and the consumption of the energy sector for its own uses or as inputs in transformations (e.g. power generation, refining, oil, coal, gas extraction, LNG plants...), in transport and distribution (T&D losses...), as well as statistical discrepancies. Final consumption measures the needs of the final consumers of the country. They are broken down into several sectors: industry, transport, residential, tertiary, agriculture and non-energy uses.

Final consumption of industry

Final consumption of industry includes the final consumption of the mining sector, manufacturing sector, and construction and water distribution and processing. It excludes the fuel used as input for autoproduction and includes the autoproduced electricity. It excludes the fuel consumption of all modes of transport used by industry, and also excludes energy products employed for non energy uses (e.g. raw materials in petrochemicals, lubricants).

Final consumption of transport

Final consumption of transport is the total consumption of all modes of transportation regardless of to whom they belong, and to what purpose the transport serves. Aviation and marine bunkers (international aviation and sea transport) are excluded.

Final consumption of residential, tertiary and agriculture

This consumption is broken down into three sub-sectors: residential, tertiary, agriculture (including fishing activities). It is often defined as the total final energy consumption energy uses, excluding industry and transport sectors.

Final consumption for non energy uses

This covers products used in the petrochemical industry (e.g. naphta), for the production of ammonia (natural gas), for electrodes (carbon), and all other products used for their physical-chemical properties (bitumen, paraffin, motor oils, etc...). It is divided into chemical and others.

CO₂

CO₂ emissions cover the emissions from fossil fuels combustion (coal, oil and gas). They are calculated according to the UNFCCC methodology. Here the sectoral approach is presented, ie the sum of CO₂ emissions of each sector.
Prices

Gasoline and diesel prices
Price all taxes in Dollar or Euro. For gasoline corresponds to the premium gasoline unleaded 95; for the former years series extrapolated from the variation of premium gasoline 98 and / or normal unleaded gasoline and / or premium leaded gasoline. For diesel, corresponds to price including all taxes of the motor fuel for the motorists.

Households and Industry prices (Gas and Electricity)
Price all taxes in Dollar or Euro. They used to be calculated as the average revenues per kWh of electricity received by all (or main) public or private utilities of the sector. They can also refer to the price applied to a particular class of consumer; in particular for European countries for prices after 2007 (Eurostat data).

Economy

GDP
GDP measures the economic activity of a country. To allow comparison between countries and avoid the impact of inflation it provided in constant price at purchasing power parities (converted on the basis of the exchange rate of 2005 and the rate of purchasing power parity of World Bank).
Enerdata Research

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