

Introduction

The Japanese economy grew in the third quarter of 2017 for the seventh straight quarter. Its expansion has continued for 58 months until September 2017, topping the 57-month Izanagi boom during the high economic growth period. The overseas economy, though plagued with prices and other challenges, has gotten on the first full-fledged recovery path since the global financial crisis.

In the international crude oil market, OPEC at its general meeting in November 2017 decided to extend an OPEC/non-OPEC coordinated production cut for nine months beyond the earlier-set expiration deadline of March 2018. Brent crude oil prices have risen to a \$60/bbl-\$65/bbl range, continuing an upward trend.

Japan restarted five nuclear power plants by December 2017. Preparations are being made for the restart of seven others that have cleared examinations on their conformity to regulatory standards. In addition, 13 plants are under examinations. In November 2017, the Japan Atomic Power Company filed an application for extending the service life of the Tokai No.2 Power Station.

As for the Feed-in Tariffs (FIT) scheme for renewable energy, biomass-fired power generation projects have expanded in response to purchased prices cut under the revised FIT Act implemented in April 2017. Certifications for non-residential solar photovoltaic power generation projects are expected to lose effect under the revised law.

Key assumptions behind the Reference Scenario

Global economy

We expect the global economy to continue recovery. Global economic growth is expected at 3.6% in FY2017 and 3.7% in FY2018. The U.S. economy, though affected by hurricanes in September, has remained very robust. In the future, private consumption expansion on employment and income improvements will drive the U.S. economy to continue autonomous growth. The European economy will remain steady, although private consumption deceleration amid slowing employment improvements will become a downside factor. The Asian economy will decelerate growth on slower expansion in China in FY2018, while retaining robust growth on recovering external demand and steady domestic demand.

Crude oil/LNG/coal import CIF prices

While OPEC and non-OPEC oil producing countries will continue their coordinated production cut, shale and other oil production in the United States will increase. However, the oil supply-demand balance will slightly tighten. Oil and LNG prices are thus assumed to increase through FY2018. Oil import CIF prices are assumed to average \$56/bbl in FY2017 and

\$65/bbl in FY2018. LNG import CIF prices are assumed to average \$8.8/MBtu in FY2017 and \$9.9/MBtu in FY2018. In contrast, coal prices will fall on slack coal demand in Europe and other regions through FY2018 after their present hike amid growing supply disruption fears arising from strikes at some Australian coalmines. Steam coal import CIF prices are assumed to average \$98/t in FY2017 and \$93/t in FY2018. Coking coal import CIF prices are assumed to average \$145/t in FY2017 and \$124/t in FY2018.

Exchange rate

We assume the average exchange rate to be JPY113/USD in FY2017 and JPY115/USD FY2018.

Nuclear power generation

Japan has restarted five nuclear power plants. Others will be restarted at a steady pace depending on progress in regulatory standards conformity examinations. We expect a total of six plants to be operational at the end of FY2017. In the year, they will operate for an average eight months and generate 32.3 TWh. A total of nine plants will be operational at the end of FY2018. In the year, they will operate for an

average 10 months and generate 67.5 TWh (accounting for 7% of total power generation).

Electricity supply and demand

Based on a report by the government's Basic Policy Subcommittee on Electricity and Gas, we assume that Japan will secure the generation reserve margin of 3% or more required for stable nationwide electricity supply.

Air temperature

According to the Japan Meteorological Agency's three-month weather forecast, we assume that winter in FY2017 will be colder (-0.4°C) than in the previous year before air temperatures return to normal levels. This means that summer in FY2018 will be cooler (-0.3°C) than in the previous year and that winter will be warmer ($+0.3^{\circ}\text{C}$).

The macroeconomic situation

The Japanese economy will grow by 1.8% in steady expansion in FY2017.

Private demand will accelerate expansion, contributing 1.3 percentage points to the total economic growth. Public demand will contribute 0.2 points thanks to an increase in public works. External demand will increase on robust economic growth, contributing 0.3 points. The trade surplus will shrink to JPY1.9 trillion as fossil fuel import value increases on energy price rises. The current account will post a surplus of JPY21 trillion. The consumer price index will rise by 0.7%.

In FY2018, the Japanese economy will decelerate growth to 1.1%. Robust demand for the Tokyo Olympics and employment environment improvements will support economic growth, while external demand growth will slow down.

In FY2018, employment environment improvements will drive consumption expansion. The unemployment rate will remain low after falling in FY2017 to the lowest level since the bubble economy period. Non-residential investment will increase on labour-saving investment amid labour shortages

and robust investment related to the 2020 Tokyo Olympics. Residential investment will decrease as an upward push of inheritance tax measures is lost. Private demand will contribute 0.9 points to the total economic growth. Public demand will rise on robust government spending despite a slowdown in construction investment related to public works, contributing 0.2 points. External demand will make a negative contribution of 0.0 points, affected by overseas economic growth deceleration.

Fossil fuel imports including crude oil and LNG will decline in volume due to progress in the restart of nuclear power plants, while increasing in value for the second straight year because of price rises. The trade balance surplus will fall close to zero, leading the current account surplus to decrease for the first time in five years while being as high as JPY20.2 trillion. The consumer price index will rise 0.8% whether it covers energy prices or not, posting an increase for the third straight year.

Nominal GDP in FY2018 will total JPY559 trillion, still far below the Abe administration's target of JPY600 trillion around 2020.

Table 2 | Macroeconomic indicators

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Real GDP (JPY trillion in 2011 prices)	492.9	510.9	518.3	524.4	533.9	539.6	1.2%	1.8%	1.1%
Private demand	369.0	388.2	392.6	395.3	402.7	407.6	(0.3%)	(1.3%)	(0.9%)
Private consumption	286.5	294.0	296.3	297.1	300.5	302.9	0.3%	1.1%	0.8%
Private residential investment	13.9	14.7	15.2	16.1	16.4	15.7	6.2%	1.6%	-4.1%
Private non-residential investment	67.6	79.8	81.6	82.6	84.9	87.6	1.2%	2.8%	3.1%
Public demand	122.6	129.4	130.9	131.6	132.8	133.9	(0.1%)	(0.2%)	(0.2%)
Government consumption	98.1	103.2	105.2	105.7	106.4	107.5	0.5%	0.6%	1.0%
Public investment	24.7	26.1	25.7	25.9	26.4	26.4	0.9%	2.0%	0.1%
Net exports of goods and services	1.3	-7.3	-7.0	-3.3	-2.0	-2.2	(0.8%)	(0.3%)	(-0.0%)
Exports of goods and services	74.7	82.2	82.8	85.6	89.3	91.1	3.4%	4.3%	2.0%
Imports of goods and services	73.4	89.5	89.8	88.9	91.3	93.3	-1.1%	2.8%	2.1%
Nominal GDP (JPY trillion)	499.3	518.5	533.9	539.3	549.9	559.4	1.0%	2.0%	1.7%
Balance of trade (JPY trillion)	5.3	-9.1	-1.1	4.0	1.9	0.0	-465%	-52.2%	-98.7%
Exports	67.8	74.7	74.1	71.5	78.0	80.6	-3.5%	9.0%	3.4%
Imports	62.5	83.8	75.2	67.5	76.1	80.6	-10.2%	12.7%	6.0%
Fossil fuels	18.1	25.1	16.1	13.1	16.6	18.3	-18.2%	26.0%	10.5%
Oil	12.3	15.2	9.6	7.8	9.7	10.9	-18.3%	23.8%	12.8%
LNG	3.5	7.8	4.5	3.3	4.2	4.8	-26.6%	27.0%	12.8%
Current account (JPY trillion)	18.3	8.7	17.7	20.2	21.0	20.2	14.1%	4.1%	-3.5%
Domestic corporate goods price index (2015=100)	97.6	102.5	99.1	96.8	99.2	101.3	-2.3%	2.6%	2.0%
Consumer price index (2015=100)	96.4	99.8	100.0	100.0	100.6	101.4	-0.1%	0.7%	0.8%
GDP deflator (2011=100)	101.3	101.5	103.0	102.8	103.0	103.7	-0.2%	0.2%	0.6%
Unemployment rate(%)	5.0	3.5	3.3	3.0	2.8	2.7	[-0.3%]	[-0.2%]	[-0.1%]

Note: GDP components may not add up to the total GDP due to stock changes and minor data deviations. (.) contributions. [] difference from the previous year.

Production activities

The industrial production index will hit the highest level since the Lehman Shock in FY2017 and rise further at a slower pace in FY2018.

In FY2017, the industrial production index will score a substantial increase of 3.3% from the previous year thanks to export expansion amid a full-fledged overseas economic recovery and growth in demand related to the 2020 Tokyo Olympics while effects of some companies' quality inspection scandals on production volume will be limited. Major drivers of the growth will include chemicals, as well as metal products and machinery supported by robust capital investment and exports. Metal products and machinery will take advantage of labour-saving investment and other factors to drive industrial production growth in FY2018. However, a rise in the index will slow to 1.3% due to decelerating export growth.

Crude steel production will exceed 105 Mt for the third straight year thanks to Tokyo Olympic demand, brisk manufacturing and demand expansion before a VAT increase.

In FY2017, crude steel production will log a slight increase of 0.4% from the previous year as exports decline despite growth in domestic demand including steel products for the Tokyo Olympics and for automobile and electrical machinery manufacturers. In FY2018, crude steel production will rise by 1.4% as Olympics-related demand is coupled with expansion from the second half of the year in demand for time-consuming condominium construction toward the VAT hike in October 2019.

Ethylene production will increase in FY2017 before falling due to U.S. product exports made from shale gas and more regular production equipment repairs in FY2018

Ethylene production in FY2017 will increase by 1.9% from the previous year as robust domestic and overseas demand and price hikes are coupled with fewer regular production equipment repairs. In FY2018, however,

production will fall by 1.8% as regular equipment repairs increase, with competition intensifying from U.S. ethylene products made from shale gas in the international market.

Cement production will exceed 60 Mt for the second straight year on growth in demand related to the Tokyo Olympics and SCMAGLEV Chuo Shinkansen Line construction.

Cement production in FY2017 will increase by 3.7% to exceed 60 Mt. for the first time in three years as demand increases for cement for reconstruction after the 2016 Kumamoto Earthquake and the Tokyo Olympics. In FY2018, production will rise by 1.0% to 62.1 Mt for the second straight year of growth as robust demand related to the Tokyo Olympics is coupled with construction gaining momentum for the SCMAGLEV Chuo Shinkansen Line.

Paper and paperboard production will continue to increase slightly in FY2017 and FY2018 on expanding sales via the Internet in China and Japan.

While paper production will decline in FY2017 and FY2018 on a population fall and a switch to electronic media, paperboard production will expand due to growth in exports amid increasing sales via the Internet in China, as well as growing Internet sales supported by the diffusion of the free market application in Japan. Paper and paperboard production will grow by 0.4% in FY2017 and by 0.2% in FY2018.

Automobile production will exceed 9.5 million units in FY2017 for the first time in three years and grow further to 9.7 million units on robust exports in FY2018.

In FY2017, automobile production will increase by 2.5% from the previous year to exceed 9.5 million units for the first time in three years as domestic shipments expand on new model effects and exports grow on a full-fledged overseas economic pickup. In FY2018, production will rise by 1.2% as domestic

shipments increase slightly despite the loss of new model effects and exports mainly to Europe and the United States continue to rise.

Table 3 | Production activities

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Production									
Crude steel (Mt)	110.8	109.8	104.2	105.2	105.5	107.1	0.9%	0.4%	1.4%
Ethylene (Mt)	7.00	6.69	6.78	6.29	6.41	6.29	-7.3%	1.9%	-1.8%
Cement (Mt)	56.1	61.1	59.2	59.3	61.5	62.1	0.1%	3.7%	1.0%
Paper and paperboard (Mt)	27.3	26.3	26.2	26.3	26.5	26.5	0.4%	0.4%	0.2%
Automobiles (Million units)	8.99	9.59	9.19	9.36	9.59	9.71	1.8%	2.5%	1.2%
Production indices									
Mining and manufacturing (2010=100)	99.4	98.4	97.5	98.6	101.8	103.1	1.2%	3.3%	1.3%
Food	98.2	95.5	96.9	96.8	98.0	98.7	-0.1%	1.3%	0.7%
Chemicals	99.7	95.2	98.0	100.7	104.6	105.0	2.8%	3.8%	0.4%
Non-ferrous metals	98.9	97.9	96.5	98.9	100.8	101.6	2.5%	1.9%	0.8%
Machinery	99.3	100.1	98.4	99.5	103.2	104.5	1.1%	3.7%	1.3%
Tertiary industry activity index (2010=100)	99.9	102.1	103.5	103.9	105.4	106.4	0.4%	1.4%	0.9%

Notes: Chemicals include chemical fibers.

Machinery includes general machinery, electrical machinery, information and telecommunications equipment, electronic parts and devices, precision machinery and metal products.

Primary energy supply

Primary energy supply will increase in FY2017 for the first rise in four years before decreasing by 0.3% in FY2018. Natural gas will decline to the lowest level since the Great East Japan Earthquake as shifts from fossil fuels to nuclear and renewable energy.

In FY2017, primary energy supply in Japan will increase by 0.7% from the previous year for the first rise since FY2013 due to the robust economy and air temperature changes. The increase will comprise 0.4 percentage points for final energy consumption (next chapter) and 0.3 points for the energy transformation sector including power generation. As non-fossil energy grows in the power generation sector, Japan's energy self-sufficiency rate will rise back above 10% for the first time in six years to 10.7%, still far below 17.8% in FY2010 before the Great East Japan Earthquake seriously affected the rate.

In FY2018, primary energy supply will drop by 0.3%, falling back again. A final energy consumption decline will push primary energy supply down by 0.3%, while the energy transformation sector will make no contribution to the primary energy supply drop due to a rise in electricity's share of final energy consumption and a decrease in efficient natural gas-fired power generation's share.

Posting the largest change among energy sources in FY2018 will be nuclear that will increase by 7.3 Mtoe as the number of operating nuclear power plants rises to nine by the end of the year. However, nuclear will still be less than one quarter of the level in FY2010 before the

Great East Japan Earthquake fully affected nuclear power generation.

Nuclear growth will impose the greatest impact on natural gas and oil. The nuclear growth and a final oil consumption fall will push oil supply down by 6.6 Mtoe. Oil will decrease to 195 GL of crude oil equivalent (Table 1), slipping below 200 GL for the first time in a half-century since 1969 before the oil crises. Oil's share of total primary energy supply will fall to 39.7% in FY2017 and to 38.4% in FY2018, slipping below 40% for two years on end.

Nuclear growth will exert greater downward pressure on natural gas than on oil. However, the pressure will be eased by an increase in city gas for industrial use. Nevertheless, natural gas will decline to the lowest level since the Great East Japan Earthquake, pushing down its share of primary energy supply to 23.7% from more than a quarter in FY2014.

Solar, wind, biomass, geothermal and other new energies will increase by 1.8 Mtoe in continuation of strong growth taking advantage of the FIT scheme, accounting for nearly 5% of primary energy supply.

Coal will post a smaller change and remain in a 120-125 Mtoe range for five years on end, with its share of primary energy supply staying in a 26-27% range.

Japan's energy-related CO₂ emissions will decline by 10.6% from FY2013 to 1,104 Mt. An energy consumption decline will contribute 4.8 percentage points to the decline, followed by 2.6 points for nuclear growth and 2.5 points for new energy growth.

Table 4 | Primary energy supply

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Primary energy supply (Mtoe)	513.5	472.9	465.5	463.5	466.7	465.3	-0.4%	0.7%	-0.3%
Coal	119.2	124.4	123.7	121.9	122.5	122.6	-1.5%	0.5%	0.1%
Oil	212.0	198.6	193.3	187.6	185.1	178.5	-3.0%	-1.3%	-3.6%
Natural gas	95.7	118.9	113.0	114.7	114.8	110.5	1.5%	0.1%	-3.8%
LNG imports (Mt)	70.6	89.1	83.6	84.7	82.8	81.0	1.4%	-2.3%	-2.2%
Hydro	17.2	17.1	17.7	16.3	16.7	16.9	-7.7%	2.3%	1.3%
Nuclear	60.7	0.0	2.0	3.7	6.7	14.0	91.3%	78.6%	109%
Geothermal, new energy, etc.	8.9	13.9	15.8	19.3	21.0	22.8	22.1%	8.4%	8.7%
Self-sufficiency rate	17.8%	7.5%	8.5%	9.4%	10.7%	12.7%	0.9p	1.3p	2.0p
Energy intensity (FY2011=100)	105.2	93.4	90.7	89.2	88.3	87.0	-1.6%	-1.1%	-1.4%
Energy-related CO ₂ emissions (Mt-CO ₂)	1,131	1,186	1,150	1,144	1,132	1,104	-0.5%	-1.0%	-2.5%
(FY2013=100)	91.5	96.0	93.1	92.6	91.6	89.4

Notes: New energy includes solar photovoltaics, wind, biomass, solar heat, and small and medium-scale hydro power generation.

Heat contents have been revised since FY2013.

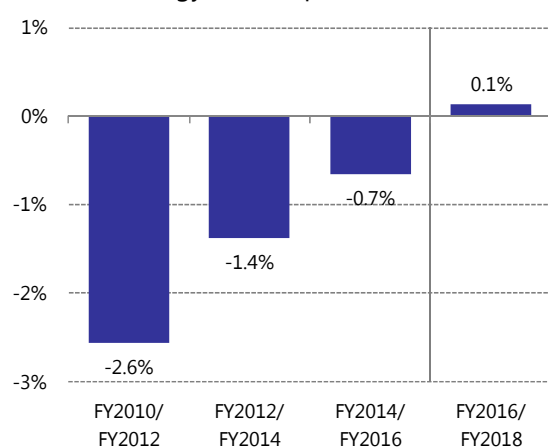
Final energy consumption

Final energy consumption will increase in FY2017 for the first time in seven years or since the Great East Japan Earthquake before decreasing in FY2018 close to the FY2016 level.

Final energy consumption will increase by 0.6% from the previous year in FY2017 after decreasing for six years on end since the Great East Japan Earthquake. While the transport sector will reduce consumption through vehicle fuel efficiency improvements and fuel-efficient vehicles' growing market share, industry and buildings sectors will expand consumption faster.

In FY2018, all sectors will cut final energy consumption. As 70% of FY2017 growth is lost, consumption will decrease by 0.4%. In the two years for this outlook, however, a medium-term downtrend since the great earthquake will ease remarkably.

Figure 2 | Compound average growth rates in final energy consumption



In FY2018, a fall in oil for automobiles through fuel efficiency improvements and a decline in petrochemical feedstock consumption through more regular ethylene plant repairs will make great contributions to a decrease in transport and industry sectors. Oil's share of final energy consumption will further decline after slipping below 50% in FY2017 for the first time in 55 years.

Electricity will post a small increase of 0.2%, rising for the third straight year. Its share of final energy consumption will hit a record 27%. Driving electricity consumption growth will be the industry sector including manufacturers that will expand production at a slower pace. In contrast, the buildings sector (covering residential and commercial) will reduce electricity for the first time in three years due to a cooler summer and a warmer winter.

Posting the largest growth among energy sources of 0.5 Mtoe will be city/natural gas, backed by consumption growth in the industry sector as is the same case with electricity. Unlike electricity, gas will increase even in the commercial sector. Gas will thus hit a record for the third straight year.

Coal and coal products will turn up for the first time in five years, reflecting crude steel and cement production growth. However, coal's negative gap with city/natural gas will expand to 2.5 Mtoe after standing close to zero in FY2015.

Table 5 | Final energy consumption

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Final energy consumption (Mtoe)	340.6	314.6	310.8	310.5	312.4	311.3	-0.1%	0.6%	-0.4%
Industry	159.3	149.2	147.4	146.7	148.3	148.3	-0.5%	1.1%	0.0%
Buildings	98.7	88.5	86.3	87.7	88.4	87.9	1.6%	0.8%	-0.6%
Residential	54.7	48.8	47.1	47.7	48.2	47.9	1.3%	1.0%	-0.6%
Commercial	44.0	39.7	39.2	40.0	40.2	40.0	1.9%	0.5%	-0.5%
Transport	82.7	77.0	77.1	76.2	75.7	75.2	-1.2%	-0.6%	-0.8%
Coal and coal products	36.7	36.0	34.0	33.8	33.7	33.8	-0.7%	-0.2%	0.2%
Petroleum products	176.2	158.4	158.5	155.9	155.9	154.1	-1.6%	0.0%	-1.2%
City and natural gases	34.4	34.3	33.8	34.8	35.8	36.3	3.1%	2.7%	1.4%
Electricity	89.8	82.7	81.5	83.0	84.0	84.1	1.8%	1.2%	0.2%
Others	3.4	3.2	3.0	3.0	3.1	3.1	-0.3%	1.9%	0.7%

Note: The industry sector's energy consumption includes non-energy use.

Electricity sales and power generation mix (electric utilities)

Electricity sales will increase in FY2018 for the second straight year, though with growth limited by energy conservation progress and decelerating production.

In FY2017, electricity sales to lighting service and low-voltage users will increase by 1.2% from the previous year due to higher early summer temperatures and an assumed colder winter that would push up cooling and heating demand. Sales to extra-high voltage and high voltage users will rise by 1.3% and 1.2%, respectively, due to robust production.

In FY2018, sales to lighting service users will decrease by 0.3% due to continuous energy conservation progress and temperature changes,

despite progress in the electrification of heating and kitchens. Sales to extra-high voltage and high voltage users will decelerate their respective rises to 0.6% and 0.4% due to slower machinery production growth amid decelerating export expansion. Overall electricity sales will increase for the second straight year, though with growth limited to 0.2%.

Because of full electricity retail deregulation launched in April 2016, power producer and supplier companies' share of total electricity sales rose to 12.1% in August 2017, indicating progress in users' switching from traditional electric utilities.

Table 6 | Electricity sales (electricity utility use)

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Total (TWh)	(926.6)	(851.4)	(837.5)	853.9	864.5	866.4	n.a.	1.2%	0.2%
Extra-high voltage	(246.1)	(233.5)	(229.3)	231.4	234.5	235.8	n.a.	1.3%	0.6%
High voltage	(330.3)	(305.8)	(303.7)	307.3	311.2	312.4	n.a.	1.2%	0.4%
Low voltage	(350.2)	(312.1)	(304.5)	315.2	318.9	318.1	n.a.	1.2%	-0.2%
Lighting service	304.2	273.1	266.9	271.8	275.2	274.5	1.9%	1.2%	-0.3%
Power service	(45.9)	(39.0)	(37.7)	43.3	43.7	43.6	n.a.	0.7%	-0.1%

Note: "Total" do not include own use. Figures in brackets are based on earlier statistical definitions.

Fossil fuels' share of total power generation in FY2018 will fall on the restart of additional nuclear power plants to 74%, still 13 points higher than before the Great East Japan Earthquake affected nuclear power generation.

In FY2017, nuclear's share of total power generation will rise to 3% due to the restart of additional nuclear power plants. New energy's share will expand to 7%, though with growth decelerating under the revised FIT scheme.

Fossil fuels' share will decline by 2.6 points to 79%.

In FY2018, nuclear's share will expand by 3.5 points to 7% on progress in the nuclear power plant restart. New energy's share will decelerate growth slightly. Renewables including hydro will expand its share to 16%. Fossil fuels' share will decline by 4.4 points to 74%, the lowest since the Great East Japan Earthquake, still 13 points higher than in FY2010 before the earthquake seriously affected nuclear power generation.

Table 7 | Power generation mix (electric utilities, generated and purchased electricity)

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Electricity generated and purchased (TWh)	1,028	936.2	920.0	994.1	1,007	1,009	n.a.	1.3%	0.2%
Share								Year-to-year changes	
Hydro	(9%)	(9%)	(9%)	8%	8%	9%	n.a.	+0.0p	+0.1p
Fossil fuels	(62%)	(87%)	(84%)	81%	79%	74%	n.a.	-2.6p	-4.4p
Coal	(25%)	(30%)	(31%)	30%	29%	29%	n.a.	-0.2p	-0.1p
LNG	(29%)	(46%)	(43%)	41%	41%	38%	n.a.	-0.8p	-2.6p
Oil, etc.	(8%)	(11%)	(9%)	10%	9%	7%	n.a.	-1.6p	-1.7p
Nuclear	(29%)	(0%)	(1%)	2%	3%	7%	n.a.	+1.5p	+3.5p
New energies and others	(1%)	(3%)	(4%)	6%	7%	8%	n.a.	+1.0p	+0.9p

Note: Figures in brackets are based on earlier statistical definitions. Only for general electric utilities in FY2010. Transmission line end from FY2016.

Due to deregulation of electricity sales, the scope of the survey has been modified since April 2016.

Components may not add up to 100% as others are not shown.

Including medium and small hydro power of 30 MW or less estimated to be about half of the "Hydro".

City gas sales (gas utilities)

City gas sales will rewrite a record high for the third straight year, driven by sales for general industrial use amid new demand + exploration efforts.

City gas sales in FY2017 will increase by 2.9% from the previous year to 42.7 billion m³ thanks to continuous demand exploration efforts and expanding production and economic activities. In FY2018, city gas sales will expand by 1.4% to 43.3 billion m³, rewriting a record high for the third straight year, driven by sales for general industrial use amid continuous demand exploration efforts.

Residential sales will increase by 1.5% in FY2017 as water and space and heating demand expands on lower temperatures than in the previous year. In FY2018, residential sales will fall by 0.4% due to the diffusion of energy efficient equipment including more efficient water heaters and the reaction to temperature changes in the previous year, despite continuous new demand exploration efforts and the spread of gas equipment.

Business sales (commercial and other sales) will increase (+1.0% for commercial sales and +4.6% for others) on new demand exploration efforts and robust commercial and services expansion in FY2017. In FY2018, they will decelerate growth (to -0.1% for commercial sales and +1.6%

for others) despite growing industrial demand for cogeneration systems and gas heat pumps as temperatures return to normal levels.

Industrial sales in FY2017 will increase by 3.4% on robust industrial activities. In FY2018, they will expand by 2.3% for the ninth straight year of growth. Sales for general industrial use will grow by 2.9% due to new demand exploration efforts mainly for large users and fuel switching from oil to city gas for industrial furnaces and boilers, as well as production expansion that will decelerate. Sales for electric utilities will level off.

Residential sales' share of total city gas sales will shrink to 22% in FY2018 from more than 50% in FY1990, while industrial sales' share will expand to 59% from 26%. Industrial sales are sensitive to economic conditions rather than temperature conditions

Under the full deregulation of city gas retail sales from April 2017, 480,000 households switched their contractors to new suppliers by the end of October. The switching rate was limited to around 2% on a nationwide basis and differed from region to region. The rate slipped below 1% in the Kanto region while ranging from 3% to 4% in other regions. Switching thus made progress in the other regions.

Table 8 | City gas sales (gas utilities)

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Total (Billion m ³)	39.28	40.16	39.91	41.53	42.71	43.30	4.1%	2.9%	1.4%
Residential	9.79	9.58	9.24	9.41	9.55	9.51	1.8%	1.5%	-0.4%
Commercial	4.75	4.34	4.26	4.32	4.36	4.36	1.4%	1.0%	-0.1%
Industrial	21.61	22.74	23.01	24.20	25.02	25.59	5.2%	3.4%	2.3%
Manufacturing	(20.18)	(19.90)	(20.16)	19.30	19.89	20.47	n.a.	3.1%	2.9%
Electric utilities	(1.43)	(2.84)	(2.85)	4.90	5.12	5.12	n.a.	4.6%	0.0%
Others	3.13	3.50	3.41	3.61	3.78	3.84	6.0%	4.8%	1.6%

Note: Converted at 1 m³=41.8605 MJ (10,000 kcal). Figures in brackets are statistics based on formerly used definitions.

Fuel oil/LPG sales and crude oil throughput

Fuel oil sales will decline despite an economic pickup in FY2017. In FY2018, they will decrease for the sixth straight year as naphtha sales fall on regular production equipment repairs, with kerosene and heavy fuel oil sales affected by switching to city gas and electricity.

Fuel oil sales in FY2017 will decrease by 0.9% from the previous year despite naphtha growth amid fewer regular ethylene plant repairs, jet fuel and diesel oil growth amid rising transport demand and kerosene growth in a colder winter. In FY2018, fuel oil sales will decline by 2.3% for the sixth straight year of fall due to a substantial drop in heavy fuel oil C amid progress in the restart of nuclear power plants, kerosene and heavy fuel oil C falls attributable to switching to electricity and city gas, and a naphtha decline amid more regular ethylene plant repairs. They will slip below 70% of the peak at 246 GL in 1996, continuing a downtrend.

Gasoline sales will decrease by 1.7% in FY2017 and by 1.5% in FY2018 due to shorter vehicle travelling distances and the further diffusion of fuel efficient vehicles such as hybrid cars and mini-vehicles.

Naphtha sales will expand by 2.8% in FY2017 due to a decline in regular ethylene plant repairs. In FY2018, they will decrease by 2.4% as regular ethylene plant repairs increase and competition intensifies in overseas markets from growing production from shale gas in the United States.

Kerosene sales will increase by 0.3% in FY2017 as demand increases in a colder winter than in the previous year, despite switching to electricity.

They will decrease by 2.0% in FY2018 on continuous fuel switching and a warmer winter.

Diesel oil sales will increase by 1.1% in FY2017 and by 0.4% in FY2018 despite progress in freight transportation and fuel efficiency improvements as freight traffic expands on growing production under an economic pickup and on rising Internet sales.

Heavy fuel oil A sales will drop by 4.0% in FY2017 as fuel switching to city gas in industry and commercial sectors makes progress in response to oil price hikes. In FY2018, a decline will decelerate to 2.7% despite further progress in switching to other fuels even for ships under environmental measures as a decline in the commercial sector's cooling and heating demand slows on a loss of temperature changes' effect.

Heavy fuel oil B/C sales for industrial use will decrease due to fuel switching and energy conservation. Those for power generation will substantially decline on the restart of additional nuclear power plants. Total heavy fuel oil B/C sales will plunge by 15.0% in FY2017 and by 14.2% in FY2018.

LPG sales will increase by 1.0% in FY2017 as residential water-heating demand expands on temperature changes. In FY2018, they will decline by 2.1% due to fuel switching to electricity and city gas.

Crude oil throughput will decrease by 2.3% in FY2017 and by 3.5% in FY2018 on a fall in fuel oil sales demand, as well as a cut in oil refining capacity under the second notification based on the Act on Sophisticated Methods of Energy Supply Structures.

Table 9 | Fuel oil/LPG sales and crude oil throughput

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Fuel oil sales (GL)	196.0	182.6	180.5	176.9	175.4	171.4	-2.0%	-0.9%	-2.3%
Gasoline	58.2	53.0	53.1	52.5	51.6	50.8	-1.2%	-1.7%	-1.5%
Naphtha	46.7	43.9	46.2	44.8	46.1	45.0	-3.1%	2.8%	-2.4%
Jet fuel	5.2	5.3	5.5	5.3	5.4	5.3	-3.1%	1.7%	-0.8%
Kerosene	20.4	16.7	15.9	16.2	16.3	16.0	1.8%	0.3%	-2.0%
Diesel oil	32.9	33.6	33.6	33.3	33.7	33.8	-0.8%	1.1%	0.4%
Heavy fuel oil A	15.4	12.3	11.9	12.0	11.5	11.2	1.0%	-4.0%	-2.7%
Heavy fuel oils B and C	17.3	17.8	14.2	12.8	10.9	9.3	-10.3%	-15.0%	-14.2%
For electric utilities	7.7	10.8	8.2	7.9	6.2	4.9	-3.0%	-22.1%	-21.1%
For other users	9.7	7.0	6.1	4.8	4.7	4.4	-20.0%	-3.4%	-5.1%
LPG sales (Mt)	16.5	15.4	14.7	14.4	14.5	14.2	-2.1%	1.0%	-2.1%
Crude oil throughput (GL)	208.9	189.0	189.0	190.6	186.1	179.6	0.8%	-2.3%	-3.5%

Renewable energy-based power generation

Before the revised FIT Act took effect eight months ago, biomass-fired power generation projects increased rapidly. Some approved non-residential solar PV projects may be cancelled.

Eight months have passed since the revised FIT Act¹ was implemented in April 2017. Renewable energy-based power generation capacity approved under the FIT scheme remained almost unchanged for one year to December 2016 but increased by as much as 16 GW in the first three months of 2017 before a purchased price cut under the revised FIT Act. Of the increase, biomass-fired power generation projects accounted for about a half. However, biomass projects heavily depend on fuel imports from a limited range of overseas suppliers, indicating energy security risks. Therefore, only about 20% of non-operational approved biomass-fired power generation capacity is growingly expected to be realized. As the revised FIT Act sets a deadline for making approved capacity operational, 27.7 GW out of approved capacity including non-residential solar PV facilities may be cancelled.

The cumulative burden on consumers will decline from JPY77 trillion to JPY42 trillion due to cancellation

If all FIT capacity, excluding cancelled capacity from 105.1 GW (including 84.5 GW for solar PV, 7.0 GW for wind and 11.5 GW for biomass) in total approved capacity including transferred facilities² at the end of March 2017, becomes operational, the 20-year burden on consumers will reach JPY42 trillion³. The estimated burden

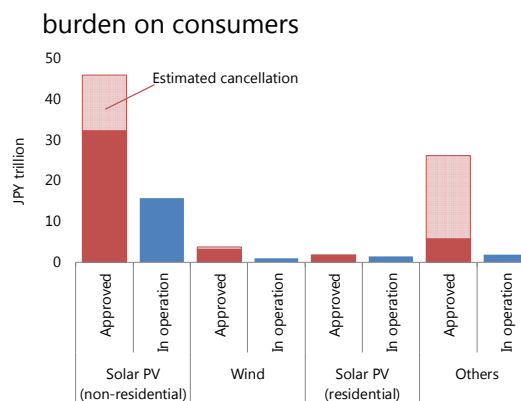
¹ Revision of the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities

² Transferred facilities are those that were installed before the introduction of the FIT scheme and later subjected to the scheme.

³ The remaining FIT periods for transferred facilities are taken into consideration. The avoidable cost has been estimated by the IEEJ, based on various

amounts to an electricity rate hike of JPY2,400/MWh, or 10% for residential users and 15% for industrial users. The estimated burden represents a substantial fall from JPY77 trillion for the case without cancellation of approved facilities, indicating some achievement of the revised FIT Act. Nevertheless, Japan will still be required to continue efforts to balance the maximum expansion of renewable energy and the restriction on the burden on citizens in consideration of a target energy mix for 2030. Measures to make growing biomass capacity independent from the FIT scheme will also have to be considered.

Figure 3 | FIT scheme's 20-year cumulative burden on consumers



(Note) Capacity approved and in operation at the end of March 2017

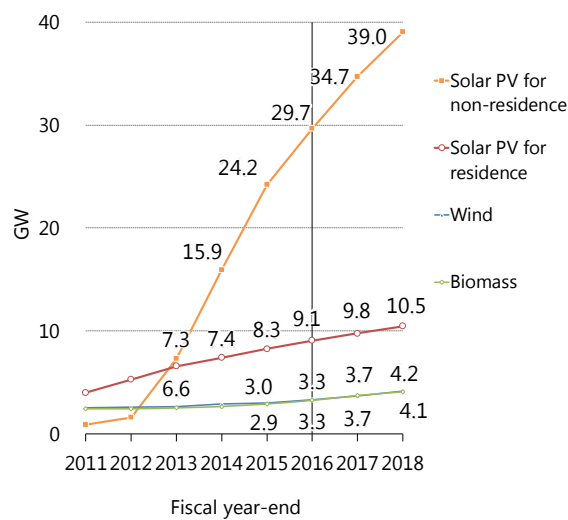
The cumulative capacity of renewable energy-based power generation facilities will total 68.2 GW.

While rapid growth in newly approved renewables power generation facilities including non-residential solar PV facilities will be corrected, installed renewables power generation capacity will reach 68.2 GW at the end of FY2018, with facilities under construction launching operations. Particularly, installed non-residential solar PV capacity will total 39.0 GW at the end of FY2018, accounting for

documents. The capacity factor is assumed at 20% for wind, 12% for solar PV, 70% for geothermal energy, 45% for hydro and 70% for biomass.

more than half the total. As five years are required for launching wind power generation after approval, installed wind generation capacity will increase to 4.2 GW at the end of FY2018. Renewable energy-based power generation in FY2018 will total 126.8 TWh (including 52 TWh for solar PV, 7.3 TWh for wind and 38.8 TWh for small and medium-sized hydroelectric plants), accounting for one-eighth of Japan's total power generation.

Figure 4 | Installed capacity in operation for renewables power generation



Impact of the pace of nuclear power plant restart

The nuclear reactor restart makes progress in FY2018. Electricity rate cuts are expected.

In October 2017, Units 6 and 7 of Tokyo Electric Power Co.'s Kashiwazaki-Kariwa Nuclear Power Station won an effective certificate for safety from the Nuclear Regulatory Commission. They were the first boiling water reactors to receive the certificate under new safety standards in Japan. In November, the Japan Atomic Power Company filed an application for extending the service life of the Tokai No.2 Power Station.

Meanwhile, a major steelmaker's quality data falsification scandal forced Units 3 and 4 of Kyushu Electric Power Co.'s Genkai Nuclear Power Station and Units 3 and 4 of Kansai Electric Power Co.'s Oi Power Station to postpone their restart for some two months. On December 13, the Hiroshima High Court ordered Unit 3 of Shikoku Electric Power Co.'s Ikata Power Station to be suspended until September 2018.

While nuclear power plants are in different situations, their restart is expected to make progress in FY2018.

Kansai Electric has announced to reduce electricity rates in the wake of a cut in August 2017 if Units 3 and 4 of its Oi Nuclear Power Station are restarted. When Kansai Electric lowered its rates, power producer and supplier companies followed suit. PPS companies thus can be expected to cut their rates if Kansai Electric does so. Some media reports said Kansai Electric was planning to expand into the Chubu and Chugoku regions upon the restart of the two Oi units. These developments under the full deregulation of electricity retail sales indicate that the restart of nuclear power plants could lead to electricity rate cuts and fiercer competition in various ways.

This chapter assesses the impact on the so-called 3Es (economic efficiency, energy security and environmental friendliness) of differing paces for restarting nuclear power plants. We have developed three hypotheses for FY2018 based on

progress in examinations of nuclear reactors' conformity to regulatory standards, the presence or absence of large-scale construction, timings of applications for the examinations and other factors. We have also prepared a hypothetical case of no nuclear reactor in operation for FY2018 to be compared with the three.

In the "Reference Scenario," we assume that the cumulative number of restarted nuclear power plants will increase from five at present to nine by the end of FY2018. Nuclear power generation will reach 67.5 TWh in FY2018, accounting for 7% of Japan's total power generation. (The share will rise to around 8% if the nine plants operate for 12 months).

In the "Low Case," we assume that the cumulative number of restarted nuclear power plants at the end of FY2018 will stand at seven, which will generate a total of 34.5 TWh accounting for 3% of Japan's total power generation.

In the "High Case," we assume that the cumulative number of restarted nuclear power plants will stand at 15 at the end of FY2018. The 15 plants account for about 60% of 26 plants subjected to applications filed so far for regulatory standards conformity examinations. They generate a total of 92.5 TWh accounting for 9% of Japan's total power generation. The share amounts to about 40% of 20-22% for nuclear in the power generation mix for 2030, as proposed in the "Long-term Energy Supply and Demand Outlook" by the Ministry of Economy, Trade and Industry.

In the "Zero Operation Case," we assume that no nuclear power plants will be in operation in FY2018. This case is prepared for comparison with the other cases.

Nuclear's contributions to the 3Es

Fossil fuel import value in the "Reference Scenario" is JPY700 billion less than in the Zero Operation Case and the value in the High Case is JPY900 billion less. The savings are some 30%

more than in the previous outlook⁴ due to crude oil and LNG price hikes. Unit electricity cost savings are worth JPY500/MWh in the Reference Scenario and JPY700/MWh the High Case. Even in the High Case, however, the unit electricity cost is 51% higher than JPY4,900/MWh in FY2010⁵ when many nuclear power plants were in operation. Real GDP in the Reference Scenario is JPY700 billion more than in the Zero Operation Case due to less fossil fuel imports. In the High Case, real GDP is JPY900 billion more.

The energy self-sufficiency rate in the Reference Scenario is 3.0 percentage points higher than in the Zero Operation Case and the rate in the High Case is 4.1 points higher. However, the energy self-sufficiency rates in the Reference Scenario and the High Case still slip below 17.8% for FY2010 before the Great East Japan Earthquake affected the Japanese energy situation seriously.

CO₂ emissions in the Reference Scenario are 34 Mt less than in the Zero Operation Case and those in the High Case are 46 Mt less. Compared with FY2013, the base year for Japan's CO₂ emission reduction target⁶ under the Paris Agreement, emissions in the Reference Scenario are 10.6% less and those in the High Case are 11.6% less. Thanks to progress in energy conservation and the diffusion of renewable energy as well as nuclear power generation, CO₂ emissions in the three cases other than the Zero Operation Case slip below 1,131 Mt in FY2010.

⁴ "Economic and Energy Outlook of Japan through FY2018" (July 2017)

⁵ At the end of 2010, a total of 39 nuclear reactors were in operation.

⁶ The target seeks to reduce greenhouse gas emissions in FY2030 by 26% from FY2013 and energy-related CO₂ emissions by 25%.

Table 10 | Impact of the pace of nuclear power plant restart (FY2018)

		Zero Case	Low Case	Reference Scenario	High Case	Changes from the Zero Case			
						Low Case	Reference Scenario	High Case	
Nuclear power presupposition	Cumulative number of restarted nuclear reactors	[0]	[5]	[6]	[6]	[+5]	[+6]	[+6]	
		End of FY2018	0	7	9	15	+7	+9	+15
	Average period for operation (months)	0	7	10	8	+7	+10	+8	
	Power generation by nuclear (TWh)	0	34.5	67.5	92.5	+34.5	+67.5	+92.5	
	Power supply composition ratio	0%	3%	7%	9%	+3p	+7p	+9p	
Economy	Electricity unit cost ¹ (JPY/kWh)	8.1	7.9	7.6	7.4	-0.3	-0.5	-0.7	
	Total fossil fuel imports (JPY trillion)	19.0	18.6	18.3	18.0	-0.4	-0.7	-0.9	
	Oil	11.2	11.0	10.9	10.9	-0.1	-0.2	-0.3	
	LNG	5.2	5.0	4.8	4.6	-0.2	-0.4	-0.6	
	Trade balance (JPY trillion)	-0.7	-0.3	0.0	0.3	+0.4	+0.7	+0.9	
	Real GDP (JPY2011 trillion)	539.0	539.3	539.6	539.9	+0.3	+0.7	+0.9	
	Gross national income per capita (JPY thousand)	4,399	4,402	4,405	4,407	+3	+6	+8	
Energy	Primary energy supply								
	Oil (GL)	200.0	197.4	195.2	193.6	-2.5	-4.8	-6.4	
	Natural gas (Mt of LNG equivalent)	92.5	88.6	84.9	82.0	-3.8	-7.6	-10.5	
	LNG imports (Mt)	88.5	84.7	81.0	78.1	-3.8	-7.6	-10.5	
	Self-sufficiency rate	9.9%	11.4%	12.9%	14.0%	+1.5p	+3.0p	+4.1p	
Environ- ment	Energy-related CO ₂ emissions (Mt-CO ₂)	1,138	1,120	1,104	1,092	-17	-34	-46	
	Changes from FY2013	-7.9%	-9.3%	-10.6%	-11.6%	-1.4p	-2.7p	-3.7p	

1. Sum of fuel cost, FIT purchasing cost and grid stabilising cost divided by total power generation.

Impact on LNG imports

Japan is the world's largest LNG importer, accounting for 31% of global LNG consumption (as of 2016). LNG imports are susceptible to the restart of nuclear power plants, as well as electricity and city gas demand changes depending on economic growth and production activities, and renewable energy expansion. LNG imports totalled 70.56 Mt in FY2010 before the Great East Japan Earthquake led to the shutdown of nuclear power plants that caused a sharp increase in LNG imports. In FY2014 when no nuclear power plant was in operation, LNG imports reached 89.07 Mt. Due to the restart of nuclear power plants and renewable energy expansion, they decreased to 84.75 Mt in FY2016.

While demand for LNG for city gas in FY2018 will hit a record high, LNG imports in the year will fall to 81 Mt in the Reference Scenario in which nine nuclear power plants will have been restarted by the end of the year. In the High Case, LNG imports in the year will slip far below 80 Mt but still exceed the FY2010 level. In the Zero Operation Case, LNG imports will expand to 88.5 Mt close to the level in FY2014

when no nuclear power plant was in operation. The restart of nuclear power plants contributes to reducing LNG imports. In FY2018 when LNG prices will increase, particularly, the restart will push up economic growth through an electricity cost cut. It will also contribute to improving the energy self-sufficiency rate and reducing CO₂ emissions.

Figure 5 | Japan's LNG imports by case

