

Economic and Energy Outlook of Japan through FY2018

Energy supply and demand structure significantly changes

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Highlights

Macro economy | Japanese economy through FY2018 grows by more than 1.0% for four consecutive years

Firm growth in both domestic and foreign demand in FY2017 supports the expansion of the Japanese economy by 1.4%. Although the export expansion will slow down in FY2018, a strong domestic demand will maintain a GDP growth of 1.1% for that period. The Japanese economy will experience over 1.0% growth for four consecutive years for the first time since FY2003 to FY2007.

Primary energy consumption | Total primary energy consumption declines mainly because of decreasing use of fossil fuels. Japan's self-sufficiency ratio exceeds 10% for the first time since the Great East Japan Earthquake.

In spite of expanding economic activities, total primary energy consumption in FY2017 slightly decreases by 0.1% due to continued energy conservation efforts. Primary energy consumption in FY2018 will decline by 0.6% from the preceding year; the stronger decrease reflects lower growth in economic activities. Fossil fuels consumption will decrease by 17 Mtoe for the projected years with the restart of nuclear power plants and increased generation from renewable energy. Energy-related CO₂ emissions reached their highest level in FY2013 and have been continuously decreasing ever since (FY2017: -2.0%, FY2018: -1.6%). Japan's self-sufficiency ratio exceeds 10% for the first time since the Great East Japan Earthquake.

Energy sales | Electricity increases and city gas continues at historical high levels, while fuel oil declines.

In FY2017, electricity sales increase mainly due to rising sales to industry associated with the expanded production activities. In FY2018, electricity sales will remain almost flat (FY2017: 0.4%, FY2018: 0.0%). City gas sales reach record high levels for the third consecutive year, mainly because of rising sales to general industry due to the production/economic activities and exploiting new demand (FY2017: 1.0%, FY2018: 0.6%). In FY2017, total fuel oil sales decline by 1.6% due to less heavy fuel oil C required for power generation caused by the return of nuclear power plants and fuel switching. In FY2018, fuel oil sales will continue to decline (-1.7%), reaching levels below 70% of their peak.

Nuclear power generation | 10 nuclear power plants are assumed to restart by the end of FY2018, decreasing the electricity unit cost by JPY300/MWh.

A total of five nuclear power plants are now operating in Japan with units 3 and 4 of the Takahama nuclear power station restarting operation. Another seven units have already met the new regulation standards and are being prepared for re-operation. If a total of 10 units are in operations by the end of FY2018, total spending on fossil fuel imports would decrease by JPY500 billion compared to the case where none of the units are in operation. With 10 units in operations (compared to none), real GDP expands by JPY500 billion, the self-sufficiency ratio increases by 2.9 point and energy-related CO₂

emissions decline by 2.7%. Nuclear power generation clearly contributes to the improvement of the 3Es (economy, energy security, and environment).

In-depth analysis | Demand trend of diesel oil

Among fuel oils, demand for diesel oil is the third largest after gasoline and naphtha; it is consumed in a wide range of fields. Diesel oil is also the only major fuel oil that increased in consumption compared to FY2010, the year before the Great East Japan Earthquake. It is now declining through FY2018 but at more moderate pace compared to other fuel oils (FY2017: -0.6%, FY2018: -0.6%). The share of diesel oil in total fuel oil sales expands from 16.8% in FY2010 to 19.3% in FY2018.

Executive summary of outlook through FY2018 [Reference Scenario]

Macro economy

The Japanese economy will grow at 1.4% in FY2017 because of favourable private consumption expenditure and strong exports supported by overseas economic growth. Despite a slowdown in exports in FY2018, the economy will continue to grow at 1.1% due to firm growth in domestic demand greatly influenced by Tokyo Olympic Games-related investment. Although growth keeps over 1% for four consecutive years through FY2018, it seems to be far from the Government's target of a nominal GDP of JPY600 trillion.

Production activities

Since the exports of electric machinery grow alongside with the moderate restoration of overseas economy, the significant recovery of general and electric machinery production has a huge contributing factor to the overall production activities in FY2017. Also, the urban redevelopment and infrastructure construction for the Tokyo Olympics are among the contributing factors to the overall production activities. Production activities continue to enlarge in FY2018, although at a more moderate pace than the preceding year. Ethylene production declines as maintenance of plants increases relative to the previous year and as the competition for exports to China intensifies due to the operation of shale-derived ethylene plants in the United States.

Energy supply and demand

Although production and economic activities are growing, total primary energy supply in FY2017 declines slightly by 0.1% because of the continued advancement of energy efficiency. In FY2018, it decreases a little more (-0.6%) caused by more moderate production and economic growth than in the previous year. Oil dependence ratio falls to below 40% in FY2017, and the shift toward non-fossil fuels energy will continue to progress.

In FY2017, total final energy consumption in the industry sector increases slightly owing to expanded production activities (0.1%). The transport sector consumes less than in the previous year (-1.1%) due to an increase in the share of fuel-efficient cars. Consumption also decreases in the buildings sector (residential and commercial) mainly due to improvements in energy efficiency (-0.7%). Although overall production activities increase in FY2018, energy consumption in all sectors decreases. The industry sector's consumption decreases by 0.5% from the previous year, due to a consumption drop in naphtha for the petrochemical industry. Consumption in the buildings and transport sectors declines due to further advancements of energy efficiency (buildings: -0.8%, transport: -1.1%).

Energy sales

In FY2017, electricity sales augment slightly (0.4%), because increased sales to industry (0.8%) for the expanded production activities surpass the decreased sales for lighting contract and low voltage due to the improvement of energy efficiency. In FY2018, the total electricity sales remain flat as the increase of electricity

sales for industry (high and extra-high voltage) slows down (0.3%), in line with the production activities moderate growth, while low voltage sales decrease because of facilities' efficiency improvement (-1.1%).

Total city gas sales reach a record high level in FY2017. They increase by 1.0%, led by growing sales to general industry (2.1%) that continuously seeks demand development activities. Sales for domestic use increase by 0.2% also because of the constant demand development. Sales for commercial and other uses drop by 0.4% because of the diffusion of more energy-efficient equipments. In FY2018, overall sales will reach the highest record for a third consecutive year. Sales will rise moderately compared to the previous year (0.6%), led by increase sales for industrial use, while sales for domestic use will remain flat and those for commercial and other uses decline.

In FY2017, fuel oil sales decrease for the fifth consecutive year. The decrease of 1.6% in FY2017 is caused by a huge decline in the use of heavy fuel oil C for power generation (due to the return of nuclear power plants) and a decline in sales of kerosene and heavy fuel oil A, B and C because of fuel switching toward electricity and city gas. In FY2018, sales of all fuel oils will be lower by 1.7% than the previous year for the sixth consecutive year. Naphtha for the petrochemical industry turns to the decrease.

Renewable power generation

With regard to renewable power generation, a rapid increase in approved capacity under the FIT program seems suppressed by a fall in the electricity price for solar PV and the cancellation of previously approved capacities but non-operated. If the expired capacities were excluded from the approved 94.6 GW capacity at the end of February 2017, 66.9 GW would be operated. In this case, the cumulative amount of consumer burden for twenty years will reach JPY45 trillion (including capacities which were introduced before FIT and included in FIT later). This is equivalent to a rise in electricity price of JPY2,600/MWh – 11% for the residential and 16% for the industry sector.

CO₂ emissions

Energy-related CO₂ emissions, which reached a historical high in FY2013, will decrease for a fifth consecutive year through FY2018. Energy efficiency, the restart of nuclear power plants as well as an increase in renewable energy will lower the emission to 1,113 Mt-CO₂ in FY2017 and 1,096 Mt-CO₂ in FY2018 (9.9% and 11.3% less than in FY2013, respectively). FY2018 will be below 1,100 Mt-CO₂ for the first time in 25 years, except for FY2009 just after the Lehman shock.

Table 1 | Summary of the Reference Scenario

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Primary energy supply (Mtoe) ¹	514.7	473.9	467.0	465.6	465.4	462.4	-0.3%	-0.1%	-0.6%
Oil ² (GL)	232.3	217.1	211.7	205.4	198.3	193.0	-2.9%	-3.5%	-2.7%
Natural gas ² (Mt of LNG equiv.)	73.3	90.5	86.0	88.1	85.3	83.4	2.5%	-3.2%	-2.2%
LNG imports (Mt)	70.6	89.1	83.6	84.7	82.1	80.3	1.4%	-3.1%	-2.3%
Coal ² (Mt)	184.7	190.0	190.2	188.0	188.2	188.8	-1.1%	0.1%	0.3%
Nuclear (TWh)	288.2	0.0	9.4	18.1	55.6	65.6	91%	208%	17.9%
Hydro (TWh)	84.3	83.8	87.4	80.1	80.1	80.1	-8.4%	0.0%	0.0%
Other renewables ³ (TWh)	63.9	87.6	99.7	109.7	118.9	127.3	10.1%	8.3%	7.1%
Final energy consumption ⁴ (Mtoe)	342.1	315.9	311.4	311.4	309.9	307.6	0.0%	-0.5%	-0.8%
Industry ⁵	159.3	149.2	147.2	146.6	146.7	145.9	-0.4%	0.1%	-0.5%
Buildings	100.2	89.9	87.2	88.7	88.0	87.3	1.7%	-0.7%	-0.8%
Transport	82.5	76.8	76.9	76.1	75.2	74.3	-1.1%	-1.1%	-1.2%
Petroleum products	177.6	159.4	158.9	156.5	154.1	151.3	-1.5%	-1.6%	-1.8%
Natural gas and city gas	34.5	34.6	34.1	35.1	35.5	35.7	3.1%	1.1%	0.6%
Coal and coal products	36.7	36.0	33.7	33.6	33.9	34.1	-0.3%	0.9%	0.6%
Electricity	89.8	82.7	81.6	83.1	83.4	83.4	1.8%	0.4%	0.0%
Electricity sales ⁶ (TWh)	(926.6)	(851.4)	(837.5)	853.9	857.7	857.7	n.a.	0.4%	0.0%
City gas sales ⁷ (Billion m ³)	39.28	40.16	39.91	41.53	41.93	42.19	4.1%	1.0%	0.6%
Fuel oil sales (GL)	196.0	182.7	180.5	176.8	173.9	171.0	-2.1%	-1.6%	-1.7%
Energy-related CO ₂ emissions ⁴ (Mt)	1,139	1,189	1,149	1,136	1,113	1,096	-1.1%	-2.0%	-1.6%
(FY2013=100)	92.2	96.3	93.0	92.0	90.1	88.7
Crude oil, import, CIF (\$/bbl)	84	89	49	48	51	52	-2.5%	7.2%	0.8%
LNG, import, CIF (\$/t)	584	797	452	363	399	395	-19.8%	10.0%	-1.0%
(\$/MBtu)	11.3	15.3	8.7	7.0	7.7	7.6
Steam coal, import, CIF (\$/t)	114	93	76	81	93	87	6.8%	14.7%	-6.5%
Coking coal, import, CIF (\$/t)	175	109	88	110	121	101	25.8%	9.7%	-16.9%
Nominal GDP (JPY trillion)	499.2	517.7	531.8	537.5	545.1	553.4	1.1%	1.4%	1.5%
Real GDP (JPY2011 trillion)	492.8	510.3	516.6	523.0	530.5	536.6	1.2%	1.4%	1.1%
Industrial production (CY2010=100)	99.4	98.4	97.5	98.6	101.1	102.5	1.2%	2.6%	1.3%
Exchange rate (JPY/\$)	86.1	109.2	120.4	108.4	114.8	115.0	-9.9%	5.8%	0.2%

Notes:

1. Mtoe = 10¹³ kcal2. Conversion factors for Oil: 9,126 kcal/L; Natural gas: 13,043 kcal/kg; Steam coal: 6,139 kcal/kg; Coking coal: 6,928 kcal/kg until FY2012.
Conversion factors for Oil: 9,145 kcal/L; Natural gas: 13,141 kcal/kg; Steam coal: 6,203 kcal/kg; Coking coal: 6,877 kcal/kg since FY2013.

3. Excluding large hydro 30 MW or more

4. Estimated actual value for fiscal 2016

5. Industry includes non-energy use.

6. Figures in parentheses are old statistical figures.

7. Conversion factor: 1 m³ = 10,000 kcal

Executive summary of topics

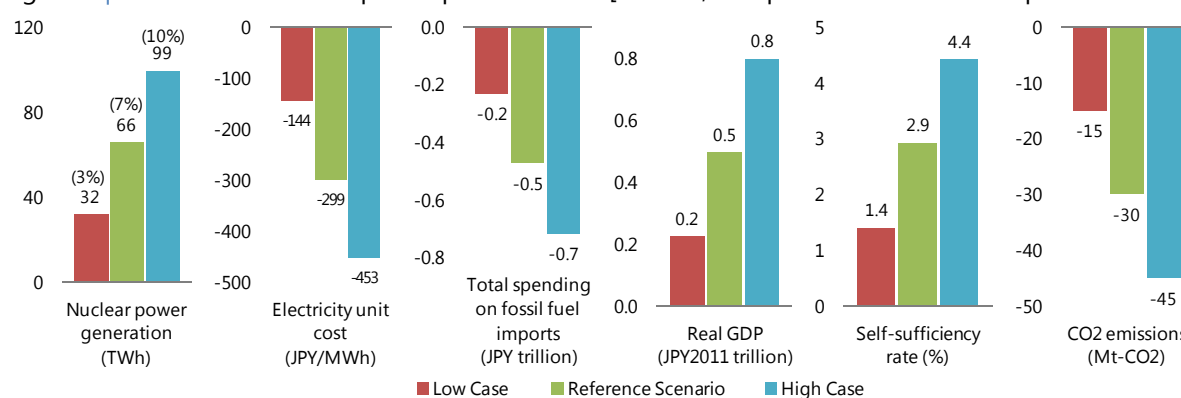
Effect of the nuclear power plants' restart

The *Reference Scenario* assumes that five more power plants will restart by the end of FY2018 in addition to the currently operating five plants, for a total of 10. Electricity generation from nuclear will reach 65.6 TWh, which represents a 7% share of the power generation mix. Electricity unit cost should decrease by JPY300/MWh compared to the *Zero Operation Case*, which assumes none of the nuclear power plants is in

operations. Relative to the *Zero Operation Case*, total spending on fossil fuel imports decreases by JPY500 billion, real GDP and self-sufficiency ratio expand by JPY500 billion and by 2.9 point respectively, and energy-related CO₂ emissions decline by 30 Mt (2.7%).

In the *Low Case*, which assumes no new plants to restart by the end of FY2018, total electricity generation from nuclear is almost half of the *Reference Scenario* with a 3% share of the power generation mix. The contribution to the 3Es (economy, energy security, and environment) is also half of the *Reference Scenario*. On the other hand, the *High Case* assumes a total of 17 nuclear power plants to be in operation by the end of FY2018 with electricity generation from nuclear reaching 1.5 times of *Reference Scenario* level. The *High Case* represents a 10% share of the power generation mix, which is almost half of the share of 20% to 22% prospected in METI's Long-term Energy Supply and Demand Outlook. Relative to the *Zero Operation Case*, electricity unit cost decreases by JPY500/MWh, and total spending on fossil fuel imports decline by JPY700 billion. Real GDP and self-sufficiency ratio expand by JPY800 billion and by 4.4 point respectively, while energy-related CO₂ emissions decline by 45 Mt (4.0%). The pace of restarting nuclear power plants has a definite impact on the improvement of the 3Es.

Figure 1 | Effect of the nuclear power plants' restart [FY2018, compared with the Zero Operation Case]



Note: Figures in parentheses are nuclear's share in power generation mix.

If we try to achieve lower spending on fossil fuel imports (JPY700 billion) and CO₂ emissions (45 Mt) as in the *High Case* by only electricity saving, a reduction of 100 TWh (equivalent to the decrease of electricity generation from FY2010 to FY2014) would be required. It, however, would be very difficult to reduce the electricity unit cost or increase the self-sufficiency ratio using electricity savings alone.

In-depth analysis <1> Demand trend of diesel oil

Diesel oil sales, which are relatively firm among fuel oils, decline at a rate of 0.6% per year during the period in review, while total fuel oils sales decrease by 1.7% per year. Diesel oil sales for transportation account for over 80% of total sales. Diesel oil use for freight among transportation decreases at an annual rate of 0.9%, far less than the decreasing pace for FY2016 of 1.4%. The advancement of fuel economy and energy savings in the transportation system are continuously acting as decreasing factors. On the other hand, the increase of home delivery service associated with expanded internet shopping and related demand for truck transportation are also important determinants of diesel oil demand. The number of home delivery service operation in FY2016 increased by 7% from the previous year, and is expected to grow through FY2018. These ease the pace of decreasing the volume of diesel oil sales.

Introduction

The Japanese economy has been moderately expanding, with real GDP in the first quarter of 2017 growing for the fifth straight quarter for the first time since the 2005-2006 period. The global economy has been moderately growing despite a rising number of uncertain political and economic factors.

In the international crude oil market, inventories have remained high despite a coordinated production cut by OPEC and non-OPEC oil-producing countries. Although they decided in May to extend the coordinate production cut until March 2018, Brent crude oil prices stand around \$50/bbl, almost unchanged from levels just before the production cut decision at an OPEC meeting in November 2016.

Japan began to import shale LNG from the United States in January. Although U.S. LNG accounted for only 2% of Japan's total LNG imports between January and May, imports from the United States are growingly expected to help diversify supply sources and prices for Japan.

By July 2017, Japan restarted five nuclear power plants. Preparations are being made for the restart of seven others that have cleared examinations on their conformity with regulatory standards. In addition, 13 plants are under examinations. Since November 2015, no application has been filed for examinations.

As for the Feed-in Tariffs (FIT) scheme for renewable energy, a new law took effect in April 2017 to curb tariffs, launching an initiative to restrict the scheme's burden on citizens.

Key assumptions behind the Reference Scenario

Global economy

We expect the global economy to moderately grow. In the U.S. economy plagued with political risks of the Trump administration, the employment market has sustained recovery, encouraging consumption. Non-residential investment is recovering after slackness, providing a positive factor. In Europe, the United Kingdom has filed an official notice to exit from the EU. However, negotiations on the exit are expected to remain difficult, increasing uncertainties about the U.K. economy. In the whole of Europe, private consumption has been steady, supported by employment and income improvements and favourable consumer sentiment. Investment and export recovery is a positive factor. The Asian economy is expected to continue high growth, supported by the Chinese economy's acceleration, export recovery and steady private consumption. We expect the global economy to grow 3.0% in FY2017 and 3.3% in FY2018.

Crude oil/LNG/coal import CIF prices

Although OPEC and non-OPEC oil producing countries have extended their coordinated

production cut, production expansion mainly in the United States will offset a major part of the effect of the production cut. As oil demand posts relatively robust growth, a supply-demand equilibrium may be achieved within the year. European and U.S. political risks and Middle Eastern geopolitical risks will have limited impacts on crude oil prices. Crude oil import CIF prices are assumed to average \$51/bbl in FY2017 and \$52/bbl in FY2018. LNG import CIF prices are assumed to average \$7.7/MBtu in FY2017 and \$7.6/MBtu in FY2018. Steam coal import CIF prices are assumed to average \$93/t in FY2017 and \$87/t in FY2018.

Exchange rate

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

Nuclear power generation

Nuclear power plants will be restarted at a steady pace depending on progress in regulatory standards conformity examinations. We expect a total of nine nuclear power plants to be operational at the end of FY2017. In the year, they will operate for an average eight months and generate 55.6 TWh. A total of 10 nuclear

power plants will be operational at the end of FY2018. In the year, they will operate for an average nine months and generate 65.6 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% required for stable nationwide electricity supply.

Air temperature

According to the Japan Meteorological Agency's three-month weather forecast, we assume that summer in FY2017 will be warm before air temperatures return to normal levels. This means that summer in FY2017 will be as warm as in the previous year and that winter will be as cold as in the previous year. In FY2018, summer will be cooler (-0.5°C) than in the previous year and winter will be as cold as in the previous year.

The macroeconomic situation

The Japanese economy will grow by 1.4% on robust domestic and foreign demand in FY 2017.

Private consumption will moderately increase on an improvement in employees' income. Non-residential investment will expand on an increase in investment in productivity-boosting measures such as automation responding to labour shortages, as well as earnings growth. Inventory accumulation from low levels will contribute to pushing up GDP. While residential investment will increase thanks to income improvements, the increase will substantially decelerate due to condominium price hikes. Private demand will contribute to 0.8 percentage points of the GDP growth. Public demand will increase thanks to the implementation of a supplementary budget for FY2016, contributing to 0.3 points. Exports will increase on overseas economic growth, while imports will expand on domestic demand growth. External demand will contribute to 0.3 points of the GDP growth.

Fossil fuel imports will increase for the first time in three years due to price hikes, reaching JPY15 trillion. The trade surplus will

fall to JPY1.3 trillion and the current account surplus to JPY19.7 trillion. The consumer price index will rise by 0.4%.

In FY2018, the Japanese economy will grow by 1.1%. While exports will decelerate on slowing improvements in the information technology cycle, domestic demand will remain brisk to support moderate growth.

Private consumption will retain moderate growth on a real wage improvement. Non-residential investment will expand, including investment in automation as well as projects related to the 2020 Tokyo Olympics and Paralympics. Residential investment will turn down on the deceleration of rental housing construction. Of public demand, government spending and public investment will increase. Public demand will contribute to 0.2 percentage points of the 1.1% growth. Exports will expand for the sixth straight year. External demand will contribute to 0.1 points of the GDP growth.

Trade and current account surpluses will increase for the first time in two years to JPY2.0 trillion and JPY21.2 trillion, respectively. The consumer price index will rise by 0.2%.

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)	492.8	510.3	516.6	523.0	530.5	536.6	1.2%	1.4%	1.1%
Private demand	369.0	388.2	392.6	395.3	399.7	403.8	0.7%	1.1%	1.0%
Private consumption	286.4	293.7	295.2	296.9	299.2	301.1	0.6%	0.7%	0.7%
Private residential investment	13.9	14.7	15.1	16.0	16.2	16.0	6.3%	1.1%	-1.1%
Private non-residential investment	67.6	79.0	79.5	81.5	83.2	85.7	2.5%	2.0%	3.1%
Public demand	122.6	129.4	130.9	130.5	132.1	133.4	-0.3%	1.2%	1.0%
Government consumption	98.1	103.2	105.4	105.8	106.7	107.8	0.4%	0.9%	1.0%
Public investment	24.7	26.1	25.6	24.7	25.3	25.5	-3.2%	2.3%	0.8%
Net exports of goods and services	1.3	-7.3	-6.9	-3.2	-1.5	-0.9	-54.3%	-51.5%	-43.3%
Exports of goods and services	74.7	82.2	82.8	85.3	88.9	91.0	3.1%	4.2%	2.4%
Imports of goods and services	73.4	89.5	89.7	88.5	90.4	91.9	-1.4%	2.2%	1.7%
Nominal GDP (JPY trillion)	499.2	517.7	531.8	537.5	545.1	553.4	1.1%	1.4%	1.5%
Balance of trade (JPY trillion)	5.3	-9.1	-1.1	4.1	1.3	2.0	-474%	-68.5%	55.7%
Exports	67.8	74.7	74.1	71.5	76.2	78.5	-3.5%	6.6%	3.0%
Imports	62.5	83.8	75.2	67.5	74.9	76.5	-10.3%	11.1%	2.1%
Fossil fuels	18.1	25.1	16.1	13.1	15.0	14.7	-18.2%	14.4%	-2.2%
Oil	12.3	15.2	9.6	7.8	8.8	8.8	-18.3%	12.2%	0.0%
LNG	3.5	7.8	4.5	3.3	3.8	3.7	-26.6%	12.6%	-2.6%
Current account (JPY trillion)	18.3	8.7	17.9	20.4	19.7	21.2	14.1%	-3.5%	7.6%
Domestic corporate goods price index (2015=100)	97.6	102.5	99.1	96.8	98.7	99.4	-2.4%	2.0%	0.7%
Consumer price index (2015=100)	96.4	99.8	100.0	100.0	100.4	100.6	0.0%	0.4%	0.2%
GDP deflator (2011=100)	101.3	101.5	102.9	102.8	102.7	103.1	-0.2%	0.0%	0.4%

Note: GDP components may not add up to the total GDP due to stock changes and minor data deviations.

Production activities

The industrial production will rise thanks to growing exports.

The industrial production in FY2017 will increase by 2.6% from the previous year thanks to growing exports amid an overseas economic recovery and to rising domestic demand. Particularly, general and electrical machinery production will expand substantially due to increasing electrical machinery exports. Inventory accumulation from low levels will also push up production. In FY2018, the industrial production index will increase by 1.3% on robust exports and domestic demand.

Crude steel production will increase to 107 Mt in FY2017 and to 108 Mt in FY2018 due to domestic demand expansion related to the Tokyo Olympics.

In FY2017, crude steel production will increase by 1.5% from the previous year to 106.8 Mt due to the expansion of domestic demand for urban redevelopment and infrastructure construction for the Tokyo Olympics. In FY2018, crude steel production will rise by 1.0% to 107.8 Mt thanks to domestic demand expansion related to the Tokyo Olympics.

Ethylene production with equipment running at full capacity will increase in FY2017 due to fewer regular repairs but decrease in FY2018 due to more repairs.

Ethylene production in FY2017 will increase by 0.6% from the previous year to 6.32 Mt as regular repairs decrease. In FY2018, however, production will fall by 2.6% to 6.16 Mt as regular repairs increase, with competition intensifying from U.S. ethylene made from shale gas at new plants.

Cement production will increase for the third straight year thanks to growing public works and construction projects related to the Tokyo Olympics, exceeding 60 Mt.

Cement production in FY2017 will increase by 1.1% to 59.91 Mt as public works grow along with construction projects related to the Tokyo Olympics. In FY2018, production will rise by 0.6% to 60.29 Mt on growing demand related to the Tokyo Olympics, exceeding 60 Mt for the first time in four years.

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

While paper demand will decline on a population fall and a switch to electronic media in FY2017, paperboard production will expand due to growth in exports amid increasing sales via the Internet in China. Paper and paperboard production in the year will thus rise by 0.3% from the previous year. In FY2018, paper and paperboard production will grow by 0.3% to 26.49 Mt as the FY2017 trend continues.

Automobile production will increase to 9.43 million units on robust domestic and overseas demand in FY2017 and to 9.51 million units in FY2018.

In FY2017, automobile production will increase by 0.7% from the previous year to 9.43 million as domestic private consumption growth coincides with robust exports amid an overseas economic recovery. In FY2018, production will rise by 0.8% despite decelerating exports as domestic private consumption grows robustly on an improvement in real wages.

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	106.8	107.8	0.9%	1.5%	1.0%
	Ethylene (Mt)	7.00	6.69	6.78	6.29	6.32	6.16	-7.3%	0.6%	-2.6%
	Cement (Mt)	56.1	61.1	59.2	59.3	59.9	60.3	0.1%	1.1%	0.6%
	Paper and paperboard (Mt)	27.3	26.3	26.2	26.3	26.4	26.5	0.4%	0.3%	0.3%
	Automobiles (Million units)	8.99	9.59	9.19	9.36	9.43	9.51	1.9%	0.7%	0.8%
Production indices	Mining and manufacturing (2010=100)	99.4	98.4	97.5	98.6	101.1	102.5	1.2%	2.6%	1.3%
	Food	98.2	95.5	96.9	96.8	97.5	98.2	-0.1%	0.7%	0.8%
	Chemicals	99.7	95.2	98.0	100.7	102.2	102.7	2.8%	1.4%	0.5%
	Non-ferrous metals	98.9	97.9	96.5	98.9	99.5	100.2	2.5%	0.6%	0.7%
	General and electrical machinery, etc.	101.3	100.0	98.5	98.3	102.2	104.4	-0.2%	4.0%	2.2%
Tertiary industry activity index (2010=100)		99.9	102.1	103.5	103.9	105.0	106.0	0.4%	1.1%	0.9%

Notes: Chemicals include chemical fibers.

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

Primary energy supply

While production and economic activities will expand on robust domestic and overseas demand, primary energy supply will decrease on progress in energy conservation.

Primary energy supply in Japan in FY2017 will decline by 0.1% from the previous year on progress in energy conservation, despite manufacturing production and economic expansion that usually boosts energy supply. In FY2018, primary energy supply will decrease by 0.6% as a slow production recovery is coupled with progress in energy conservation.

Oil in FY2017 will decrease by 3.5% due to vehicle fuel efficiency improvements, fuel switching and a fall in oil for power generation amid the restart of additional nuclear power plants, although naphtha will expand on an increase in ethylene production. Oil's share of total primary energy supply will fall to 39.0%, slipping below 40% for the first time since FY1961 when the energy revolution was going on. In FY2018, oil will drop by 2.7% due to fuel switching, progress in energy conservation and a decrease in oil for power generation amid the restart of additional nuclear power plants.

Natural gas in FY2017 will fall by 3.2% for the first drop in two years due to a large fall in natural gas for power generation amid the restart of additional nuclear power plants and renewable energy expansion, although supply for city gas will increase thanks to manufacturing production expansion and fuel switching. In FY2018, natural gas will decrease by 2.2% due to a decline in power generation, despite an increase in city gas.

Coal will post a slight increase of 0.1% in FY2017 as industrial demand expands on growing cement and steel production. In FY2018, coal will rise by 0.4% on crude steel production expansion.

Nine nuclear power plants will have restarted by the end of FY2017, with nuclear power generation totalling 55.6 TWh. In FY2018, the number of restarted nuclear power plants will increase to 10, with nuclear power generation aggregating 65.6 TWh, equivalent to more than 20% of the FY2010 level before the Great East Japan Earthquake and nuclear power plant accident seriously affected nuclear power generation.

Renewable energy will follow an uptrend as mainly solar PV generation expands. In FY2018, renewable energy's share of primary energy supply will reach 5.1%.

Energy self-sufficiency rate will rise to 12.8% in FY2018 due to nuclear and renewable energy expansion. The rate will still be 5.2 points lower than 18.0% in FY2010 before the disaster affected Japan's energy self-sufficiency.

After peaking at 1,235 Mt in FY2013, Japan's energy-related CO₂ emissions in FY2018 will decrease for five years on end due to progress in energy conservation and in the restart of nuclear power plants and renewable energy expansion. FY2018 emissions will total 1,096 Mt, slipping below 1,100 Mt. for the first time in 25 years excluding FY2009 when emissions fell exceptionally due to the Lehman Shock. The FY2018 emissions represent an 11.3% decline from FY2013, compared with Japan's target of cutting emissions in FY2030 by 25% from FY2013 under the Paris Agreement target.

Table 4 | Primary Energy Supply

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Primary energy supply (Mtoe)	514.7	473.9	467.0	465.6	465.4	462.4	-0.3%	-0.1%	-0.6%
Coal	119.2	124.4	123.7	121.9	122.0	122.5	-1.5%	0.1%	0.4%
Oil	212.0	198.6	193.6	187.9	181.4	176.5	-2.9%	-3.5%	-2.7%
Natural gas	95.7	118.9	113.0	115.8	112.1	109.6	2.5%	-3.2%	-2.2%
Hydro	17.7	17.4	18.1	16.6	16.6	16.6	-8.4%	0.0%	0.0%
Nuclear	60.7	0.0	2.2	3.7	11.5	13.6	74.0%	208%	17.9%
Geothermal, new energy, etc.	9.5	14.6	16.6	19.8	21.8	23.6	19.3%	10.0%	8.4%
Self-sufficiency rate	18.0%	7.7%	8.8%	9.5%	11.9%	12.8%	0.7p	2.4p	0.9p
Energy intensity (FY2011=100)	105.1	93.5	91.0	89.6	88.3	86.8	-1.5%	-1.5%	-1.8%
Energy-related CO2 emissions (Mt-CO2)	1,139	1,189	1,149	1,136	1,113	1,096	-1.1%	-2.0%	-1.6%
(FY2013=100)	92.2	96.3	93.0	92.0	90.1	88.7

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

While economic expansion will work to expand final energy consumption, progress in energy conservation and other factors will push down final energy consumption in FY2017 and FY2018.

Final energy consumption in FY2017 will decrease by 0.5% from the previous year. The industry sector will boost consumption slightly on production expansion. On the other hand, the buildings sector will reduce consumption through progress in energy conservation. The transport sector will also cut consumption as fuel efficient vehicles expand their market share. In FY2018, final energy consumption will widen a decline to 0.8% as all sectors reduce consumption. The industry sector will cut consumption through progress in energy conservation. The buildings sector will cut consumption due to temperature changes as well as energy conservation. The transport sector will continue to see fuel efficiency improvements. Final energy consumption in FY2018 will decrease for the eighth straight year since the Great East Japan Earthquake.

The industrial sector will expand energy consumption by a mere 0.1% in FY2017 despite energy conservation as cement and steel production expands in line with growing demand related to the Tokyo Olympics. While city gas and electricity will increase, petroleum products will fall on progress in fuel switching. In FY 2018, the industrial sector's energy consumption will fall by 0.5% due to an ethylene production cut.

The residential sector will reduce energy consumption in FY2017 by 0.8% from the previous fiscal year due to equipment efficiency improvements. In FY2018, the sector will cut energy consumption by 1.0% due to an assumed cooler summer and the further diffusion of energy-saving equipment. The sector's electricity consumption will fall as air-conditioning demand decreases. Its city gas will increase slightly in FY2017 thanks to continuous demand exploration and residential equipment's growing use of city gas. In FY2018, the sector's city gas consumption will level off. Its consumption of petroleum products including kerosene will decline on fuel switching.

In the commercial sector, energy consumption will decline by 0.6% in FY2017 due to progress in energy conservation regarding air conditioning and lighting equipment, although the economic expansion will work to boost energy consumption. In FY2018, the sector's energy consumption will decrease by 0.6% as energy conservation progress is combined with temperature changes.

The transport sector will reduce energy consumption by 1.1% in FY2017 and by 1.2% in FY2018 due mainly to rising transport efficiency and fuel efficiency improvements accompanying fuel-efficient vehicles' growing market share. In the outlook period through FY2018, the transport sector will account for nearly 50% of the total final energy decline in Japan.

Table 5 | Final Energy Consumption

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Final energy consumption (Mtoe)	342.1	315.9	311.4	311.4	309.9	307.6	0.0%	-0.5%	-0.8%
Industry	159.3	149.2	147.2	146.6	146.7	145.9	-0.4%	0.1%	-0.5%
Buildings	100.2	89.9	87.2	88.7	88.0	87.3	1.7%	-0.7%	-0.8%
Residential	54.7	48.8	47.1	48.0	47.6	47.1	1.8%	-0.8%	-1.0%
Commercial	45.6	41.1	40.1	40.7	40.5	40.2	1.5%	-0.6%	-0.6%
Transport	82.5	76.8	76.9	76.1	75.2	74.3	-1.1%	-1.1%	-1.2%
Coal and coal products	36.7	36.0	33.7	33.6	33.9	34.1	-0.3%	0.9%	0.6%
Petroleum products	177.6	159.4	158.9	156.5	154.1	151.3	-1.5%	-1.6%	-1.8%
City and natural gas	34.5	34.6	34.1	35.1	35.5	35.7	3.1%	1.1%	0.6%
Electricity	89.8	82.7	81.6	83.1	83.4	83.4	1.8%	0.4%	0.0%
Others	3.4	3.2	3.0	3.0	3.1	3.1	-0.2%	2.0%	0.5%

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

Electricity sales and power generation mix (electric utilities)

Electricity sales will increase due to robust industrial demand under brisk production, despite a decline in sales to lighting service users. A rapid decline trend since the Great East Japan Earthquake will end.

In FY2017, electricity sales to lighting service and low-voltage users will decrease by 0.2% and 0.5%, respectively, thanks to the expansion of energy-saving equipment. Sales to extra-high voltage and high voltage users will increase by 0.6% and 1.0%, respectively, due to robust production accompanying brisk electric machinery exports.

In FY2018, sales to lighting service users will decrease by 0.4% for the second straight year of drop as summer temperatures are lower than in the previous year. Sales to low-voltage users will decrease by 1.1% on the expansion of energy-saving equipment and a drop in late-night electricity supply contracts amid an increase in all-electric home contracts. Sales to extra-high voltage and high voltage users will increase by 0.3% and 0.2%, respectively, as production continues to recover. Total electricity sales will remain almost unchanged from the previous year, ending a rapid-decline trend since the Great East Japan Earthquake.

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	857.7	857.7	n.a.	0.4%	0.0%
Extra-high voltage	(246.1)	(233.5)	(229.3)	231.4	232.9	233.5	n.a.	0.6%	0.3%
High voltage	(330.3)	(305.8)	(303.7)	307.3	310.4	311.1	n.a.	1.0%	0.2%
Low voltage	(350.2)	(312.1)	(304.5)	315.2	314.5	313.0	n.a.	-0.2%	-0.5%
Lighting service	304.2	273.1	266.9	271.8	271.4	270.4	1.9%	-0.2%	-0.4%
Power service	(45.9)	(39.0)	(37.7)	43.3	43.1	42.7	n.a.	-0.5%	-1.1%

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

Fossil fuels' share of total power generation in FY2017 will slip below 80% for the first time in five years on the restart of additional nuclear power plants and the expansion of renewable energy and fall further in FY2018 to the lowest level since the Great East Japan Earthquake.

In FY2017, nuclear energy's share of total power generation will rise by 3.8 percentage points to 6% as more nuclear power plants are in operation. Renewable energy's share will also increase by 0.9 points to 7%. In contrast, fossil

fuels' share will decline by 4.2 points to 77%, slipping below 80% for the first time in five years. In FY2018, nuclear energy's share will expand only by 1.0 points to 7% as fewer nuclear power plants are restarted than in the previous year. Renewable energy will further raise its share to 8%. Fossil fuels' share, though still being high, will decline by 1.8 points to 75%, the lowest since the Great East Japan Earthquake. Due to the restart of nuclear power plants and the rapid expansion of renewable energy, oil's share of power generation will fall close to the level before the earthquake. Liquefied natural gas will see its share slipping below 40%.

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)	(920.1)	994.1	997.9	997.9	n.a.	0.4%	0.0%
Share	Year-to-year changes								
Hydro	(9%)	(9%)	(9%)	8%	8%	8%	n.a.	+0.0p	+0.0p
Fossil fuels	(62%)	(87%)	(84%)	81%	77%	75%	n.a.	-4.2p	-1.8p
Coal	(25%)	(30%)	(31%)	30%	30%	30%	n.a.	-0.0p	+0.0p
LNG	(29%)	(46%)	(43%)	41%	39%	37%	n.a.	-2.7p	-1.5p
Oil, etc.	(8%)	(11%)	(9%)	10%	9%	9%	n.a.	-0.9p	-0.3p
Nuclear	(29%)	(0%)	(1%)	2%	6%	7%	n.a.	+3.8p	+1.0p
New energies and others	(1%)	(3%)	(4%)	6%	7%	8%	n.a.	+0.9p	+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 30MW or less estimated to be about half of the "Hydro".

City gas sales (gas utilities)

City gas sales will continue to rewrite a record high in FY2017 and FY2018, driven by sales for general industrial use amid robust production and demand exploration.

City gas sales in FY2017 will increase by 1.0% from the previous year to 41.9 billion m³ thanks to continuous demand development activities, continuing to rewrite a record high. In FY2018, city gas sales will expand by 0.6% to 42.2 billion m³, rewriting a record high for the third straight year, driven by sales for general industrial use amid continued robust production.

Residential sales will increase by 0.2% in FY2017 due to continuous demand development activities and the diffusion of city gas-using equipment such as residential fuel cells. In FY2018, residential sales will level off under a similar trend.

Business sales (commercial and other sales) will decrease (-0.4% for commercial sales and -0.3%

for others) on the diffusion of energy-saving equipment in FY2017. In FY2018, they will decline further (-0.5% for commercial sales and -0.2% for others) as the diffusion of energy-saving equipment is combined with a decline in air conditioning demand under lower summer temperatures than in the previous year.

Industrial sales in FY2017 will increase by 1.7% to 24.6 billion m³ on robust steel, chemical and machinery production and growing sales for general industrial use accompanying fuel switching from oil to city gas for industrial furnaces and boilers. In FY2018, they will expand by 1.2% to 24.9 billion m³ as capacity utilization rates of existing production equipment rise on brisk production, with fuel switching continuing.

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%.

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	41.93	42.19	4.1%	1.0%	0.6%
Residential	9.79	9.58	9.24	9.41	9.42	9.43	1.8%	0.2%	0.0%
Commercial	4.75	4.34	4.26	4.32	4.30	4.28	1.4%	-0.4%	-0.5%
Industrial	21.61	22.74	23.01	24.20	24.61	24.90	5.2%	1.7%	1.2%
Manufacturing	(20.18)	(20.07)	(20.57)	19.26	19.67	19.96	n.a.	2.1%	1.5%
Electric utilities	(1.43)	(2.68)	(2.44)	4.94	4.94	4.94	n.a.	0.0%	0.0%
Others	3.13	3.50	3.41	3.61	3.60	3.59	6.0%	-0.3%	-0.2%

Note: Converted at 1 m³=41.8605 MJ (10,000 kcal). Figures in brackets are statistics based on formerly used definitions and do not match up.

Fuel oil/LPG sales and crude oil throughput

While naphtha sales will expand in FY2017, other fuel oil sales will decline. All fuel oils will post sales declines in FY2018, with total sales slipping below 70% of the peak.

Fuel oil sales in FY2017 will decline by 1.6% due to a substantial fall in heavy fuel oil C for power generation amid the restart of nuclear power plants and the expansion of renewable energy, as well as kerosene and heavy fuel oil A, B/C sales drops amid fuel switching to electricity and city gas, although naphtha will rise on an ethylene production increase. In FY2018, all fuel oils will post sales drops. Total fuel oil will decline by 1.7% for the sixth straight annual fall, slipping below 70% of the fuel oil peak at 246 billion litre in FY1999.

Gasoline will decrease by 1.7% each in FY2017 and FY2018 due to shorter travelling distances, the further diffusion of fuel efficient vehicles and the advancement of fuel-saving technologies.

Naphtha will expand by 0.2% in FY2017 in response to an ethylene production increase. In FY2018, naphtha will decrease by 1.4% as ethylene production declines on regular plant repairs and competition from the launch of ethylene production from shale gas in the United States.

Kerosene will decrease by 1.9% in FY2017 and by 1.5% in FY2018 on continuous fuel switching to electricity and city gas, after increasing in FY2016 for the first time in six years.

Heavy fuel oil A will drop by 3.3% in FY2017 and by 2.6% in FY2018 due to a reactionary fall after a FY2016 rise amid crude oil price plunges, as well as energy conservation and fuel switching to city gas in the industry and commercial sectors.

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 and the expansion of renewable energy. Total heavy fuel oil B/C sales will plunge by 8.7% in FY2017 and by 5.6% in FY2018.

LPG will fall by 2.9% in FY2017 and by 1.9% in FY2018 due to fuel switching to city gas, the enhancement of LPG-fuelled equipment's efficiency, a taxi fleet decline under the enactment of the Taxi Vehicle Reduction Act and the improvement of fuel efficiency for taxis.

Crude oil throughput will decrease by 0.8% in FY2017 and by 1.2% in FY2018 on a fall in petroleum product demand and a cut in oil refining capacity under the third 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	182.7	180.5	176.8	173.9	171.0	-2.1%	-1.6%	-1.7%
Gasoline	58.2	53.0	53.1	52.5	51.6	50.7	-1.2%	-1.7%	-1.7%
Naphtha	46.7	43.9	46.2	44.8	44.9	44.3	-3.0%	0.2%	-1.4%
Jet fuel	5.2	5.3	5.5	5.3	5.3	5.3	-3.5%	-0.2%	-0.4%
Kerosene	20.4	16.7	15.9	16.2	15.9	15.7	1.8%	-1.9%	-1.5%
Diesel oil	32.9	33.6	33.6	33.3	33.1	32.9	-0.8%	-0.6%	-0.6%
Heavy fuel oil A	15.4	12.3	11.9	12.0	11.6	11.3	1.0%	-3.3%	-2.6%
Heavy fuel oils B and C	17.3	17.9	14.2	12.6	11.5	10.9	-11.4%	-8.7%	-5.6%
For electric utilities	7.7	10.8	8.2	6.6	5.5	4.9	-18.9%	-16.5%	-11.0%
For other users	9.7	7.2	6.1	6.0	6.0	5.9	-1.3%	-0.1%	-0.6%
LPG sales (Mt)	16.5	15.4	14.7	14.4	14.0	13.7	-2.1%	-2.9%	-1.9%
Crude oil throughput (GL)	208.9	189.0	189.0	190.6	189.1	186.8	0.8%	-0.8%	-1.2%

In-depth analysis: Diesel oil demand trend

Diesel oil sees relatively steady demand, accounting for nearly 20% of fuel oil.

Diesel oil, ranked third after gasoline and naphtha among fuel oils in sales, is widely consumed in the transport, industrial and buildings sectors and the only major fuel oil scoring a sales increase from FY2010 before the Great East Japan Earthquake seriously affected energy demand.

Through FY2018, diesel oil will post slower sales decreases (-0.6% in FY2017 and -0.6% in FY2018) than other fuel oils products. As a result, diesel oil's share of total fuel oil sales will rise to 19.3% from 16.8% in FY2010.

Diesel oil for freight transportation will slow down a decline.

Diesel oil for vehicles (the transport sector), which account for more than 80% of total diesel sales, will follow a downtrend through FY2018, posting a 0.7% fall in the year. Diesel oil sales for freight transport will fall at an annual rate of 0.9%, slower than a 1.4% fall in FY2016. Fuel and transport system efficiency improvements will continuously work to cut diesel oil. Meanwhile, growing parcel delivery services accompanying growing Internet sales and truck transportation demand are also key determinants of diesel oil demand. The number of parcels for delivery services in FY2016 increased by 7%. Further growth is expected through FY2018. This trend will mitigate a decline in diesel oil for freight transport.

Diesel oil for bus and other passengers will increase slightly.

Diesel oil sales have continued a slow uptrend and will post slight increases through FY2018

(+0.4% in FY2017 and +0.1% in FY2018). Buses, which account for the core share of diesel oil consumption for passengers, are increasing at an annual rate of 2%. In the future, sightseeing and other large buses may growingly be used in response to an increase in the number of foreign tourists visiting Japan. Although diesel passenger cars have discontinued declining, the discontinuation falls short of contributing to increasing diesel oil sales.

While diesel oil for agriculture, forestry and fisheries will decline, the fall will be more than offset by an increase in those for construction.

Diesel oil in the industrial sector will level off or increase slightly through FY2018. Within the industrial sector, the agriculture, forestry and fisheries industry substantially consumes diesel oil. However, the industry has been shrinking as workers have decreased and aged. This industry will thus reduce diesel oil consumption. Meanwhile, construction machines consume much diesel oil. Construction will increase on reconstruction after the Great East Japan Earthquake, the 2016 Kumamoto Earthquake and toward the Tokyo Olympics. The construction industry activity index in FY2016 increased by 2.2% from the previous year, before posting a sharp year-on-year increase of 7.3% in April 2017 after seasonal adjustment. Although the substantial growth in April is unlikely to be sustained, the index is expected to increase moderately through FY2018, contributing to expanding diesel oil sales.

Table 10 | Diesel Oil Sales

	Historical				Projections		Year-to-year changes		
	FY2010	FY2014	FY2015	FY2016	FY2017	FY2018	FY2016	FY2017	FY2018
Diesel oil sales (GL)	32.89	33.58	33.62	33.34	33.13	32.92	-0.8%	-0.6%	-0.6%
Industrial	2.66	3.04	3.19	3.18	3.18	3.19	-0.4%	0.1%	0.4%
Residential & Commercial	1.29	1.35	1.32	1.34	1.31	1.29	1.4%	-2.4%	-1.6%
Transport	28.79	29.00	28.98	28.66	28.47	28.27	-1.1%	-0.7%	-0.7%
Passenger	4.89	4.91	4.98	4.98	5.00	5.01	0.1%	0.4%	0.1%
Freight	23.90	24.09	24.00	23.67	23.47	23.27	-1.4%	-0.9%	-0.9%
Power sector	0.15	0.19	0.13	0.17	0.17	0.17	29.7%	0.0%	0.0%
Diesel oil share of total fuel oil	16.8%	18.4%	18.6%	18.9%	19.0%	19.3%	+0.2p	+0.2p	+0.2p

Renewable energy-based power generation

A new scheme will be introduced under the Revised Renewable Energy Feed-in-Tariff Law.

The revised FIT Act¹ took effect in April 2017 to substantially change the feed-in tariff scheme to address problems with the favourable treatment of renewable energy, including non-operational approved renewable energy-based power generation facilities and high feed-in tariffs boosting burdens on citizens.

Under the new FIT scheme, large solar PV facilities with capacity at 2 MW or more will be subjected to bidding from October 2017. Long-term cost levels will be set to encourage solar PV facilities to become independent from the FIT scheme. The feed-in tariff for residential solar PV facilities will be lowered to a level equivalent to the residential electricity rate (JPY24,000/MWh) in 2019.

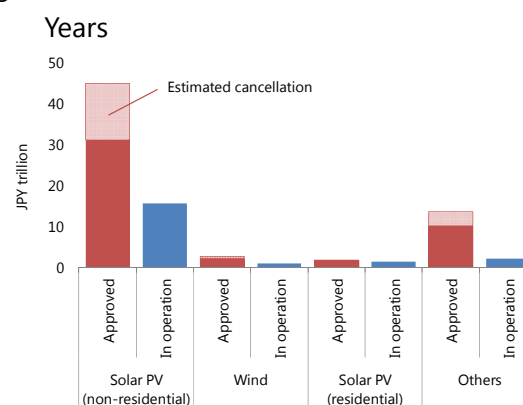
The cancellation of approval for some non-operational solar PV capacity has been implemented to restrict rapid growth in approved non-residential solar PV capacity, leading approved capacity to level off in the past year. As the revised FIT Act sets a deadline for making approved capacity operational, 27.7 GW out of approved non-residential solar PV capacity may be cancelled.

The cumulative burden on consumers will decline from JPY63 trillion to JPY45 trillion due to cancellation

If all FIT capacity at 66.9 GW, excluding cancelled capacity from 94.6 GW in total approved capacity including transferred facilities² at the end of February 2017, becomes operational, the 20-year burden on consumers

will reach JPY45 trillion³. The estimated burden amounts to an electricity rate hike of JPY2,600/MWh or 11% for residential users and 16% for industrial users. The estimated burden represents a substantial fall from JPY63 trillion for the case without cancellation of approved facilities, indicating some achievement of the revised FIT Law. 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.

Figure 2 Cumulative Burden of FIT over 20



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

The cumulative capacity of renewable energy-based power generation facilities is approaching 68.3 GW

While rapid growth in newly approved renewable energy power generation facilities including non-residential solar PV facilities will be corrected, installed renewable energy generation capacity will reach 68.3 GW at the end of FY2018, with facilities under construction

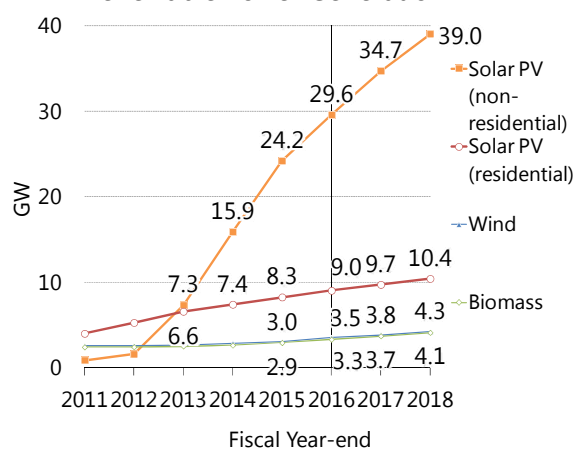
¹ Revision of the Act on Special Measures Concerning Procurement of Electricity from Renewable Energy Sources by Electricity Utilities

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 marginal avoidance cost is put at JPY10,900/MWh based on the renewable energy FIT scheme on the website of the Agency for Natural Resources and Energy. The capacity factor is assumed at 20% for wind, 12% for solar PV, 70% for geothermal energy, 45% for hydro and 70% for biomass.

launching operations. Particularly, installed non-residential solar PV capacity will total 39.0 GW at the end of FY2018, accounting for more than half the total. Given that five years are required for launching wind power generation after approval, installed wind generation capacity will be limited to 4.3 GW at the end of FY2018. Renewable energy-based power generation in FY2018 will total 127.3 TWh (including 52 TWh for solar PV, 7.4 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 3 Installed Capacity in Operation of Renewable Power Generation



The Impact of the pace of nuclear power plant restarts

The Takahama Nuclear Power Station resumed commercial operation of Units 3 and 4. The nuclear power plant restart will make progress in FY2017.

Kansai Electric Power Co.'s Takahama Nuclear Power Station has restarted commercial operation of Units 3 and 4 in addition to Units 1 and 2 of Kyushu Electric Power Co.'s Sendai Nuclear Power Station and Unit 3 of Shikoku Electric Power Co.'s Ikata Nuclear Power Station. A total of five plants are now in commercial operation in Japan. Kansai Electric announced that it would take advantage of a fossil fuel cost decline through the restart of Takahama Units 3 and 4 to implement an average 4.29% cut in electricity rates on August 1, demonstrating that the restart would benefit the relevant region.

Seven other nuclear power plants have been qualified to conform to new regulatory standards and are planned to restart operation in the near future. They are Units 3 and 4 of Kyushu Electric's Genkai Nuclear Power Station, Units 3 and 4 of Kansai Electric's Oi Nuclear Power Station, Unit 3 of Kansai Electric's Mihama Nuclear Power Station, and Units 1 and 2 of Kansai Electric's Takahama Nuclear Power Station. As well as the five plants in operation, the seven plants are located in western Japan. In eastern Japan, applications have been filed for examinations of eight nuclear power plants' conformity to regulatory standards. However, the examinations have not been completed for any of the eight plants.

This chapter assesses the effect on the so-called 3Es (economic efficiency, stable energy supply 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 power plants' 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 power plant 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 stand at nine at the end of FY2017 and at 10 at the end of FY2018. Nuclear power plants will operate for an average of about nine months in FY2018, generating a total of 65.6 TWh accounting for 7% of Japan's total power generation.

In the "Low Case," we assume that the cumulative number of restarted nuclear power plants at the end of FY2018 will remain unchanged from five at present. They will operate for an average of about 10 months in FY2018, generating a total of 31.6 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 nine at the end of FY2017 and at 17 at the end of FY2018. The 17 plants account for about two-thirds of the 25 plants subjected to applications filed so far for regulatory standards conformity examinations. They will operate for an average of about eight months in FY2018, generating a total of 99.4 TWh accounting for 10% of Japan's total power generation. The share amounts to about a half of 20-22% for nuclear energy in the electricity 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 plant will be in operation in FY2018. This case is prepared for comparison with the other cases.

Nuclear energy's contributions to the 3Es.

Fossil fuel import value in the "Reference Scenario" is JPY500 billion less than in the Zero Operation Case and the value in the High Case is JPY700 billion less. As a result, unit electricity cost savings are worth JPY0.3/kWh in the Reference Scenario and JPY0.5/kWh the

High Case. Even in the High Case, however, the unit electricity cost is 14% higher than JPY4.9/kWh in FY2010⁴ when many nuclear power plants were in operation. Real GDP in the Reference Scenario is JPY500 billion more than in the Zero Operation Case due to less fossil fuel imports. In the High Case, real GDP is JPY800 billion more.

The energy self-sufficiency rate in the Reference Scenario is 2.9 percentage points higher than in the Zero Operation Case and the rate in the High Case is 4.4 points higher. However, the energy self-sufficiency rates in the Reference Scenario and the High Case still slip below 18.0% for FY2010 before the Great East Japan Earthquake affected the Japanese energy situation seriously.

CO₂ emissions in the Reference Scenario are 30 Mt less than in the Zero Operation Case and those in the High Case are 45 Mt less. Compared with FY2013, the standard year for Japan's CO₂ emission reduction target⁵ under the Paris Climate Accord, emissions in the Reference Scenario are 11.3% less and those in the High Case are 12.5% less. Given progress in energy conservation and the diffusion of renewable energy, CO₂ emissions in both cases slip below 1,139 Mt in FY2010.

Progress in the restart of nuclear power plants contributes to reducing fossil fuel consumption for power generation, lowering electricity costs, boosting the economy, improving the energy self-sufficiency rate and cutting CO₂ emissions.

⁴ At the end of 2010, a total of 39 nuclear plants were in operation.

⁵ The target seeks to reduce greenhouse gas emissions in FY2030 by 26% from FY2013 and energy-related CO₂ emissions by 25%.

Table 11 | The Impact of the Pace of Restarting of Nuclear Power Plants (FY2018)

		Zero Case	Low Case	Reference Scenario	High Case	changes from the Zero Case		
						Low Case	Reference	High Case
Nuclear power presupposition	Cumulative number of restarted nuclear reactors	[0]	[5]	[9]	[9]	[+5]	[+9]	[+9]
	End of FY2017	0	5	10	17	+5	+10	+17
	End of FY2018	0	5	10	17	+5	+10	+17
	Average period for operation(months)	0	10	9	8	+10	+9	+8
Economy	Power generation by nuclear (TWh)	0	31.6	65.6	99.4	+31.6	+65.6	+99.4
	Power supply composition ratio	0%	3%	7%	10%	+3p	+7p	+10p
	Electricity unit cost ¹ (JPY/kWh)	6.1	5.9	5.8	5.6	-0.1	-0.3	-0.5
	Fuel cost	3.8	3.7	3.5	3.4	-0.1	-0.3	-0.5
	FIT purchasing cost	2.3	2.3	2.3	2.3	-	-	-
	Total fossil fuel imports (JPY trillion)	15.2	15.0	14.7	14.5	-0.2	-0.5	-0.7
	Oil	9.0	8.9	8.8	8.7	-0.1	-0.2	-0.3
	LNG	4.0	3.8	3.7	3.5	-0.1	-0.3	-0.5
	Trade balance (JPY trillion)	1.5	1.7	2.0	2.2	+0.2	+0.5	+0.7
	Real GDP (JPY2011 trillion)	536.1	536.3	536.6	536.9	+0.2	+0.5	+0.8
Energy	Gross national income per capita (JPY thousand)	4,361	4,363	4,365	4,367	+2	+4	+6
	Primary energy supply							
	Oil (GL)	197.3	195.1	192.8	190.8	-2.2	-4.6	-6.6
	Natural gas (Mt of LNG equivalent)	90.0	86.8	83.4	79.9	-3.1	-6.5	-10.1
	LNG imports (Mt)	86.8	83.7	80.3	76.7	-3.1	-6.5	-10.1
	Self-sufficiency rate	9.9%	11.3%	12.8%	14.3%	+1.4p	+2.9p	+4.4p
	Environment	Energy-related CO ₂ emissions (Mt-CO ₂)	1,126	1,111	1,096	1,081	-15	-30
Changes from FY2013		-8.8%	-10.0%	-11.3%	-12.5%	-1.2p	-2.5p	-3.7p

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

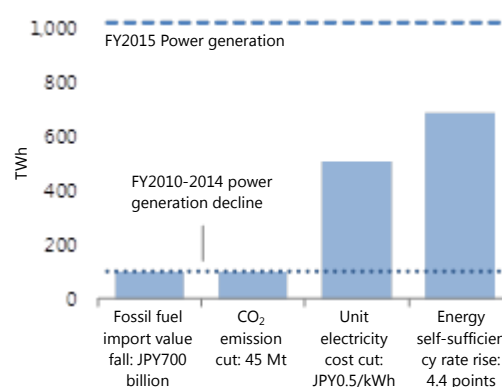
How could electricity conservation realize the same effect as the restart of nuclear power plants?

If electricity conservation instead of nuclear power utilization is implemented to realize a cut of JPY700 billion in fossil fuel import value and a reduction of 45 Mt in CO₂ emissions in the High Case, power generation will have to be reduced by about 100 TWh. The reduction amounts to a power generation decline from FY2010 to FY2014. Rough estimates indicate that power generation must be cut by about 500 TWh (or about 50%) to reduce the unit electricity cost by JPY0.5/kWh and that power generation must be cut by 690 TWh or about 70% to raise the energy self-sufficiency rate by 4.4 percentage points. However, this magnitude of electricity conservation is unrealistic. It is extremely difficult to get the same effect with electricity conservation alone without nuclear power generation as with the nuclear restart.

The secure restart of nuclear power plants conforming to regulatory standards is indispensable for achieving the best energy mix

for 2030 that gives consideration to the 3Es. To this end, Japan will have to continuously improve safety, promote accurate nuclear energy policies and accumulate safe operation records for restarted nuclear power plants.

Figure 4 Additional electricity conservation required to get the same effect as in the High Case



(Note) On a power generation base.

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