Economic and Energy Outlook of Japan through FY2017

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Introduction

The Japanese economy has experienced three consecutive quarters of growth since the start of 2016. There has also been a recovery in demand from overseas. Signs of recovery can also be seen in overseas economies.

With regard to the international energy situation, Brent crude oil prices, which until August 2014 had been trending at over $100/bbl, dropped below $28/bbl in January 2016. Oil prices subsequently gradually increased however, and in November OPEC members agreed to cut oil production. Supply and demand in the oil market is expected to head toward equilibrium in 2017.

With regard to the domestic energy situation, as of December 2016, five nuclear plants had been restarted. There have also been a string of approvals for facilities to operate beyond the 40-year limit placed on them. With regard to the Feed-in Tariffs (FIT) scheme for renewable energy sources, efforts to limit the burden placed on general consumers are now underway including legal reform aimed at applying the scheme to facilities that are not in operation and the reduction of purchasing prices.

Based on this understanding of the current situation we have formulated a projection for the Japanese economy and energy supply and demand in FY2017, and have also carried out impact assessment analysis of a variety of related factors.

Key assumptions behind our Reference Scenario

Global economy

We expect the global economy to achieve gradual growth. We expect steady consumption in the U.S. economy as a result of improvements to the employment situation as well as increased investment in infrastructure by the upcoming president. We expect the European economy to remain steady despite the decision by the United Kingdom to leave the European Union, with steady private consumption underpinning the economy across Europe. In Asia, we expect the Chinese economy to achieve a growth rate of approximately 5%, reflecting a pause in China's economic slowdown. We expect the global economy to grow at 3.1% in FY2016, and 3.4% in FY2017.

Crude oil/LNG/coal import CIF prices

We expect oil supply and demand to head gradually toward equilibrium in 2017. We expect energy import prices to gradually increase. Note however that there are factors that are expected to limit price increases including interest rate rises in the United States and political/economic risks in Europe. We expect crude oil import prices to be $48/bbl in FY2016 and $58/bbl in FY2017. We expect LNG import prices to be $6.6/MBtu in FY2016 and $8.0/MBtu in FY2017. Coal prices are rising rapidly as a result of Chinese government supply side reforms and other factors, and steam coal is expected to be $81/t in FY2016 and $88/t in FY2017.

Exchange rate

We expect the average exchange rate to be JPY108/USD in FY2016 and JPY110/USD in FY2017.

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Nuclear power generation

Although no additional nuclear plants are expected to be restarted before the end of FY2016, restarting of nuclear plants is expected to continue at a steady pace in FY2017 depending on how much progress is made with regulatory standards conformity reviews and so on. A total of five nuclear plants were operational at the end of FY2016. The plants operated for an average of five months and generated 17.2 TWh. We expect a total of 14 nuclear plants to be operational as of the end of FY2017. We expect these plants to be in operation for an average of six months and generate 62.9 TWh (accounting for 7% of total power generation).

Electricity demand and supply

Based on a report by the Basic Policy Subcommittee on Electricity and Gas we expect it will be possible to secure the 3% reserve supply required for the provision of a stable electricity supply nationwide.

Air temperature

According to the Japan Meteorological Agency's three-month weather forecast, winter in FY2016 is expected to be substantially colder (-1.1°C) than that of the previous fiscal year, meaning demand for space and water heating is expected to increase. Following this period, the assumption is for normal temperatures. This means that summer in FY2017 is expected to be cooler (-0.5°C) than in FY2016, and winter is expected to be about the same (+0.1°C).

The macroeconomic situation

The Japanese economy grew by 1.2% in FY2016. Monetary easing and the government's economic measures are underpinning domestic demand

Although private demand is expected to decrease from the previous fiscal year, it is expected to account for more of overall demand (+0.4%) than it accounted for in the previous fiscal year. Public demand is expected to increase from the previous fiscal year as the implementation of the FY2016 budget was moved up to FY2017. It is expected to account for more (+0.4%) of total demand. With regard to imports, uncertainty in overseas markets is expected to gradually recede, but the increasingly strong yen and other factors are expected to weaken performance. Demand from overseas markets is expected to account for more (+0.4%) of total demand. Fossil fuel imports are expected to drop to JPY13.3 trillion, and the trade balance is expected to shift into positive territory for the first time in six years. The current account surplus is expected to be JPY18.9 trillion. Inflation in consumer prices is expected to be -0.1%.

1.0% growth is expected in FY2017. Consumption, investment, and exports—drivers of stable growth—are expected to steadily expand

With favourable employment and income conditions, consumer spending is expected to remain firm. Capital investment is expected to increase as overseas markets experience gradual growth and corporate income reaches higher levels. Investment in housing is expected to decrease following the end of last-minute demand prior to the consumption tax increase scheduled for April 2017. Private demand will contribute 0.4 points to GDP growth. With regard to public demand, while large-scale economic measures, enhancement of disaster preparedness, and measures against aging infrastructure have been in place, there is also emerging demand for the upcoming Tokyo Olympic and Paralympic Games. Public demand will contribute 0.3 points to GDP growth. Exports are expected to increase as a result of steady growth in overseas markets, with strong exports of consumer goods to the United States, the European Union, and Asia. With the recovery of domestic production, imports are expected to switch from a decrease to an increase. External demand will contribute 0.3 points to GDP growth.

Imports are expected to grow more than exports partially as a result of energy prices increase and other factors, meaning the trade balance is expected to switch to a deficit from a surplus in the previous fiscal year. The current account balance is expected to remain at the high level of JPY17.4 trillion, although this represents a slight decrease. The Consumer price index will score a 0.8% increase as both energy and non-energy prices.

Nominal GDP in FY2017 is expected to be JPY545 trillion. Additional structural reforms will be necessary to reach the mid-term target of JPY600 trillion set by the Abe administration.

Table 2. Macroeconomic indicators

	Historical					Projections		Year-to-year changes		
	FY2010	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Real GDP (JPY2011 trillion)	492.8	499.6	512.7	510.4	517.2	523.4	528.5	1.3%	1.2%	1.0%
Private demand	369.1	381.8	393.6	388.2	392.4	394.5	396.6	1.1%	0.5%	0.5%
Private consumption	286.4	293.7	301.7	293.6	295.2	297.1	298.7	0.5%	0.7%	0.6%
Private residential investment	13.9	15.0	16.3	14.7	15.1	15.6	15.5	2.7%	3.3%	-0.4%
Private non-residential investment	67.6	72.1	77.2	79.1	79.6	80.3	81.2	0.6%	0.9%	1.1%
Public demand	122.6	125.6	129.5	129.4	130.9	133.0	134.6	1.2%	1.6%	1.2%
Government consumption	98.1	101.1	102.8	103.2	105.3	106.7	107.8	2.0%	1.3%	1.1%
Public investment	24.7	24.5	26.6	26.1	25.5	26.3	26.7	-2.0%	3.0%	1.4%
Net exports of goods and services	1.3	-7.8	-10.3	-7.2	-6.4	-4.5	-3.1	-11.8%	-30.2%	-29.4%
Exports of goods and services	74.7	72.4	75.6	82.2	82.9	83.9	86.9	0.8%	1.2%	3.6%
Imports of goods and services	73.4	80.2	85.9	89.4	89.2	88.3	90.1	-0.2%	-1.0%	2.0%
Nominal GDP (JPY trillion)	499.2	494.7	507.4	517.9	532.2	538.8	545.3	2.8%	1.2%	1.2%
Balance of trade (JPY trillion)	5.3	-8.2	-13.8	-9.1	-1.1	1.9	-2.4	-88.1%	-273%	-227%
Exports	67.8	63.9	70.9	74.7	74.1	69.4	72.3	-0.7%	-6.3%	4.1%
Imports	62.5	72.1	84.6	83.8	75.2	67.6	74.7	-10.3%	-10.2%	10.6%
Fossil fuel	18.1	24.7	28.4	25.1	16.1	13.3	15.9	-36.0%	-17.0%	19.2%
Oil	12.3	16.2	18.7	15.2	9.6	8.2	10.0	-37.0%	-14.3%	22.1%
LNG	3.5	6.2	7.3	7.8	4.5	3.0	3.6	-41.4%	-33.2%	17.5%
Current account (JPY trillion)	18.3	4.2	2.4	8.7	18.0	18.9	17.4	106%	5.2%	-8.1%
Domestic corporate goods price index (2010=100)	100.2	100.5	102.4	105.2	101.8	99.7	102.2	-3.3%	-2.0%	2.5%
Consumer price index (2015=100)	96.4	96.1	96.9	99.8	100.0	99.9	100.7	0.2%	-0.1%	0.8%
GDP deflator (2011=100)	101.3	99.0	99.0	101.5	102.9	102.9	103.2	1.4%	0.0%	0.2%

Note: GDP and subtotals do not match as a result of stock changes and deviations.

Production activities

Industrial production is on course for recovery in FY2017

Despite factors such as the Kumamoto Earthquake that worked to slow the economy in the first half of FY2016, the industry is on course for a recovery (+0.3%). Production is expected to increase in FY2017 as a result of increased exports of heavy electrical machinery to Asian markets, and consumers upgrading to high-value-added home appliances, etc. Other factors such as increased capital investment are also expected to contribute to improved performance (+1.4%).

Although crude steel production recovered to 105 Mt in FY2016, FY2017 is expected to lack momentum despite increased demand ahead of the Tokyo Olympics

Crude steel production in FY2016 is expected to recover from a substantial slowdown in the preceding fiscal year to 149 Mt (+0.6%). Gradual growth to 156 Mt (+0.7%) is expected in FY2017 as a result of growth in Asian markets as well as increased capital investment and construction-related demand ahead of the Tokyo Olympics.

Ethylene production dropped to 6.48 Mt in FY2016 but is expected to increase to 6.58 Mt in FY2017

Production is expected to drop in FY2016 to 6.48 Mt (-4.4%) as a result of plant closures in September 2015 and February 2016 and scheduled repair work. Less repair work is scheduled for FY2017 and production is expected to increase to 6.58 Mt (+1.6%). While domestic demand is expected to increase slightly from the preceding fiscal year, demand from other Asian markets is also expected to lead to increased exports.

Expanded public work projects and other factors are expected to push cement production up to 60 Mt for the first time in three years

As a result of lackluster domestic demand and other factors, cement production in FY2016 is expected to grow only marginally from the preceding fiscal year (+0.3%) to 59.4 Mt. Cement production is expected to increase to 60 Mt (+1.1) in FY2017 as a result of the government's public work projects such as moves to enhance disaster preparedness, address ageing infrastructure, and projects relating to the Tokyo Olympics.

Paper production is expected to amount to 26.3 Mt in FY2016 and is expected to increase to 26.5 tons in FY2017—its highest level since the VAT increase

Although demand for paper for use in producing newspapers and advertising is expected to decrease in FY2016, paperboard production is expected to increase on freight traffic improvement. Overall paper and paperboard production is expected to increase slightly (+0.2%). Although the downward trend is expected to continue in FY2017 as a result of the declining population and the shift toward digital media, demand for paperboard for processed food and beverage packaging is expected to increase and overall paper/paperboard production is expected to increase (+0.9%).

Automobile exports etc. are expected to be solid in FY2016 with production volume of 9.29 million units. In FY2017, production is expected to reach 9.47 million units due to increased domestic and overseas demand

While domestic shipments decreased slightly in FY2016 as a result of the problem of falsification of mini-vehicle fuel efficiency etc., exports to North American markets have been solid and production is expected to increase (+1.2%). In FY2017 production is expected to increase to 9.47 million units (+1.9%) as a result of increased domestic shipments due to a gradual improvement in private consumption and solid exports to North American markets.

Table 3. Production activities

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Production									
Crude Steel (Mt)	110.8	111.5	109.8	104.2	104.9	105.6	-5.1%	0.6%	0.7%
Ethylene (Mt)	7.00	6.76	6.69	6.78	6.48	6.58	1.4%	-4.4%	1.6%
Cement (Mt)	56.1	62.4	61.1	59.2	59.4	60.0	-3.1%	0.3%	1.1%
Paper/paperboard (Mt)	27.3	26.7	26.3	26.2	26.3	26.5	-0.2%	0.2%	0.9%
Automobiles (million)	8.99	9.91	9.59	9.19	9.29	9.47	-4.2%	1.2%	1.9%
Production Indices									
Mining and manufacturing (2010=100)	99.4	99.0	98.4	97.4	97.7	99.1	-1.0%	0.3%	1.4%
Food	98.2	98.9	95.5	97.6	98.1	98.5	2.1%	0.5%	0.4%
Chemicals	99.7	98.3	95.2	97.3	97.2	98.4	2.2%	-0.1%	1.2%
Non-ferrous metals	98.9	97.3	97.9	96.5	97.8	99.3	-1.5%	1.4%	1.5%
General/electrical machinery, etc.	101.3	97.6	100.0	98.4	97.4	99.5	-1.6%	-1.1%	2.2%
Tertiary industry activity index (2010=100)	99.9	103.2	102.1	103.5	103.8	104.0	1.3%	0.3%	0.2%

Note: "Chemicals" includes 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

The shift from fossil fuels to nuclear and renewable energies is progressing. CO_2 emissions are lower than pre-Great East Japan Earthquake levels

The decline in the primary energy supply is expected to slow in FY2016 (-0.2%) due to the gradual economic recovery despite continued energy conservation efforts. Although production/economic activities are expected to improve in FY2017, air temperatures and energy conservation are expected to have an inhibiting effect, and primary energy supply is expected to decline for the fourth consecutive year (-0.3%). The shift from oil and natural gas to nuclear and renewable energies is progressing.

Oil is expected to see an overall decline in FY2016 (-1.4%) as a result of a decline in naphtha due to reduced ethylene production and a decline in heave fuel oil C for power generation due to the increasing use of nuclear and renewable energy-based power generation. In FY2017 the extent of the decline is expected to increase (-3.1%) due to reduced demand for heavy fuel oil C for power generation with the restarting of more nuclear plants as well as reduced demand for gasoline and kerosene.

Although use of natural gas as city gas is expected to increase in FY2016, its use in power generation is expected to decrease leading to an overall decline (-2.4%). Despite the fact that the increase in the use of natural gas as city gas is expected to continue in FY2017, the restarting of nuclear plants is expected to cause a substantial decrease in its use for power generation, leading to an overall decrease (-6.8%) for the third consecutive year. Natural gas is expected to see the biggest decline in volume of all energy sources in FY2017, but despite this the volume is still expected to be over 7% higher than in FY2010, the year prior to the Great East Japan Earthquake.

Coal is expected to increase slightly in FY2016 (+0.2%) due to a gradual recovery in production of crude steel etc. In FY2017 coal is expected to increase slightly (+0.3%) due to an increase in domestic demand for crude steel associated with a gradual increase in capital investment. Steam coal is expected to maintain its current level as a base-load power source.

With a total of five nuclear plants having been restarted by the end of FY2016, nuclear power generation in FY2016 is expected to total 17.2 TWh. Although a total of 14 nuclear plants are expected to be back in operation by the end of FY2017, nuclear power generation is expected to total 62.9 TWh—only about 20% of the level in FY2010, the year before the Great East Japan Earthquake. Nuclear is expected to account for only 3% of the overall primary energy supply.

Renewable energy is trending upwards with solar photovoltaic power generation playing a central role. Renewable energy is expected to account for 9.4% of the primary energy supply in FY2017: Of this, hydro is expected to account for 3.8%, and other alternative energy sources, etc. are expected to account for 5.6%.

Energy self-sufficiency is expected to recover to double digits (12.0%) in FY2017. However this is still 5.5% lower than in FY2010 (17.5%), the year before the Great East Japan Earthquake.

After peaking at 1,235 Mt in FY2013 energy-related, energy-related CO_2 emissions have decreased for each of the four subsequent years leading up to FY2017. This decrease is due to reduced use of fossil fuels as a result of energy conservation, restarting of nuclear plants, and greater utilization of renewable energy. In FY2016, energy-related CO_2 emissions dropped below the level in FY2010, the year before the Great East Japan Earthquake. In FY2017, such emissions are expected to drop to 1,105 Mt (10.5% lower than the level in FY2013)—one step closer to achieving the Paris Agreement target of reducing greenhouse gas emissions to 26% below that of FY2013 by FY2030 (energy-related CO_2 emissions accounts for 25% with other sources accounting for the remaining 1%).

Table 4. Primary energy supply

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Primary energy supply (Mtoe)	513.3	493.2	477.5	470.3	469.5	468.0	-1.5%	-0.2%	-0.3%
Coal	119.2	126.1	124.4	123.7	124.0	124.5	-0.6%	0.2%	0.3%
Oil	212.0	214.4	198.6	193.3	190.6	184.7	-2.6%	-1.4%	-3.1%
Natural gas	95.7	118.4	118.9	113.0	110.2	102.7	-5.0%	-2.4%	-6.8%
Hydro	17.2	16.2	17.1	17.7	17.8	17.8	3.2%	0.7%	0.1%
Nuclear	60.7	1.9	0.0	2.0	3.5	12.4	..	76.4%	258%
Geothermal, new energies, etc.	8.7	16.2	18.4	20.7	23.4	26.0	12.2%	12.9%	11.2%
Self-sufficiency rate	17.5%	7.1%	7.4%	8.6%	9.5%	12.0%	1.1p	0.9p	2.5p
Energy intensity (2011=100)	95.0	87.7	85.3	82.9	81.8	80.7	-2.8%	-1.4%	-1.3%
Energy-related CO_2 emissions (Mt)	1,139	1,235	1,190	1,148	1,137	1,105	-3.5%	-1.0%	-2.8%
(FY2013=100)	92.2	100.0	96.4	93.0	92.1	89.5	..	..	..

Note: "New energies, etc." includes solar PV, wind, biomass, solar thermal, small- and medium-scale hydro, etc.
Revisions were made to the defined calorific value of each energy source in FY2013.

Final energy consumption

Energy and electricity conservation has become well-established practice and this, in addition to other factors, is expected to result in reduced final energy consumption in FY2016 and FY2017 as well. Final energy consumption has decreased for seven consecutive years since the Great East Japan Earthquake.

Total final energy consumption is expected to remain almost unchanged (-0.1%) in FY2016. The transport sector is decreasing with greater utilization of fuel-efficient vehicles, etc. The buildings sector is increasing as it rebounds from the effects of the previous fiscal year's cool summer and mild winter and other factors. The industrial sector is expected to remain unchanged. Total final energy consumption is expected to decrease in FY2017 (-0.6%). Although the industrial sector is expected to continue to make progress with energy conservation, a recovery in economic activities means final energy consumption is expected to remain level. The building sector is expected to decrease as a result of the effects of air temperature-related factors, and the entrenchment of energy and electricity conservation activities, etc. The trend toward greater fuel efficiency in the transport sector is expected to continue, contributing to a decrease in final energy consumption. Final energy consumption has decreased for seven consecutive years since the Great East Japan Earthquake, and is now at the same level as that of the late 1980s.

With regard to the industrial sector in FY2016, although production activities have expanded in certain areas such as iron/steel and automobiles, final energy consumption is expected to post a slight fall of 0.1% in ethylene, electric machinery production decreases and energy saving, etc. In FY2017 the production activities of major industries are all expected to experience a recovery and this is expected to more than cancel out the effect of energy conservation to cause a slight increase overall (+0.3%). Although electricity and city gas has increased in FY2016 as a result of fuel switching and is expected to do so in FY2017 as well, petroleum products are expected to decrease. Coal, which is influenced by the recovery of crude steel and cement production, is expected to increase.

The residential sector is expected to increase in FY2016 (+0.9) as it rebounds from the effects of the previous fiscal year's cool summer and mild winter, etc. In FY2017 this is expected to decrease (-0.8%) as a result of continued energy conservation efforts centering on air conditioning and lighting. With the shift toward increasing use of household appliances that utilize electricity and gas, kerosene and LPG is expected to decrease.

The commercial sector is expected to increase in FY2016 (+0.9%) as a result of air temperature-related factors and a gradual recovery of economic activity. In FY2017 this is expected to decrease (-0.8%) as a result of increased energy conservation centering on air conditioning and lighting etc. Although electricity and city gas is

expected to increase as a result of the fuel switching trend, petroleum products is expected to continue to decrease.

With regard to the transport sector in FY2016, expanded use of fuel efficient vehicles etc. is expected to cause a decrease (-1.2%) despite a certain amount of revitalization of freight movement due to gradual economic growth. In FY2017 this is expected to decrease by an even greater margin (-2.0%) as a result of a variety of factors including more widespread use of fuel efficient vehicles due to progress with vehicle body weight reduction technologies as well as the trend for increasing numbers of consumers to shun automobile ownership, as well as enhanced transport efficiency with improvements in transport routes and cargo loading ratios.

Table 5. Final energy consumption

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Final energy consumption (Mtoe)	340.4	327.7	319.2	315.7	315.5	313.7	-1.1%	-0.1%	-0.6%
Industry	159.1	156.9	153.7	152.3	152.2	152.6	-0.9%	0.0%	0.3%
Buildings	98.7	91.5	88.5	86.3	87.1	86.4	-2.4%	0.9%	-0.8%
Residential	54.7	50.5	48.8	47.1	47.5	47.1	-3.5%	0.9%	-0.8%
Commercial	44.0	41.0	39.7	39.2	39.6	39.2	-1.2%	0.9%	-0.8%
Transport	82.7	79.3	77.0	77.1	76.1	74.6	0.1%	-1.2%	-2.0%
Coal and coal products	36.7	36.4	36.0	34.0	34.3	34.4	-5.4%	0.7%	0.4%
Petroleum products	176.2	164.3	158.4	158.5	156.8	153.9	0.0%	-1.1%	-1.9%
City and natural gases	34.4	34.5	34.3	33.8	34.5	35.0	-1.3%	2.1%	1.4%
Electricity	89.8	84.7	82.7	81.5	82.0	82.4	-1.4%	0.6%	0.5%
Others	3.2	7.8	7.8	7.8	7.9	8.0	0.5%	0.4%	1.1%

Note: Industrial includes non-energy use.

Electricity sales and power generation mix (electric utilities)

Industrial/commercial electricity demand, etc. is expected to increase in FY2017 as a result of a recovery in economics activities. Overall demand is also expected to increase for the second consecutive year

Electricity sales in FY2016 are expected to increase (+0.6%) for the first time since the Great East Japan Earthquake, as a result of increased demand for space heating and cooling, and water heating as the market rebounds from the cool summer and mild winter of the preceding fiscal year. High voltage/extra-high voltage sales are expected to increase (extra-high voltage: +0.4%, high voltage: +0.8%) as a result of a gradual recovery in economic activities.

In FY2017 lighting services sales are expected to remain virtually level (+0.1%) despite continued progress with lighting device/home appliance energy saving and further entrenchment of consciousness of the importance of energy and electricity conservation. High voltage/extra-high voltage sales are expected to increase (extra-high voltage: +0.8%, high voltage: +0.6%) in many industries in FY2017 including iron and steel, chemicals, automobiles, and machinery. There is expected to be an overall increase (+0.5%) over two consecutive years for the first time in the six years since the Great East Japan Earthquake.

Table 6. Electricity sales (electricity utility use)

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Total (TWh)	926.6	871.5	851.4	837.5	842.7	846.6	-1.6%	0.6%	0.5%
Extra-high voltage	(246.1)	(235.5)	(233.5)	(229.3)	230.2	232.0	(-1.8%)	0.4%	0.8%
High voltage	(328.8)	(308.9)	(304.3)	(302.2)	304.5	306.3	(-0.7%)	0.8%	0.6%
Low voltage	(351.7)	(327.1)	(313.6)	(306.0)	307.9	308.3	(-2.4%)	0.6%	0.1%
Lighting service	304.2	284.3	273.1	266.9	268.5	268.8	-2.3%	0.6%	0.1%
Power service	(47.5)	(42.8)	(40.5)	(39.2)	39.5	39.5	(-3.3%)	0.8%	0.2%

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

Although additional nuclear plants are expected to be restarted in FY2017 causing a decrease in the share of thermal power, the share is still expected to be 13% higher than the level prior to the Great East Japan Earthquake.

No additional nuclear plants are expected to be restarted during the remainder of FY2016, and their share of overall power generation is expected to be 2%. New energies and others are expected to increase steadily (1.6%) thanks to the boost provided by the FIT scheme. Thermal power generation is expected to decrease (-1.9%) to 82%.

With the restarting of additional nuclear plants in FY2017 the share of nuclear is expected to increase to 7% (+4.7%). New energies and others are also expected to increase (1.4%). Although thermal power is expected to drop (6.4%) to its lowest level since the Great East Japan Earthquake (75%), that will still be 13% higher than the level in FY2010, prior to the disaster. Within the thermal power, LNG-fired is expected to decrease the most (-4.8%).

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

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Total (TWh)	1,028	963.5	936.2	920.0	927.8	932.1	-1.7%	0.8%	0.5%
Share							Year-on-year rate		
Hydro	(9%)	8%	9%	9%	9%	9%	+0.7p	+0.1p	-0.2p
Fossil fuel-fired thermal	(62%)	88%	87%	84%	82%	75%	-3.4p	-1.9p	-6.4p
Coal	(25%)	30%	30%	31%	31%	31%	+0.5p	+0.0p	-0.3p
Natural and city gases	(29%)	44%	46%	43%	42%	37%	-2.7p	-1.8p	-4.8p
Oil, etc.	(8%)	14%	11%	9%	9%	8%	-1.2p	-0.2p	-1.3p
Nuclear	(29%)	1%	0%	1%	2%	7%	+1.0p	+0.8p	+4.7p
New energies and others	(1%)	2%	3%	4%	6%	7%	+1.4p	+1.6p	+1.4p

Note: Only for general electric utilities in FY2010. Components may not add up to 100% as others are not shown.

City gas sales (gas utilities)

General industrial use is expected to lead the market in FY2016 and FY2017 as a result of demand development, etc. and record performance is expected for two consecutive years

In FY2016, overall city gas sales are expected to increase to a record 40.8 billion m^3 (+2.2%) as a result of increased demand due to demand development activities and air temperature-related factors. In FY2017 this is expected to increase (+1.4%) to 41.4 billion m^3 (making FY2017 the second consecutive record year), driven by

general industrial use thanks to expansion of production/economic activities and continued demand development etc.

Residential sales are expected to increase in FY2016 (+1.3%) because of increased demand for space and water heating due to air temperature-related factors (a rebound from the mild winter of the preceding fiscal year). In FY2017 this is expected to remain level due to widespread use of energy conserving equipment such as high-efficiency water heaters and other factors, despite factors such as more widespread use of equipment that use city gas contributing to increased demand.

Business sales (commercial and others) are expected to increase (commercial: +0.6%, other: +1.7%) in FY2016 as a result of air temperature-related factors, etc. In FY2017 this is expected to increase (commercial: +0.3%, other: +0.7%) as a result of the drumming up of demand for cogeneration systems and gas heat pumps, etc.

Industrial sales are expected to increase in FY2016 to 23.7 billion m^3 (+2.9%) driven by an increase in general industrial-use. In FY2017 this is expected to increase to 24.2 billion m^3 (+2.3%), the eighth consecutive year in which this has increased. A number of factors have led to the increase in general industrial-use, including increased utilization of existing facilities due to a gradual recovery in production activities, the capturing of new demand relating to the shift to the use of non-petroleum products in industrial furnaces/boilers, and increased utilization of cogeneration systems due to the continued stability of LNG prices. Electric utility-use is expected to decrease in FY2017 (-1.3%). Residential, which accounted for 50% of the market in FY1990, is expected to account for 23% in FY2017. Industrial on the other hand, has increased from a 26% share to 59%.

Following on from the full liberalization of the electricity retail market, the city gas retail market (including household retail) is scheduled to be fully liberalized in April 2017. There are high expectations for the stated aims of the gas system reform including “creation of new services and business” and “curbing of rates through invigoration of competition”.

Table 8. City gas sales (gas utilities)

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Total (billion m^3)	39.28	39.82	40.16	39.91	40.77	41.35	-0.6%	2.2%	1.4%
Residential	9.79	9.55	9.58	9.24	9.36	9.36	-3.5%	1.3%	0.0%
Commercial	4.75	4.49	4.34	4.26	4.28	4.29	-1.9%	0.6%	0.3%
Industrial	21.61	22.20	22.74	23.01	23.67	24.21	1.2%	2.9%	2.3%
For general industries	(20.18)	(20.26)	(20.07)	(20.57)	20.77	21.35	(2.5%)	n.a.	2.8%
For electric utilities	(1.43)	(1.94)	(2.68)	(2.44)	2.90	2.86	(-8.8%)	n.a.	-1.3%
Others	3.13	3.58	3.50	3.41	3.46	3.49	-2.6%	1.7%	0.7%

Converted at $1m^3$=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 throughout

A drop to below 180 billion litres for the first time in 47 years is expected in FY2016. FY2017 is expected to see a decrease centered on kerosene and heavy fuel oil as a result of a trend toward switching to utilization of city gas and electricity, making it the fifth consecutive year of decreases.

Fuel oil sales are expected to decrease in FY2016 (-2.2%) as a result of decreased naphtha due to reduced ethylene production. Fuel oil sales are expected to decrease for the fifth consecutive year in FY2017 (-2.4%) as a result of a substantial decrease in heavy fuel oil C for power generation due to the restarting of additional nuclear plants, and a decrease in kerosene, heavy fuel oils A and B/C due to the shift to switch to electricity and city gas. The level is expected to drop below 70% of the level in FY1996, the peak year.

Gasoline is expected to decrease (FY2016: -0.8%, FY2017: -2.4%) due to a trend away from private vehicle ownership and other factors which are expected to result in lower vehicle ownership levels, shorter travelling distances, more widespread use of hybrids and other eco-cars, and progress with technologies that enhance fuel efficiency.

Naphtha is expected to decrease in FY2016 (-4.0%) as a result of a decrease in production of ethylene. Naphtha is expected to increase in FY2017 (+0.3%) as a result of increased production of ethylene, benzene, toluene, and xylene.

Kerosene is expected to increase in FY2016 (+1.6%) for the first time in six years as the market rebounds from the mild winter of the preceding year. In FY2017 this is expected to drop (-4.1%) to a level not seen for 47 years, as the air temperature is expected to be similar to the preceding fiscal year and the trend toward switching to use of electricity and city gas is expected to continue.

Diesel oil is expected to decrease (-0.8%) in FY2016 as movement of freight vehicles decreases. A decrease is also expected in FY2017 (-1.1%) due to increased freight transport efficiency and enhanced fuel efficiency, despite the positive contribution of an increase in the ownership of diesel-engine passenger vehicles.

Heavy fuel oil A is expected to increase in FY2016 (+0.3%) for the first time in 14 years as a result of factors such as decreasing oil prices. A decrease is expected in FY2017 (-2.5%) as industry and commercial continue with the trend toward switching to use of city gas as oil prices rise again.

Industrial-use of heavy fuel oil B/C is expected to decrease as a result of the fuel switching trend and progress with energy conservation. Heavy fuel oil B/C used for electric utilities is expected to decrease by a large margin (FY2016: -14.5%, FY2017: -18.8%) as more nuclear plants are restarted.

LPG is expected to decrease in FY2016 (-2.6%) as a result of the fuel switching and a decrease in LPG for use in adjusting the calorific value of city gas. In FY2017 this is expected to drop (-0.9%) to a level not seen for 38 years as a result of a decrease in transport-use LPG following the reduction in the number of taxis following the enactment of the Taxi Vehicle Reduction Act, as well as improved vehicle fuel efficiency, and a decrease in power generation-use LPG following the restarting of additional nuclear plants.

Crude oil throughput is expected to increase in FY2016 (+0.4%) due to an increase in exports. In FY2017 this is expected to decrease (-2.4%) both in reaction to the increase in FY2016 and as a result of a reduction in refining capacity due to the need to conform to the Act on Sophisticated Methods of Energy Supply Structures.

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

	Historical				Projection		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Fuel oils (GL)	196.0	193.6	182.7	180.5	176.6	172.4	-1.2%	-2.2%	-2.4%
Gasoline	58.2	55.5	53.0	53.1	52.7	51.4	0.3%	-0.8%	-2.4%
Nphtha	46.7	45.7	43.9	46.2	44.4	44.5	5.3%	-4.0%	0.3%
Jet fuel	5.2	5.1	5.3	5.5	5.2	5.2	3.1%	-4.8%	0.2%
Kerosene	20.4	17.9	16.7	15.9	16.2	15.5	-4.3%	1.6%	-4.1%
Diesel oil	32.9	34.1	33.6	33.6	33.3	33.0	0.1%	-0.8%	-1.1%
Heavy fuel oil A	15.4	13.4	12.3	11.9	11.9	11.6	-3.6%	0.3%	-2.5%
Heavy fuel oil B and C	17.3	21.9	17.9	14.2	12.9	11.2	-20.7%	-9.7%	-13.2%
For electric utilities	7.7	14.4	10.8	8.2	7.0	5.7	-24.1%	-14.5%	-18.8%
For other users	9.7	7.5	7.2	6.1	5.9	5.5	-15.6%	-3.2%	-6.5%
LPG (Mt)	16.5	15.5	15.4	14.7	14.3	14.2	-4.5%	-2.6%	-0.9%
Crude oil throughput (GL)	208.9	200.4	189.0	189.0	189.8	185.3	0.0%	0.4%	-2.4%

Renewable energy-based power generation

Introduction of a new scheme under the Revised Renewable Energy Feed-in Tariff Law

Four years have passed since the launch of the Feed in Tariff (FIT) scheme for electricity generated from renewable energy, and issues relating to economic aspects and technical aspects such as grid operation are starting to become evident. The Revised Renewable Energy Feed-in Tariff Law was promulgated in June 2016 to address these issues.

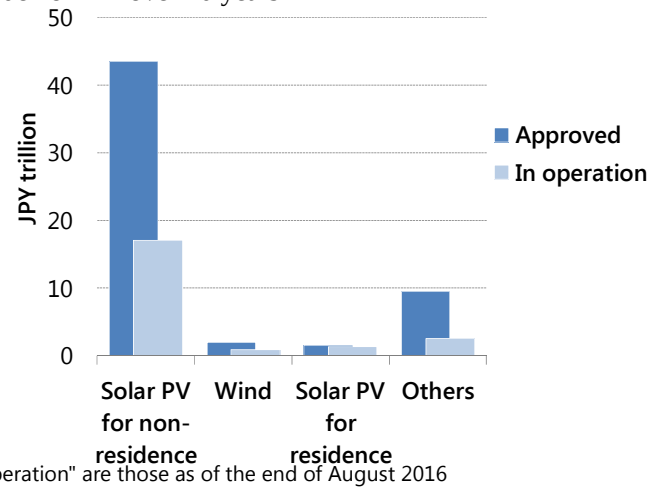
Under the new scheme, which comes into effect in April 2017, large-scale purchases of electricity generated from solar photovoltaic (2 MW or more) will be carried out through a bidding system and the setting of price ceilings has been proposed. A general agreement has been reached to reduce the price of residential-use electricity generated from solar PV to a price closer to that of standard household electricity rates (JPY2,400/MWh).

Under an electricity rate reduction scheme aimed at enabling businesses that consume large volumes of electricity to maintain their global competitiveness, reduction rates are calculated in accordance with each target business's electric power consumption enhancement initiatives etc. Under the current scheme however the total budget for reductions in FY2015 was JPY45.6 billion, which is a very small sum when compared to the levied amount (expected to be JPY1.3222 trillion). This change will not provide solutions to the intrinsic problems of the FIT scheme.

The cumulative burden of the contracts already approved under the FIT scheme is in the range of JPY57 trillion

Rapid increases in the amount of approved non-residential solar PV power generation facilities are currently being curbed by purchase price reductions and cancelation of certifications. The setting of a time limit on the period following certification in which facilities must commence operations, may work to further curb such increases. Even so, the system in which rapid increases in the amount of renewable energy-based power generation leads to rapid increases in fiscal burden will remain in place for now. If all approved FIT capacity at 88.2 GW as of the end of August 2016 (including 80.3 GW for solar PV and 3.0 GW for wind), including newly approved facilities and transferred facilities[2], were all to come online at once, the 20-year burden on consumers would add up to a cumulative total of JPY57 trillion[3], which is close to Japan's general tax revenue for FY2016. This is comparable to a rate increase of JPY3,300/MWh, or +14% for households, and +20% for industry, etc.

Figure 2. Cumulative burden of FIT over 20 years



Note: "Approved" and "In operation" are those as of the end of August 2016

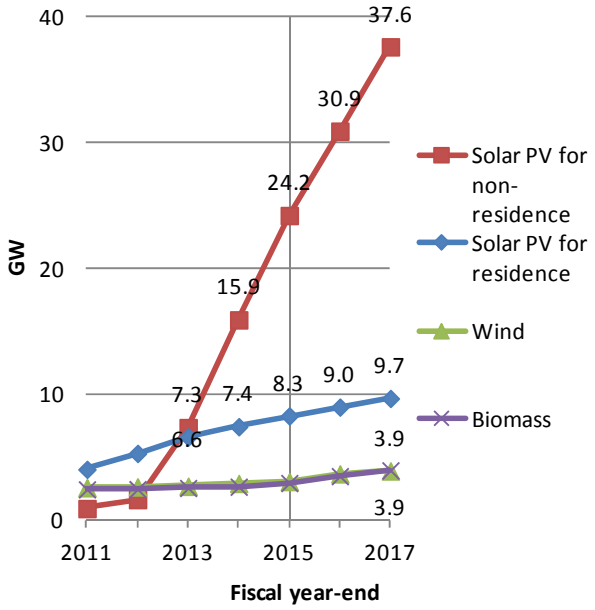
[2] Facilities installed prior to FIT scheme that were later transferred to the scheme.

[3] The remaining purchasing period of transferred facilities has also been taken into consideration. Limit-avoidance costs have been calculated at JPY10,900/MWh based on information about the FIT scheme for renewable energy posted on the website of the Agency for Natural Resources and Energy. Assumed capacity factors are, wind 20%, solar PV 12%, geothermal 70%, hydro 45%, and biomass 70%.

The cumulative capacity of renewable energy-based power generation facilities is approaching 65 GW

Although some of the facilities that have already been approved are expected to be retired, the capacity of renewable energy-based power generation (excluding large scale hydro) facilities is expected to reach 65.5 GW by the end of FY2017. Non-residential solar PV is expected to expand to 37.6 GW, accounting for more than half of the total. Five years after the launch of the FIT scheme, wind is also beginning to show signs of a gradual increase. Renewable energy-based power generation in FY2017 is expected to be 122.9 TWh (Solar PV: 49.7 TWh, small/medium scale hydro: 38.5 TWh, biomass: 24.1 TWh, wind: 6.8 TWh, geothermal: 3.7 TWh), meaning it is expected to account for 10% of total power generation.

Figure 3.Installed capacity in operation of renewable power generation



The impact of the pace of nuclear plant restarts

Mihama Nuclear Power Station has received permission to extend the period of operation of its Unit 3 plant. This is the second such case following the case of Takahama Nuclear Power Station, and represents significant progress for Japan's nuclear power generation policies.

The Nuclear Regulation Authority (NRA) has approved the extension of the operational life of the Unit 3 plant of Kansai Electric Power Co., Inc.'s Mihama Nuclear Power Station to 60 years, the second such case following the extension of the operational life of Takahama Nuclear Power Station's Units 1 and 2. This brought the number of nuclear plants permitted to extend their operational life to three. The fact that the NRA gave their approval to these extensions is also a significant step forward in terms of the government's nuclear power generation policies.

Following the restarting of Unit 3 of Shikoku Electric Power Co., Inc.'s Ikata Power Station, no further plants are expected to be restarted before the end of FY2016. As of December 2016 there are 20 plants that are under review, and there is expectation that progress will be made with the restarting of further plants.

In this section we will examine the impact on the economy, energy, and the environment (the so-called 3Es), of differing paces in the restarting of nuclear plants. That is, we have developed three hypotheses based on consideration of progress with reviews of regulatory standards, whether any large-scale construction is underway, application periods, etc., and we have also created a hypothetical scenario based on the composition of electricity sources in 2030 as proposed by the Ministry of Economy, Trade and Industry in the Long-term Energy Supply and Demand Outlook.

In the "Reference Scenario", we hypothesize that nuclear plants are restarted in FY2017 at a pace of approximately one plant every 1.5 months and that the cumulative number of restarted plants at the end of FY2017 totals 14. The average months of plant operation is six months in this scenario, and the total volume of electricity generated is 62.9 TWh, which is 22% of the total in FY2010, prior to the Great East Japan Earthquake.

In the "Low Nuclear Case", nuclear plants are restarted in FY2017 at a pace of approximately one plant every six months, and the cumulative number of restarted plants totals seven at the end of FY2017. The average months of plant operation is eight months in this scenario, and the total volume of electricity generated is 26.7 TWh, which is 58% less than in the Reference Scenario.

In the "High Nuclear Case", nuclear plants are restarted in FY2017 at a pace of approximately one plant per month, and the cumulative number of restarted plants totals 18 at the end of FY2017. The average months of plant operation is seven months in this scenario, and the total volume of electricity generated is 88.9 TWh, which is 41% more than in the Reference Scenario.

In the "Best Mix Case", we prepared a hypothesis based on the Long-term Energy Supply and Demand Outlook, with an electricity source composition for FY2017 of 23% renewable energy, 20% nuclear, and 57% thermal. The total volume of electricity generated from nuclear in this scenario is 195.0 TWh, 210% more than in the Reference Scenario, making it the case with the highest generation volume.

Figure 4.Assumption of restarting nuclear power plants

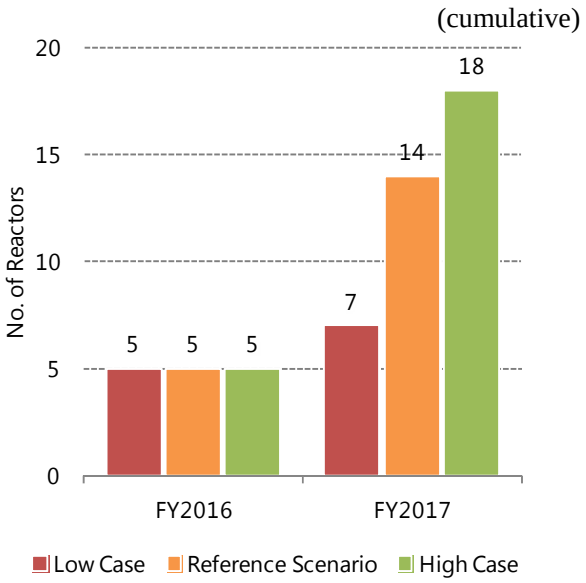
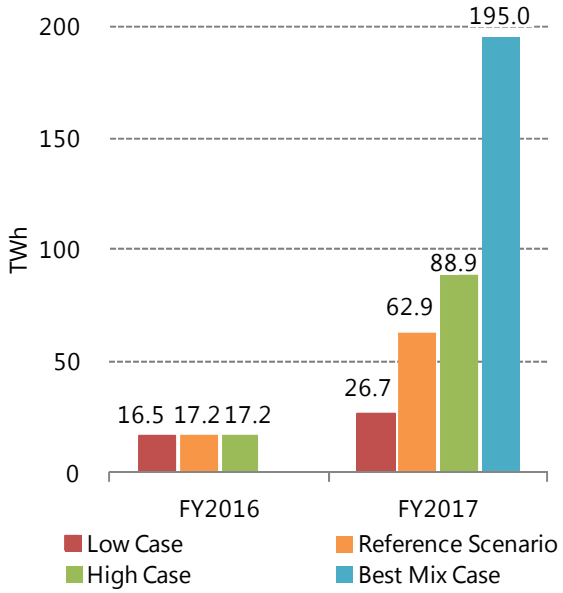


Figure 5. Assumption of nuclear power generation



Nuclear power generation has a significant role to play in achievement of the "3E" targets

The restarting of additional nuclear plants would facilitate reduced fossil fuel cost, a boost to the economy due to reduced electricity costs, an enhanced energy self-sufficiency rate, reduced CO_2 emissions, etc.

The respective reductions in oil import volume in the High Nuclear Case and Best Mix Case compared with the Reference Scenario would be 1.5 billion litres and 8.4 GL. The reductions in LNG imports compared with the Reference Scenario would be 2.8 Mt with the High Nuclear Case, and 15.2 Mt with the Best Mix Case. Real GDP would increase by between 0.2% and 1.0% as a result of decreased spending on fossil fuel imports.

In the Low Nuclear Case on the other hand, petroleum imports would increase by 2.2 GL compared with the Reference Scenario and LNG imports would increase by 3.8 Mt compared with the Reference Scenario. Real GDP would decrease by 0.2%.

While the energy self-sufficiency rate would improve by 1.1% in the High Nuclear Case, and 7.9% in the Best Mix Case, it would decrease by 1.5% in the Low Nuclear Case. Apart from the hypothetical Best Mix Case, all

of the other cases (the Low Nuclear Case, Reference Case, and High Nuclear Case) still result in a lower self-sufficiency rate than that of FY2010.

CO_2 emissions would be reduced by 12 Mt in the High Nuclear Case and by 101 Mt in the Best Mix Case.

Table 10. The impact of the pace of restarting of nuclear power plants (FY2017)

		FY2010	FY2017 (changes from **FY2010**)				FY2017 (changes from the Reference Scenario)		
			Low Case	Reference Scenario	High Case	Best Mix Case	Low Case	High Case	Best Mix Case
Economy	Electricity unit cost[1] (JPY/kWh)	4.9	+2.1	+1.9	+1.8	+2.4	+0.2	-0.2	+0.5
	Fuel cost	3.8	+1.1	+0.8	+0.7	-0.0	+0.2	-0.2	-0.9
	FIT purchasing cost	0.2	+1.9	+1.9	+1.9	+3.3	-	-	+1.4
	Total fossil fuel imports (JPY trillion)	18.1	-2.0	-2.2	-2.5	-3.5	+0.3	-0.2	-1.2
	Oil	12.3	-2.1	-2.2	-2.3	-2.6	+0.1	-0.1	-0.4
	LNG	3.5	+0.2	+0.0	-0.1	-0.7	+0.2	-0.1	-0.7
	Trade balance (JPY trillion)	5.3	-8.0	-7.7	-7.5	-6.7	-0.3	+0.2	+1.0
	Real GDP (JPY2005 trillion)	492.8	+35.4	+35.6	+35.8	+36.6	-0.2	+0.2	+1.0
	Gross national income (JPY trillion)	480.5	+31.0	+31.3	+31.5	+32.5	-0.3	+0.2	+1.2
Energy	Primary energy supply								
	Oil (GL)	232.3	-28.4	-30.5	-32.0	-38.9	+2.2	-1.5	-8.4
	Natural gas (Mt of LNG equivalent	73.3	+8.6	+4.8	+2.0	-10.2	+3.8	-2.8	-15.0
	LNG imports (Mt)	70.6	+10.6	+6.8	+3.9	-8.5	+3.8	-2.8	-15.2
	Self-sufficiency rate	17.8%	-6.6p	-5.1p	-4.0p	+2.9p	-1.5p	+1.1p	+7.9p
Environ-ment	Energy-related CO_2 emissions (Mt-CO_2	1,139	-17	-33	-45	-134	+16	-12	-101
	Changes from FY2013	-7.8%	-9.2%	-10.5%	-11.5%	-18.7%	..	..	..

Reference Scenario: A cumulative total of 14 nuclear plants restarted by the end of FY2017. Restarting of one plant every 1.5 months on average in FY2017.
Low Case: A cumulative total of 7 nuclear plants restarted by the end of FY2017. Restarting of one plant every 6 months on average in FY2017.
High Case: A cumulative total of 18 nuclear plants restarted by the end of FY2017. Restarting of one plant per month on average in FY2017.
Best Mix Case: A hypothetical scenario based on the power generation mix in 2030 (22%-24% renewable, 20%-22% nuclear, etc.) as presented by the Ministry of Economy, Trade and Industry in the Long-Term Energy Supply and Demand Outlook (2015).
[1] Power generation cost in FY2010 is for the general electric utilities, estimated based on their profit-and-loss statements.

There are certain issues that only apply to the Best Mix Case

Under the Best Mix Case, however, FIT purchasing costs would increase and the electricity unit cost[1] would increase more than with the other scenarios. During the short period until the end of FY2017, there would not be a significant impact on the economy from rapid increases in electricity costs. In the long-term, however, electricity price increases would lead to reduced consumer purchasing power and industrial competitiveness, etc. and could have a role in depressing the Japanese economy. Consideration of appropriate electricity price levels would presumably be an issue needing to be addressed on the way to achieving the Best Mix Case.

Miyuki Tsunoda

[1] Calculated by dividing fuel costs, FIT purchasing costs, and grid stabilization costs by the total volume of electricity generated

Renewable energy-based power generation income and expenditure

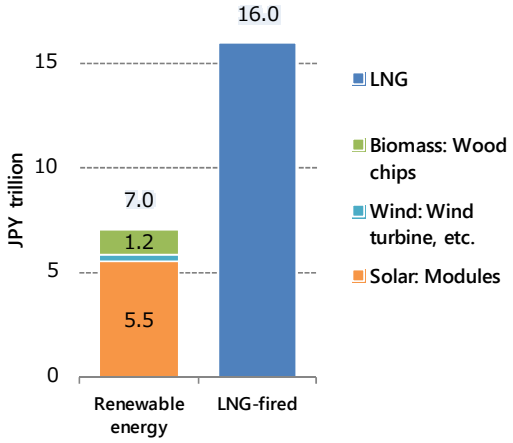
Hopes are high for renewable energy-based power generation

Installation of renewable energy-based power generation facilities is proceeding apace. As of August 2016, facilities with a total capacity of 51 GW were operating under the FIT scheme, while the total capacity of all the facilities that have been approved under the scheme is 1.7 times larger at 88 GW. If, for argument's sake, certified non-residential-use solar photovoltaic generation facilities (75 GW), onshore wind (3 GW), and general wood biomass[1] (3 GW) totaling 81 GW generated 2.1 PWh over a 20-year purchasing period and this was used to replace electricity generated using LNG-fired power plants, cumulative CO_2 emissions would be reduced by 800 Mt and LNG imports would be reduced by 294 Mt. Increased utilization of renewable energy-based power generation is expected to contribute to reducing CO_2 emissions and increasing energy self-sufficiency.

Although LNG imports can be reduced by JPY16 trillion, the cost of importing solar panels, etc. would increase by JPY7 trillion

LNG import costs would be reduced by as much as JPY16 trillion[2]. This is expected to make a considerable contribution to shrinking the trade deficit, which in FY2015 ran to JPY1.9 trillion.

Figure 6. Import costs of renewable energy and LNG-fired power generation



Note: Figures are cumulative 20-year totals. Renewable energy includes approved non-residential-use solar PV, onshore wind, and general wood biomass-fired power generation facilities with a total capacity of 81 GW.

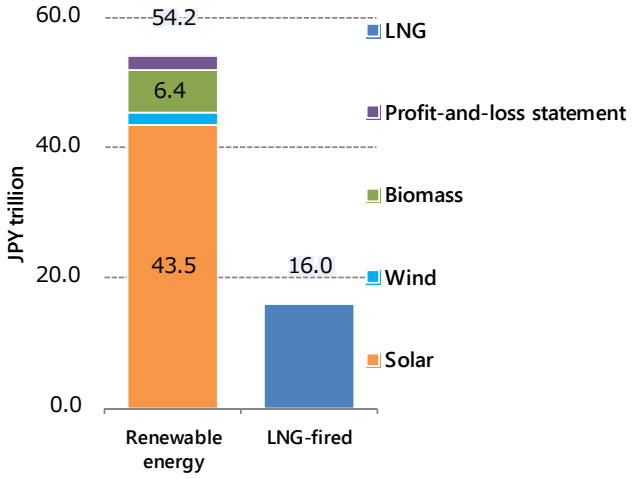
It is not the case however that renewable energy-based power generation does not rely on importation as well. In FY2015 for example, 63% of solar modules and 69% of wind power generators were imported[3]. Although only 28% of fuel was imported[4], if one includes palm kernel shells this rises to 50%. Even just accounting for these, the importation costs total JPY7 trillion, or JPY3,100/MWh-JPY3,500/MWh per generated unit. In addition, importation of highly competitive biomass is expected to increase. This means the net effect of renewable energy-based power generation on import reduction would actually only be JPY9 trillion or even less.

[1] Includes agricultural residues. Lumber, mill ends, imported material, palm kernel shells, rice husks, rice straw, etc. Does not include forest thinnings, felled timber, pruned branches, or wood chips.
[2] Calculated based on the average price in FY2015: JPY54,418/t.
[3] Calculated/projected using data from the Japan Photovoltaic Energy Association and the New Energy and Industrial Technology Development Organization (NEDO)
[4] Charcoal, fuelwood, fuel chips, and pellets. Includes materials used for purposes other than power generation. Calculated based on the Ministry of Agriculture, Forestry and Fisheries of Japan's "Table of Wood Supply and Demand".

While importation costs would decrease, electricity costs would increase substantially

Although a reduction in importation costs of JPY9 trillion is certainly a considerable benefit, an issue with the FIT scheme is that it causes an escalation in electricity prices. The electricity cost of generating 2.1 PWh of electricity with LNG-fired would amount to JPY16 trillion. With the abovementioned renewable energy, however, this would cost JPY38 trillion more, raising the cost to JPY54 trillion, as a result of the powerful incentive provided by the FIT scheme for people to adopt renewable energy: High purchasing prices. Although there are times when people choose domestically produced food and other products even when they are slightly more expensive, it has to be said that it is unclear whether broad agreement can be really received for an additional burden of as much as JPY38 trillion.

Figure 7. Electricity cost of renewable energy and LNG-fired



Note: This is the same as Figure 6

If renewable energy-based power generation is expected to play a role in regional revitalization and the fostering of industry, a situation in which the market is dominated by imported products and national wealth flows outside the country is surely not to be desired. Reconstruction of the system in a way that takes into account burden-bearing capacity and industrial competitiveness is necessary for encouraging adoption of renewable energy-based power generation.

The impact of realizing plans to build large numbers of coal-fired power plants

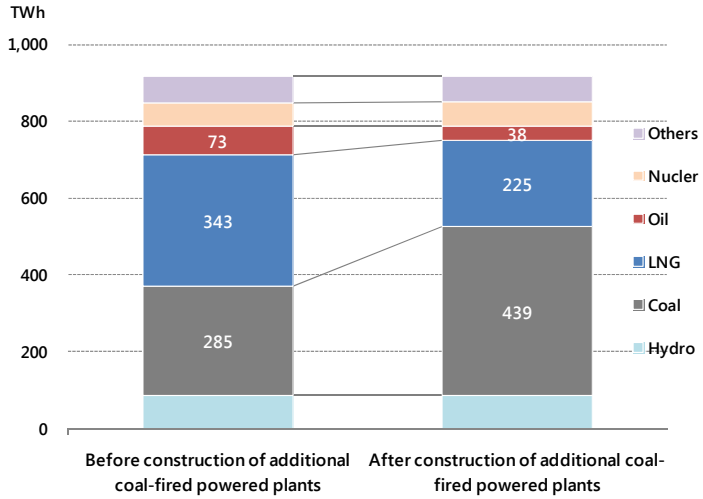
What impact will moves to build large numbers of coal-fired power plants (with a total capacity rivalling that of Chubu Electric Power Company's thermal power plants) have?

The economic performance of coal-fired power plants is regarded highly, and following the liberalization of the electricity market the construction of a large number of additional coal-fired power plants is now under consideration. As of December 2016, a total of 48 plants with a huge capacity of 23 GW are currently being planned/considered—their total capacity is close to 50% of the capacity of all existing coal-fired plants, and rivals the entire capacity of Chubu Electric Power Company's thermal power plants (24 GW). In this section we utilized the projected FY2017 economy and energy supply and demand situation to analyse the impact if all of the coal-fired plants currently being planned/considered were to go into operation.

The proportion of electricity generated with coal-fired power plants would rise to 48%

If all of the coal-fired power plants currently being planned/considered were to go into operation and replace LNG, and oil-fired power plants, coal-fired power generation would rise to 153.8 TWh taking its share up to 48%. On the other hand, LNG-fired power generation would decrease to 117.9 TWh and a 25% share, while oil-fired power generation would decrease to 35.6 TWh.

Figure 8. Power generation mix (electric utilities, generated and purchased electricity)



Replacing LNG-fired power generation with low-cost coal-fired power generation would reduce electricity costs by 10% to JPY630 billion

Coal consumption would increase 67% to 54.1 Mt, while LNG consumption would decrease 37% to 17 Mt. By decreasing the use of highly efficient LNG-fired power generation while increasing the use of less efficient coal-fired power generation the total amount of fuel used in thermal power generation would increase 2% to 3 Mtoe. The cost however, would decrease by 10% or JPY631 billion, as coal is cheaper than LNG. This would correspond, even when including non-thermal electricity, to a JPY700/MWh reduction in the electricity unit price. If all of this cost reduction was passed on to consumers, household electricity bills would be roughly JPY2,200 cheaper per year (calculated assuming annual electricity consumption of 3,300 kWh).

CO_2 emissions are expected to increase by 54 Mt, the equivalent of 3.8% of greenhouse gas emissions in FY2013

CO_2 emissions are expected to increase by 54 Mt. This is the equivalent of 3.8% of greenhouse gas emissions in FY2013. This would represent a setback for Japan in achieving the target of reducing greenhouse gas emissions by 26% of the level in FY2013 by FY2030.

The LNG-fired power plant capacity factor would decrease by 19% to 30%

There would be a considerable impact on the LNG-fired power plant capacity factor. If the current generation capacity of 73 GW was maintained, the LNG-fired power plant capacity factor would decrease by 19%, from 49% to 30%. If the capacity factor were to drop this much, some LNG-fired power plants might be unable to withstand the drop in profitability and be shut down. If the generation capacity of LNG-fired and oil-fired power plants was reduced to an extent that corresponds with the increased capacity of coal-fired power plants (LNG: 20 GW, oil: 3 GW) and the LNG-fired power plants of the former general electric utilities were decommissioned in order of age, it would be necessary to decommission all plants constructed up to the year 1984. If the current capacity factor of 50% were maintained, it would be necessary to reduce thermal power plant capacity by 28 GW by decommissioning/shutting down combined cycle gas turbine power plants constructed all the way up to the year 1990.

Evaluation and reviews based on comprehensive judgment is essential

There are considerable economic benefits associated with the addition of large numbers of coal-fired power plants. On the other hand, it would increase CO_2 emissions and would render relatively new LNG-fired power plants surplus to requirements, necessitating their decommissioning/closure. Plans for new coal-fired power plants ought not to be viewed as discrete individual projects—it is essential that the trend is evaluated and reviewed in a broad-fired and comprehensive manner.

Toshiya Kato

[Reference information] Cases in which the U.S. dollar appreciates against the Japanese yen by JPY10/USD, and in which the price of crude oil decreases by $10/bbl

Case in which the U.S. dollar strengthens by JPY10/USD

Currently there is speculation that the U.S. dollar will strengthen under the upcoming Trump administration. Therefore, we have evaluated the impact (Table 11) on the economy and on energy if the U.S. dollar strengthens JPY10 above the level assumed in our Reference Scenario.

Table 11. Case in which the U.S. dollar strengthens by JPY10

		Histrical	Projections			Year-to-year changes			changes from Reference Scenario
			Reference Scenario		JPY10 strengthening of $US	Reference Scenario			JPY10 strengthening of $US
		FY2015	FY2016	FY2017	FY2017	FY2015	FY2016	FY2017	FY2017
Energy	Primary energy supply (Mtoe)	470.3	469.5	468.0	467.5	-1.5%	-0.2%	-0.3%	-0.1%
	Oil (GL)	211.4	208.4	201.9	201.2	-2.6%	-1.4%	-3.1%	-0.3%
	Natural gas (Mt of LNG equiv.)	87.0	84.8	79.0	79.0	-4.9%	-2.6%	-6.8%	0.0%
	Coal (Mt)	190.1	190.5	190.9	191.1	0.1%	0.2%	0.2%	0.1%
	Final energy consumption (Mtoe)	315.7	315.5	313.7	313.2	-1.1%	-0.1%	-0.6%	-0.2%
	Electricity sales (TWh)	837.5	842.7	846.6	846.7	-1.6%	0.6%	0.5%	0.0%
	City gas sales (billion m^3)	39.91	40.77	41.35	41.33	-0.6%	2.2%	1.4%	-0.1%
	Fuel oil sales (GL)	180.5	176.6	172.4	171.8	-1.2%	-2.2%	-2.4%	-0.4%
	Energy-related CO_2 emissions (Mt)	1,148	1,137	1,105	1,104	-3.5%	-1.0%	-2.8%	-0.1%
Economy	Real GDP (JPY 2011 Trillion)	517.2	523.4	528.5	528.6	1.3%	1.2%	1.0%	0.0%
	Mining and manufacturing (2010=100)	97.4	97.7	99.1	99.3	-1.0%	0.3%	1.4%	0.2%
	Exchange rate (JPY/$)	120.4	107.8	110.0	120.0	10.2%	-10.4%	2.0%	9.1%

Case in which the price of crude oil decreases by $10/bbl

The price of crude oil has increased following the OPEC agreement to cut oil production. Some however have begun to point to scepticism regarding the effectiveness of OPEC production cuts as well as the price-curbing effect of shale oil. Therefore, we have evaluated the impact (Table 12) on the economy and on energy if crude oil prices were $10/bbl lower than the level assumed in our Reference Scenario.

Table 12. Case in which the price of crude oil decreases by $10/bbl

		Histrical	Projections			Year-to-year changes			changes from Reference Scenario
			Reference Scenario		$10/bbl crude oil price reduction	Reference Scenario			$10/bbl crude oil price reduction
		FY2015	FY2016	FY2017	FY2017	FY2015	FY2016	FY2017	FY2017
Energy	Primary energy supply (Mtoe)	470.3	469.5	468.0	469.8	-1.5%	-0.2%	-0.3%	0.4%
	Oil (GL)	211.4	208.4	201.9	203.8	-2.6%	-1.4%	-3.1%	0.9%
	Natural gas (Mt of LNG equiv.)	87.0	84.8	79.0	79.0	-4.9%	-2.6%	-6.8%	0.0%
	Coal (Mt)	190.1	190.5	190.9	191.0	0.1%	0.2%	0.2%	0.1%
	Final energy consumption (Mtoe)	315.7	315.5	313.7	315.4	-1.1%	-0.1%	-0.6%	0.5%
	Electricity sales (TWh)	837.5	842.7	846.6	847.5	-1.6%	0.6%	0.5%	0.1%
	City gas sales (billion m^3)	39.91	40.77	41.35	41.46	-0.6%	2.2%	1.4%	0.3%
	Fuel oil sales (GL)	180.5	176.6	172.4	174.2	-1.2%	-2.2%	-2.4%	1.0%
	Energy-related CO_2 emissions (Mt)	1,148	1,137	1,105	1,110	-3.5%	-1.0%	-2.8%	0.5%
Prices	Crude oil CIF price ($/bbl)	49	48	58	48	-45.2%	-2.2%	21.9%	-17.2%
	LNG CIF price ($/t)	452	344	419	355	-43.3%	-24.0%	21.9%	-15.3%
Economy	Real GDP (JPY 2011 Trillion)	517.2	523.4	528.5	529.0	1.3%	1.2%	1.0%	0.1%
	Mining and manufacturing (2010=100)	97.4	97.7	99.1	99.3	-1.0%	0.3%	1.4%	0.2%

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