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Economic and Energy Outlook of Japan through FY2017

Appropriate domestic energy policy measures are required to deal with rising oil prices.

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Executive summary

Nuclear power generation | Pay attention to the restarts

▌ Gradually, the passing of safety checks and the process of restarting under the new regulation standards is proceeding. And yet, there is still much ambiguity including judicial ruling and/or local acceptance which will influence the pace of restart. This paper analyses the influences on the 3Es (Economy, Energy Security, and Environment) of four cases of different levels of nuclear power units approval and restart by the end of FY2017.

▌ The [Reference Scenario] assumes that by the end of FY2016, a cumulative total of seven nuclear power units will have restarted and that by the end of FY2017, 19 units will be in operations. They will be in service during FY2017 with a total electricity generation reaching 119.8 TWh, which is 42% of the pre-earthquake FY2010 level. Compared to FY2010, total spending on fossil fuel imports decreases by JPY4.7 trillion, while the **electricity cost** (*) per MWh (i.e. electricity unit cost) rises by about JPY1,100/MWh. Relative to the same period, the energy-related CO_2 emissions decrease by 45 Mt-CO_2 (2.1%) and the self-sufficiency rate remains lower by 3.4% point at 14.4%.

    *   Electricity Cost = Fuel cost + FIT + Grid Stabilization Cost
    Actual power tariffs include capital and labour costs
      (Source of definition: METI, [Long-term Energy Demand and Supply Outlook] May 2015)

▌ In the [High Case], which assumes a total of 25 units to restart by the end of FY2017, total fossil fuel imports spending decreases by JPY0.7 trillion relative to the [Low Case] where only 12 units are assumed to restart. In this comparison, the average electricity cost is lowered by about JPY600/MWh, the self-sufficiency rate improves by 4.8% point and the energy-related CO_2 emissions decrease by 52 Mt-CO_2 (4.6%) whilst GDP increases by JPY0.6 trillion (0.12% point).

▌ The hypothetical [Best Mix Case] reflects the power generation mix of METI's [Long-term Energy Supply & Demand Outlook]. Under this Case, compared to the [Low Case], total fossil fuel imports spending decreases by JPY1.2 trillion. In this comparison, the self-sufficiency rate is improved by 9.0% point and the energy-related CO_2 emissions are decreased by 114 Mt-CO_2 (10.1%). The average electricity cost is increased by JPY600/MWh, reaching JPY6,900/MWh, which is the highest among the four cases (but it is lower than the estimated JPY9,100/MWh based on the [Long-term Energy Demand & Supply Outlook] target) .

▌ Because of the judicial ruling that ceased operations at the Takahama Unit No.3 and 4, it is important to analyse the effect of stopping operations of nuclear power plants from a local point of view. As a rule, if one nuclear power plant with the capacity of 1 MW stops operation for one year in an area where annual demand is about 100 TWh, total fossil fuel costs increase by JPY60 billion and the

energy-related CO_2 emissions increases by 4 Mt-CO_2 (7% increase for the local emissions). The average electricity unit cost will increase by JPY400/MWh (1.8% rise of the average power unit price).

Figure 1 | Impacts of restarting nuclear power plants (FY2017)

	Low Case	Reference Scenario	High Case	Best Mix Case
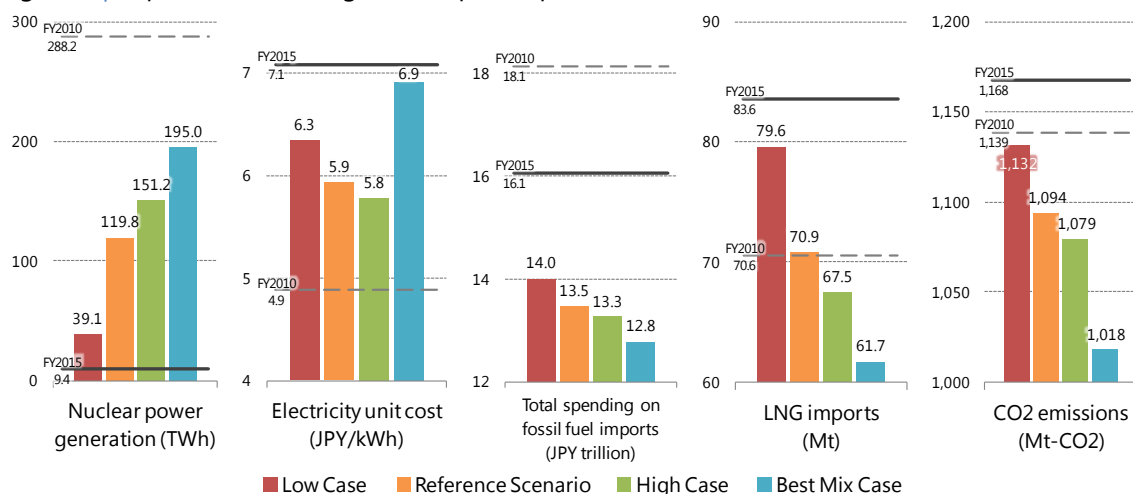
Lower oil prices | Overview of the crude oil price influence on Japan

▮ If the oil and LNG prices drop by $10/bbl and by $1.4/MBtu, they will contribute to the growth cycle for consumption and investment and Japan's GDP will increase by 0.1% (JPY0.6 trillion). The improved trade balance brought by the decrease in total fossil fuel imports spending of JPY2.0 trillion is the main factor for GDP expansion.

▮ A decrease in investment for energy resource development is feared to negatively influence the world economy. When crude oil prices dropped by $40/bbl in FY2015, world energy development investment decreased by JPY15 trillion and by JPY1 trillion in Japan, compared to FY2014.

▮ Looking at the influence of the lower oil prices on corporate profits, oil companies reported almost JPY1.0 trillion loss of final profit due to losses in inventory valuation and impairment related to resource development. On the other hand, increase in operating profit through decrease of fuel costs and power tariff was much bigger at JPY2.0 trillion.

Executive summary of outlook through FY2017 [Reference Scenario]

Macro economy | FY2016 & 17: Japanese economy grows but slowly

▮ The Japanese economy will continue to grow but more slowly in FY2016 at 0.7%. Private demand will slow down from the previous year while public and overseas demand will lead the growth. For FY2017, GDP grows at 0.9% for the period, led by private demand. Private consumption will slow down slightly, while private investment will remain strong.

Energy supply and demand | Energy use continues to decrease but at a slower pace

▮ Total primary energy supply in FY2016 decreases due to the slow recovery in domestic production of the manufacturing sector as well as the advancement of energy saving. Because of a continued economic expansion and other factors, the decline of energy supply of FY2017 will slow down. The

restart of nuclear power plants and use of renewable energy will reduce the oil and natural gas consumption.

▌ In FY2016, total final consumption decreases for the seventh consecutive year since the Great East Japan Earthquake. Industry sector's consumption decreases because of reduced production including ethylene. The transport sector consumes less due to an increased share of fuel-efficient cars while consumption increases in the residential and commercial sectors due to temperature effect. In FY2017, industry sector's consumption will increase through gradual expansion of production activities while the consumption of the residential and commercial sectors will remain flat and the transport sector will consume less.

Energy sales | City gas and electricity grow and fuel oil declines.

▌ In FY2016, electricity sales by utilities to households increase for the first time since the earthquake. This is because of the increase in cooling and heating demand as a rebound from the previous year's cooler summer and warmer winter. Sales for power services increase for the first time in four years, reflecting growth in cooling and heating demand for commercial sector and better production and economic conditions.

▌ City gas sales in FY2016 increase to 40.4 billion m^3 due to demand development efforts and temperature effect despite a slow pace of production recovery in the manufacturing sector. In FY2017, sales to industry will increase reflecting the recovery of production activities. The overall sales will mark the highest-level for a second consecutive year.

▌ Total fuel oil sales show an overall decrease in FY2016, primarily in response to a decline in naphtha sales as well as a decline in the use of Type C fuel oil for power generation due to the return of nuclear power units. In FY2017, overall sales of fuel oil will decrease for the fifth consecutive year. It is because sales for Type C fuel oil for power generation will decrease, due to more re-starts of nuclear power stations, and because of the decrease in gasoline and kerosene sales.

Renewable power generation | Operational capacities will reach 65 GW. The cumulative cost burden could be JPY56 trillion

▌ The pace of expansion for renewable power generating capacity of the last few years, supported by a generous Feed-in Tariff (FIT) system, is slowly subsiding due to reduced tariff for solar PVs and the cancellation of approvals for contracts/permits of some facilities, which have not started operation. Despite such situation, the operating capacity of renewable power generation (excluding large-scale hydro) by the end of FY2017 will reach 65 GW.

▌ Coincidently, the unavoidable burden expands also. The cumulative cost burden for 20 years could be JPY56 trillion if all of the approved 87 GW (of which 79.9 GW is solar PVs) by the end of March 2016 become operational. This is equivalent to an increase of JPY3,200/MWh above the rates in place just before FIT started – an increase of 14% for households and 19% for industrial consumers.

CO$_2$ emissions | Reduce for the fourth consecutive year through FY2017, 11.4% lower than FY2013 level

▌ Energy-related CO$_2$ emissions reached a historical high of 1,235 Mt-CO$_2$ in FY2013 but will decrease for the fourth consecutive year through FY2017. The energy saving and the restart of nuclear power plants combined with the increase in renewable energy will considerably diminish oil and natural gas consumption, lowering the emission by 141 Mt-CO$_2$ to 1,094 Mt-CO$_2$ in FY2017. While the GOJ sets

the Nationally Determined Target of 26% for GHG emissions reduction (25% for CO_2) from FY2013 by FY2030 as an international commitment, CO_2 emissions in FY2017 will be 11.4% less than in FY2013. The main contributions for the emissions reduction come from the re-starts of nuclear power generation (40%) and from the increase in renewable energy (20%).

Table 1 | Summary of Reference Scenario

		Historical				Projections		Year-to-year changes		
		FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Energy	Primary energy supply (Mtoe)[1]	513.3	488.5	473.0	466.4	463.1	462.3	-1.4%	-0.7%	-0.2%
	Oil[2] (GL)	232.3	234.5	217.6	211.7	205.5	197.3	-2.7%	-2.9%	-4.0%
	Natural gas[2] (Mt of LNG equiv.)	73.6	91.1	91.5	86.6	84.4	73.0	-5.3%	-2.5%	-13.5%
	LNG imports (Mt)	70.6	87.7	89.1	83.6	82.2	70.9	-6.2%	-1.6%	-13.8%
	Coal[2] (Mt)	184.7	194.6	190.0	190.2	190.2	190.1	0.1%	0.0%	-0.1%
	Nuclear (TWh)	288.2	9.3	0.0	9.4	18.8	113.1	..	99.4%	501%
	Renewables excl. large hydro (TWh)	63.9	67.9	76.0	87.6	99.7	112.8	15.2%	13.8%	13.2%
	Final energy consumption[3] (Mtoe)	339.6	322.2	313.5	309.4	306.7	306.0	-1.3%	-0.9%	-0.2%
	Industry[4]	157.4	151.0	147.4	145.8	143.7	144.1	-1.1%	-1.4%	0.3%
	Buildings	99.3	91.5	88.8	86.3	87.1	87.1	-2.8%	0.9%	0.0%
	Transport	82.8	79.5	77.2	77.3	75.8	74.7	0.1%	-1.8%	-1.5%
	Petroleum products	176.1	164.2	158.4	158.0	154.1	152.2	-0.3%	-2.5%	-1.2%
	Natural gas and city gas	34.6	34.6	34.4	33.8	34.3	34.9	-1.6%	1.4%	1.8%
	Coal and coal products	35.9	35.6	35.1	33.5	33.5	33.7	-4.7%	0.0%	0.6%
	Electricity	89.8	84.7	82.7	81.6	82.2	82.6	-1.4%	0.8%	0.5%
	Electricity sales (TWh)	926.6	871.5	851.4	837.5	842.9	846.7	-1.6%	0.6%	0.4%
	City gas sales[5] (Billion m³)	39.28	39.82	40.16	39.91	40.45	41.18	-0.6%	1.3%	1.8%
	Fuel oil sales (GL)	196.0	193.6	182.7	180.5	176.1	172.8	-1.2%	-2.5%	-1.9%
	Energy-related CO_2 emissions[3] (Mt)	1,139	1,235	1,189	1,168	1,151	1,094	-1.8%	-1.4%	-5.0%
	(FY2013=100)	92.2	100.0	96.3	94.5	93.2	88.6	..	..	..
Prices	Crude oil, import, CIF ($/bbl)	84	110	89	49	47	54	-45.2%	-3.2%	14.6%
	LNG, import, CIF ($/t)	584	837	797	452	324	394	-43.3%	-28.3%	21.7%
	($/MBtu)	11.3	16.1	15.3	8.7	6.3	7.6	..	..	..
	Steam coal, import, CIF ($/t)	114	108	93	76	70	72	-18.4%	-7.5%	2.6%
	Coking coal, import, CIF ($/t)	175	135	109	88	86	97	-19.3%	-1.6%	12.8%
Economy	Nominal GDP (JPY trillion)	480.5	482.4	489.6	500.4	508.0	514.9	2.2%	1.5%	1.4%
	Real GDP (JPY2005 trillion)	512.7	529.8	524.8	529.0	532.6	537.4	0.8%	0.7%	0.9%
	Industrial production (2010=100)	99.4	99.0	98.4	97.4	97.7	98.6	-1.0%	0.3%	1.0%
	Exchange rate (JPY/$)	86.1	100.0	109.2	120.4	105.5	105.0	10.2%	-12.4%	-0.5%

Notes:

1. Mtoe = 10^{13} kcal

2. 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. Final energy consumption and CO_2 emissions in FY2015 are estimation.

4. Industry includes non-energy use.

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

Table annex | Impacts of restarting nuclear power plants

	FY2010	FY2017			
		Low Case	Reference Scenario	High Case	Best Mix Case
Cumulative number of restarted nuclear reactors[1] [FY2016]	..	[5]	[7]	[9]	..
FY20017	..	12	19	25	..
Average period for operation (months)	..	5	9	8	..
Electricity generation by nuclear (TWh)	288.2	39.1	119.8	151.2	195.0

		FY2010	FY2017 (changes from **FY2010**)				FY2017 (changes from the **Low Case**)		
			Low Case	Reference Scenario	High Case	Best Mix Case	Reference Scenario	High Case	Best Mix Case
Economy	Electricity unit cost[2] (JPY/kWh)	4.9	+1.5	+1.1	+0.9	+2.0	-0.4	-0.6	+0.6
	Fuel cost	3.8	+0.4	-0.0	-0.2	-0.4	-0.4	-0.6	-0.8
	FIT purchasing cost	0.2	+1.9	+1.9	+1.9	+3.3	-	-	+1.4
	Total fossil fuel imports (JPY trillion)	18.1	-4.1	-4.7	-4.9	-5.4	-0.5	-0.7	-1.2
	Oil	12.3	-3.3	-3.5	-3.5	-3.7	-0.2	-0.2	-0.4
	LNG	3.5	-0.3	-0.6	-0.8	-1.0	-0.4	-0.5	-0.7
	Trade balance (JPY trillion)	5.3	-5.5	-5.0	-4.8	-4.5	+0.5	+0.7	+1.0
	Real GDP (JPY2005 trillion)	512.7	+24.3	+24.7	+24.9	+25.3	+0.5	+0.6	+1.0
	Gross national income (JPY trillion)	480.5	+33.8	+34.4	+34.6	+35.0	+0.6	+0.8	+1.2
Energy	Primary energy supply								
	Oil (GL)	232.3	-31.0	-35.2	-36.8	-40.1	-4.2	-5.8	-9.0
	Natural gas (Mt of LNG equivalent)	73.3	+8.5	-0.3	-3.7	-9.4	-8.8	-12.1	-17.9
	LNG imports (Mt)	70.6	+9.0	+0.3	-3.1	-8.9	-8.8	-12.1	-17.9
	Self-sufficiency rate	17.8%	-6.9p	-3.4p	-2.1p	+2.1p	+3.4p	+4.8p	+9.0p
Environment	Energy-related CO_2 emissions (Mt-CO_2)	1,139	-7	-45	-60	-121	-38	-52	-114
	Changes from FY2013	[-7.8%]	[-8.4%]	[-11.4%]	[-12.6%]	[-17.6%]	..	..	..

Reference Scenario: Seven nuclear power plants restart by the end of FY2016.
About one plant restarts every month in FY2017 and 19 plants in total restart by the end of FY2017.

Low Case: Five nuclear power plants restart by the end of FY2016.
About 0.5 plant restarts every month in FY2017 and 12 plants in total restart by the end of FY2017.

High Case: Nine nuclear power plants restart by the end of FY2016.
About 1.5 plants restart every month in FY2017 and 25 plants in total restart by the end of FY2017.

Best Mix Case: A hypothetical case reflecting the power generation mix (22%-24% of renewables, 20%-22% of nuclear, etc.)
in the Long-term Energy Supply and Demand Outlook by METI (2015).

1. Thirty-nine reactors operated at the end of 2010.
2. Sum of fuel cost, FIT purchasing cost and grid stabilising cost divided by total power generation.

Introduction

While the Japanese economy posted positive growth in real gross domestic product for the first time in two years as a sign of recovery, there are some factors to make the future course of the economy uncertain, including the deceleration of China and other emerging economies, the United Kingdom's referendum to leave the European Union and U.S. monetary policy measures shaking emerging economy markets.

In the international energy situation, the benchmark Brent crude oil price declined rapidly on such factors as a loosening supply-demand balance after staying above $100 per barrel until August 2014. It slipped below $28/bbl in January 2016 before rising back to around $50/bbl while repeating seesawing. As the supply-demand balance is expected to tighten, crude oil prices are projected to increase moderately.

In Japan, there are moves to restart nuclear reactors including Unit 3 at the Ikata Nuclear Power Station of Shikoku Electric Power Co., while judicial rulings, difficulties in obtaining local consent to restart nuclear reactors, and other factors have made future restarts uncertain. The law for the Feed-in Tariff system for renewable energy expansion has been revised to address non-operating approved FIT capacity and lower FIT levels.

Energy and economic situations are growing uncertain both in Japan and the rest of the world. With such present situations in mind, we have projected the Japanese economy and energy supply and demand through FY2017 and analysed implications of the various projections.

Major assumptions in the Reference Scenario

World economy

We assume that the world economy will post moderate growth. The U.S. economy will be supported by private consumption expansion accompanying employment environment improvements and rising consumer sentiment. The European economy will be backed by firm private consumption, while an income-expanding effect of low inflation caused by crude oil price plunges will fade away. The Asian economy, though maintaining annual growth above 5%, will moderate the growth pace, reflecting the structural change of the Chinese economy's deceleration. The world economy is assumed to grow at an annual rate of 3.1% in FY2016 and 3.4% in FY2017.

Oil, LNG and coal import CIF prices

Energy import prices are assumed to gradually rise toward 2017. The oil import CIF price for Japan is assumed at $47/bbl in FY2016 and $54/bbl in FY2017. The liquefied natural gas import CIF price for Japan is projected at $6.3 per million British thermal units in FY2016 and $7.6/MBtu in FY2017. As the supply-demand balance for coal is expected to tighten, the steam coal import CIF price is assumed at $70 per ton in FY2016 and $72/t in FY2017. The coking coal import price is assumed at $86/t in FY2016 and at $97/t in FY2017.

Exchange rate

We assume the average dollar-to-yen exchange rate at JPY195/$ for the outlook period.

Nuclear power generation

Based on progress in the assessment of nuclear power plants' conformity with new regulation standards and other procedures, we assume that nuclear reactors will be gradually restarted. By the end of FY2016, a total of seven reactors will have restarted. They will operate for four months on average in FY2016, generating 19.8 terawatt-hours of electricity in the year. By the end of FY2017, a total of 19 reactors will have restarted. They will operate for nine months on average in FY2017, generating 119.8 TWh (accounting for 13% of the power generation mix) in the year.

Electricity supply and demand

Based on a report by the Electricity Supply and Demand Verification Subcommittee, we assume that each former general electric utility can secure a reserve capacity rate of 3% or more.

Temperature

Based on the three-month weather forecast by the Japan Meteorological Agency, we assume that FY2016 will have a warmer summer than in the previous year (+0.5 degrees Celsius). Later temperatures will be normal. This means a colder winter in FY2016 than in the previous year (-1.1°C), a cooler summer in FY2017 (-0.4°C) and an unchanged winter in the year.

Macro economy

In FY2016, the Japanese economy will maintain a positive growth rate of 0.7% indicating a deceleration from the previous year.

Private consumption will post the first positive growth in three years due mainly to an unemployment rate fall. Private non-residential investment will increase in line with corporate earnings improvements. Private residential investment will decline in the absence of a demand increase just before a consumption tax increase. Stock adjustment after an increase in the previous year will make a negative contribution to private demand growth. Private demand as a whole will decelerate from the previous year, contributing 0.1 percentage points to gross domestic product growth. Public demand will contribute 0.2 points as government consumption increases. Exports will expand in line with U.S. economic growth. External demand will contribute 0.2 points to GDP growth.

Fossil fuel imports will decrease to JPY12.4 trillion due to price falls and the restart of nuclear reactors, leading the trade balance to turn black for the first time in six years. The current account will post a surplus of JPY22.3 trillion. The consumer price index will rise by 0.2%.

In FY2017, the Japanese economy will grow by 0.9%, led by private demand. Private consumption will decelerate growth while private non-residential investment will be firm.

Private consumption, though decelerating growth from the previous year, will still continue to increase due mainly to employment environment improvements. Private non-residential investment will continue to grow thanks to corporate earnings improvements. Private residential investment will decline for the second straight year. Private demand as a whole will contribute 0.9 points to GDP growth. Public demand will contribute 0.1 points as government expenditure including social security costs increases despite a decline in public investment. Exports will expand for the fifth straight year. External demand will contribute 0.2 points.

As import growth exceeds export growth, a trade surplus will shrink. However, the current balance will maintain a high level of JPY22.1 trillion, slightly less than in the previous year. The consumer price index will score a 1.2% increase as both energy and non-energy prices rise.

Table 2 | Macroeconomic indicators

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Real GDP (JPY trillion in 2005 prices)	512.7	529.8	524.8	529.0	532.6	537.4	0.8%	0.7%	0.9%
Private demand	377.1	399.1	391.3	393.8	394.6	398.2	0.6%	0.2%	0.9%
Private consumption	299.7	316.2	307.2	306.4	308.6	310.4	-0.2%	0.7%	0.6%
Private residential investment	12.5	14.9	13.1	13.5	13.1	12.8	2.4%	-2.5%	-2.7%
Private non-residential investment	64.9	70.7	70.7	72.2	73.8	75.6	2.0%	2.3%	2.5%
Public demand	118.5	124.5	124.2	125.1	126.1	126.6	0.7%	0.8%	0.4%
Government consumption	97.9	102.2	102.3	103.9	104.9	106.0	1.5%	1.0%	1.0%
Public investment	20.7	22.4	21.8	21.2	21.2	20.6	-2.7%	-0.1%	-2.5%
Net exports of goods and services	17.2	7.2	11.3	11.7	12.8	13.6	3.7%	8.8%	6.3%
Exports of goods and services	83.9	85.0	91.7	92.0	93.5	95.4	0.4%	1.6%	2.0%
Imports of goods and services	66.8	77.8	80.4	80.3	80.8	81.8	-0.1%	0.6%	1.3%
Nominal GDP (JPY trillion)	480.5	482.4	489.6	500.4	508.0	514.9	2.2%	1.5%	1.4%
Balance of trade (JPY trillion)	5.3	-13.8	-9.1	-1.1	1.7	0.3	-88.1%	-260%	-82.8%
Exports	67.8	70.9	74.7	74.1	73.1	74.4	-0.7%	-1.3%	1.7%
Imports	62.5	84.6	83.8	75.2	71.4	74.1	-10.3%	-5.0%	3.8%
Fossil fuels	18.1	28.4	25.1	16.1	12.4	13.5	-36.0%	-22.7%	8.5%
Oil	12.3	18.7	15.2	9.6	8.0	8.8	-37.0%	-16.7%	10.6%
LNG	3.5	7.3	7.8	4.5	2.8	2.9	-41.4%	-37.7%	3.6%
Current account (JPY trillion)	18.3	2.4	8.7	18.0	22.3	22.1	106%	24%	-1.1%
Domestic corporate goods price index (2010=100)	100.2	102.4	105.2	101.8	100.0	101.0	-3.2%	-1.8%	1.1%
Consumer price index (2010=100)	99.9	100.4	103.4	103.6	103.8	105.1	0.2%	0.2%	1.2%
GDP deflator (2005=100)	93.7	91.1	93.3	94.6	95.4	95.8	1.4%	0.8%	0.4%

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

Industrial production

The industrial production index will increase on a rise in private non-residential investment.

The index of industrial production index in FY2016 will post a moderate increase of 0.3% from the previous year thanks mainly to a rise in private non-residential investment, despite some deceleration factors such as the impacts of the Kumamoto Earthquake and continued uncertainties about the future Asian economy. The index in FY2017 will continue to rise due mainly to increasing private non-residential investment (up 1.0% from the previous year).

Crude steel production will be limited to 104 million tons in FY2016 and to 105 million tons in FY2017 due primarily to decelerating exports.

Crude steel production in FY2016 will post a small increase of 0.1% from the previous year to 104.3 million tons, being affected by an export deceleration amid oversupply in China. In FY2017, crude steel production will grow by 0.8% to 151.0 million tons on a moderate domestic demand expansion.

Ethylene production will decline to 6.40 million tons in FY2016 before increasing slightly to 6.41 million tons.

Ethylene production in FY2016 will decline by 5.6% from the previous year to 6.40 million tons due to plant shutdowns in September 2015 and February 2016 and regular equipment inspection. In FY2017, production will post a small rise of 0.3% to 6.41 million tons on less regular equipment repairs.

Cement production will increase slightly to 59.4 million tons in FY2016 and 59.5 million tons in FY2017.

Cement production in FY2016 will post a small increase of 0.3% from the previous year to 59.4 million tons on a moderate economic recovery. In FY2017, it will score a limited rise of 0.2% to 59.5 million tons with public investment being reduced.

Paper and paperboard production will fall to 25.8 million tons in FY2016 and a quarter-century low of 25.5 million tons in FY 2017.

In FY2016, paperboard production will increase on freight traffic improvement while paper production will be affected by decreasing demand for newspapers and New Year postcards under a population fall and consumers' shift to electronic media. Paper and paperboard production will thus decline by 1.6% from the previous year. In FY2017, demand will increase for paperboards for processed food and beverages. Due to a paper demand decline, however, paper and paperboard production will decrease by 1.1%.

Automobile production will increase to 9.27 million units in FY2016 on robust sales in North American and other markets. In FY2017, production will rise further to 9.41 million units due to domestic and overseas demand expansion.

In FY2016, domestic automobile demand will decline due to a fuel efficiency data manipulation scandal for mini-vehicles and a vehicle-related production suspension caused by the Kumamoto Earthquake. However, production will increase by 0.9% from the previous year on robust exports to North American and other markets. In FY2017, domestic demand will increase in line with private consumption growth. Driven by exports to the North American market that will remain brisk, production will grow by 1.5% to 9.41 million units.

Table 3 | Industrial production

		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	104.3	104.3	105.1	-5.1%	0.1%	0.8%
	Ethylene (Mt)	7.00	6.76	6.69	6.78	6.40	6.41	1.4%	-5.6%	0.3%
	Cement (Mt)	56.1	62.4	61.1	59.2	59.4	59.5	-3.1%	0.3%	0.2%
	Paperand paperboard (Mt)	27.3	26.7	26.3	26.2	25.8	25.5	-0.2%	-1.6%	-1.1%
	Automobiles (Million units)	8.99	9.91	9.59	9.19	9.27	9.41	-4.2%	0.9%	1.5%
Production indices	Mining and manufacturing (2010=100)	99.4	99.0	98.4	97.4	97.7	98.6	-1.0%	0.3%	1.0%
	Food	98.2	98.9	95.5	97.6	97.5	97.5	2.1%	-0.1%	0.0%
	Chemicals	99.7	98.3	95.2	97.3	97.0	97.7	2.2%	-0.3%	0.7%
	Non-ferrous metals	98.9	97.3	97.9	96.5	97.5	98.7	-1.5%	1.0%	1.3%
	General and electrical machinery, etc.	101.3	97.6	100.0	98.4	99.2	100.8	-1.6%	0.8%	1.6%
Tertiary inudstry activity index (2005=100)		99.9	103.2	102.1	103.4	104.0	104.7	1.3%	0.5%	0.7%

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

Carbon dioxide emissions will decrease as switching from fossil fuels such as oil and natural gas to nuclear and renewable energy makes progress.

Primary energy supply in Japan in FY2016 will decline by 0.7% from the previous year due to a slow production improvement and progress in energy conservation. In FY2017, it will decrease by 0.2% on a continued energy conservation trend for the fourth straight year of fall. Switching from fossil fuels to nuclear and renewable energy will make progress.

Oil in FY2016 will decline by 2.9% due mainly to a drop in naphtha amid an ethylene production cut and a decrease in demand for oil for power generation. In FY2017, demand for oil for power generation will fall further as nuclear reactors restart. As this factor is coupled with drops in gasoline and kerosene sales, an oil decline in the year will expand to 4.0%. Oil's share of total primary energy supply will slip below 40% for the first time in 56 years.

Natural gas in FY2016 will fall by 2.1% from the previous year despite a city gas increase as demand decreases for natural gas for power generation on the restart of nuclear power plants and the spread of renewable energy. In FY2017, natural gas will decrease by 13.5% to around the level in 2010 before the Great East Japan Earthquake for the third straight year of fall, despite a city gas rise, as demand for natural gas for power generation declines

substantially on progress in the restart of nuclear power plants.

Coal in FY2016 will log a small increase of 0.1% from the previous year as industrial use increases on a recovery in steel and other production. In FY2017, it will post a slight fall of 0.1%. Even as nuclear reactors are restarted one after another, coal as a baseload electricity source will maintain a certain level of supply.

Nuclear power generation will total 19.8 TWh in FY2016 as the number of restarted nuclear reactors reaches seven by the end of the year. In FY2017, the number of restarted reactors will rise to 19 generating 119.8 TWh, equivalent to 40% of the level for FY2010.

Renewable energy power generation will continue an uptrend as mainly solar photovoltaics capacity expands. Renewable energy's share of primary energy supply will reach 4.5% in FY2017.

Energy-related carbon dioxide emissions in FY2017 will drop for the fourth straight year after peaking at 1,235 Mt-CO_2 in FY2013. The restart of nuclear power plants and the expansion of renewable energy will allow oil and natural gas consumption to decline, reducing the emissions in FY2017 to 1,094 Mt-CO_2 below the FY2010 level.

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	488.5	473.0	466.4	463.1	462.3	-1.4%	-0.7%	-0.2%
Coal	119.2	126.1	124.4	123.7	123.8	123.7	-0.6%	0.1%	-0.1%
Oil	212.0	214.5	199.0	193.6	187.9	180.4	-2.7%	-2.9%	-4.0%
Natural gas	95.7	118.4	118.9	113.3	110.9	96.0	-4.7%	-2.1%	-13.5%
Hydro	17.2	16.2	17.1	17.7	17.8	17.8	3.3%	0.7%	0.1%
Nuclear	60.7	1.9	0.0	2.0	3.9	23.4	..	99.4%	501%
Geothermal, new energy, etc.	8.7	11.4	13.5	16.2	18.8	21.0	19.3%	16.2%	11.7%
Self-sufficiency rate	17.8%	7.0%	6.5%	7.7%	8.7%	13.5%	1.2p	1.1p	4.7p
Energy intensity (FY2013=100)	94.0	86.5	84.6	82.7	81.6	80.7	-2.2%	-1.4%	-1.1%
Energy-related CO_2 emissions (Mt-CO_2)	1,139	1,235	1,189	1,168	1,151	1,094	-1.8%	-1.4%	-5.0%
(FY2013=100)	92.2	100.0	96.3	94.5	93.2	88.6	..	..	..

Notes: New energy includes solar photovoltaics, wind, biomss, solar heat, and small and medium-scale hydro power generation.
　　　Heat contents have been revised since FY2013.

Final energy consumption

Spreading energy and electricity conservation will lead final energy consumption to decline both in FY2016 and FY2017 for the seventh straight year of fall.

Final energy consumption in FY2016 will decrease by 0.9% from the previous year. The industry sector will reduce consumption due to ethylene and other production cuts. The transport sector will also decrease consumption due mainly to the rising market share for fuel efficient vehicles. The buildings sector will expand consumption in response to temperature changes from the previous fiscal year including a cooler summer and a warmer winter. In FY2017, final energy consumption will log a 0.2% fall. Consumption in the industry sector will level off as a slow production recovery is combined with growing energy and electricity conservation. The buildings sector will cut consumption on growing energy and electricity conservation. The transport sector will also reduce consumption due to further improvements in vehicle fuel efficiency. Final energy consumption will thus decline for the seventh straight year since the Great East Japan Earthquake, reaching the level for the second half of the 1980s.

The industry sector in FY2016 will reduce by 1.4% from the previous year due to falling ethylene, paper and paperboard production and energy conservation, although electrical machinery, automobile and some other production will expand. In FY2017, the sector will almost level off with a 0.3% gain. Electricity and city gas will increase in both FY2016 and FY2017, while petroleum products will decline.

The residential sector will expand in FY2016 by 1.0% from the previous year in response to temperature changes from a cooler summer and a warmer winter in the previous fiscal year. In FY2017, the sector will level off with a 0.2% drop as temperatures return to normal levels with energy-saving products spreading. The sector will reduce kerosene and other petroleum product consumption by switching from them to electricity and city gas.

The commercial sector will increase in FY2016 by 0.7% from the previous year due to temperature changes and a moderate production expansion. In FY2017, it will level off with a 0.2% gain as energy conservation for air-conditioning and lighting equipment makes progress. Electricity and city gas in the sector will increase with petroleum product declining both in FY2016 and FY2017.

The transportation sector will reduce in FY2016 by 1.8% from the previous year and that in FY2017 by 1.5% due to fuel efficiency improvements under fuel-efficient vehicles' growing market share, a peaking of automobile ownership and the improvement of transportation efficiency.

Table 5 | Final energy consumption

	Historical			Estimates	Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Final energy consumption (Mtoe)	339.6	322.2	313.5	309.4	306.7	306.0	-1.3%	-0.9%	-0.2%
Industry	157.4	151.0	147.4	145.8	143.7	144.1	-1.1%	-1.4%	0.3%
Buildings	99.3	91.5	88.8	86.3	87.1	87.1	-2.8%	0.9%	0.0%
Residential	54.7	50.3	48.8	47.3	47.7	47.7	-3.2%	1.0%	-0.2%
Commercial	44.7	41.3	40.0	39.1	39.4	39.4	-2.2%	0.7%	0.2%
Transport	82.8	79.5	77.2	77.3	75.8	74.7	0.1%	-1.8%	-1.5%
Coal and coal products	35.9	35.6	35.1	33.5	33.5	33.7	-4.7%	0.0%	0.6%
Petroleum products	176.1	164.2	158.4	158.0	154.1	152.2	-0.3%	-2.5%	-1.2%
City and natural gas	34.6	34.6	34.4	33.8	34.3	34.9	-1.6%	1.4%	1.8%
Electricity	89.8	84.7	82.7	81.6	82.2	82.6	-1.4%	0.8%	0.5%
Others	3.2	3.0	2.9	2.6	2.6	2.6	-9.8%	0.1%	0.1%

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

Electricity sales and power generation mix (electric utilities)

Electricity sales to the residential sector in FY2016 will increase for the first time since the Great East Japan Earthquake due to temperature changes. Overall electricity sales will rise in FY2017 for the second straight year of growth.

In FY2016, electricity sales for lighting services will increase by 0.6% from the previous year due to temperature changes accompanying heat and cold waves, representing the first rise since the Great East Japan Earthquake. Those for power services will grow by 0.7% for the first rise in four years as demand for cooling and heating expands on temperature changes. Sales to larger industrial users will also increase by 0.3% as those to steel and machinery manufacturers grow on a moderate production recovery. Overall electricity sales will increase by 6% for the first rise in four years.

In FY2017, electricity sales for lighting services will almost level off with a 0.2% gain as steady demand for all-electric homes as a sales-expanding factor is offset with temperatures' return to normal levels and spreading electricity conservation. Those for power services will expand by 0.6%. Sales to large industrial users will grow by 0.9% as those to chemical, steel and machinery manufacturers increase on a moderate production recovery. Overall electricity sales will increase by 0.4%, representing the first two-year consecutive increase in six years since the Great East Japan Earthquake.

Table 6 | Electricity sales by use (electric utilities)

	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	842.9	846.7	-1.6%	0.6%	0.4%
Lighting services	304.2	284.3	273.1	266.9	268.5	268.9	-2.3%	0.6%	0.2%
Power services	622.4	587.2	578.3	570.7	574.5	577.8	-1.3%	0.7%	0.6%
Large industrial users	283.2	269.3	266.8	263.3	264.0	266.4	-1.3%	0.3%	0.9%
Mining and manfuacturing	234.4	222.8	220.4	215.8	217.0	219.8	-2.1%	0.5%	1.3%
Chemicals	28.1	26.6	26.3	25.6	25.6	25.8	-2.5%	-0.1%	0.8%
Iron and steel	36.3	37.3	36.6	34.3	34.5	35.0	-6.3%	0.3%	1.5%
Machinery	74.6	69.2	69.0	68.0	68.8	70.1	-1.3%	1.2%	1.9%
Others	57.8	56.0	55.3	55.7	56.1	56.9	0.7%	0.8%	1.5%

Note: Sales for power services and total sales include specified-scale demand.

Nuclear reactors will restart sequentially. Fossil fuels including liquefied natural gas will see their share of the power generation mix declining to 69% in FY2017.

In FY2016, three nuclear reactors will be restarted. However, nuclear's share of the power generation mix will be limited to 2%. New energies and others will spread smoothly on the strength of the FIT system, expanding their share by 1.5 percentage points. Fossil fuels will reduce their share by 2.4 points to 81%.

In FY2017, nuclear will expand its share by 10.5 points to 13%. New energies and others will also boost their share, by 1.5 points, outdoing oil, etc. Fossil fuels' share will decline by 11.8 points to 69%, the lowest since the Great East Japan Earthquake. Particularly, LNG's share will post a large decline of 8.7 points to 33%. Fossil fuels' share will still be 7 points higher than in FY2010.

Table 7 | Power generation mix (electric utilities)

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Electricity generated and purchased (TWh)	1,028	963.5	936.2	920.0	926.6	929.6	-1.7%	0.7%	0.3%
Share							Year-to-year changes		
Hydro	(9%)	8%	9%	9%	9%	9%	+0.7p	-0.1p	-0.1p
Fossil fuels	(62%)	88%	87%	84%	81%	69%	-3.4p	-2.4p	-11.8p
Coal	(25%)	28%	30%	31%	30%	30%	+0.5p	-0.4p	-0.4p
LNG	(29%)	43%	46%	43%	42%	33%	-2.7p	-1.5p	-8.7p
Oil, etc.	(8%)	18%	11%	9%	9%	6%	-1.2p	-0.5p	-2.8p
Nuclear	(29%)	2%	0%	1%	2%	13%	+1.0p	+1.1p	+10.4p
New energies and others	(1%)	2%	3%	4%	6%	7%	+1.4p	+1.5p	+1.5p

Note: Shares for FY2010 represent electricity generated and purchased by former general electric utilities. Due to the absence of other electricity and rounding, shares may not add up to 100%.

City gas sales (city gas utilities)

City gas sales will set a record high each in FY2016 and 2017, led by those for industrial uses.

City gas sales in FY2016 will increase by 1.3% from the previous year to a record high of 40.4 billion cubic meters despite a slow recovery in production as demand increases on new demand exploration and temperature changes. In FY2017, these sales will grow by 1.8% to 41.2 billion m^3 on the expansion of production and economic activities and continued new demand exploration, led by those for industrial uses, setting a record high for the second straight year.

Sales to the residential sector in FY2016 will increase by 0.7% as a rise in demand for space and hot water and heating under lower winter temperatures than in the previous year is combined with the spread of residential fuel cells and other city gas-using equipment, the acquisition of new users and other factors. In FY2017, these sales will rise by 0.6% thanks mainly to the continued spread of city gas-using equipment and the acquisition of new users.

Sales for commercial and other uses in FY2016 will increase (by 0.9% for commercial uses and 0.7% for other uses) due to heat and cold waves. These sales in FY2017 will grow (by 0.6% for commercial uses and 0.7% for other uses) due mainly to a steady rise in air-conditioning demand in the services industry and new demand for micro gas engines and gas heat pumps.

Sales for industrial uses in FY2016 will increase by 1.8% to 23.4 billion m^3, driven by growth in those for manufacturing. Sales for manufacturing will rise by 2.6% thanks mainly to a higher capacity utilization rate under a production rebound amid an economic recovery and new demand accompanying fuel switching for industrial furnaces and boilers. Sales for industrial uses in FY2017 will expand by 2.6% to 2.4 billion m^3, setting a new record for the second straight year. Of them, those for manufacturing will increase by 3.1% due mainly to growing steel and automobile production and continued new demand exploration efforts. Those for electric utilities will decline by 1.3%, continuing a downtrend. Sales for industrial uses will account for 58% of total city gas sales in FY2017, a steep increase from 26% in FY1990.

Table 8 | City gas sales (city 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	40.45	41.18	-0.6%	1.3%	1.8%
Residential	9.79	9.55	9.58	9.24	9.31	9.36	-3.5%	0.7%	0.6%
Commercial	4.75	4.49	4.34	4.26	4.29	4.33	-1.9%	0.9%	0.7%
Industrial	21.61	22.20	22.74	23.01	23.41	24.02	1.2%	1.8%	2.6%
Manufacturing	20.18	20.26	20.07	20.57	21.01	21.66	2.5%	2.2%	3.1%
Electric utilities	1.43	1.94	2.68	2.44	2.40	2.37	-8.8%	-1.8%	-1.3%
Others	3.13	3.58	3.50	3.41	3.44	3.47	-2.6%	1.0%	0.8%

Note: Converted at 1 m^3=41.8605 MJ (10,000 kcal)

Fuel oil and LPG sales, and crude oil throughput

Fuel oil sales in FY2016 will slip below 180 gigaliters for the first time in 47 years due primarily to a substantial fall in naphtha sales. In FY2017, sales will decline for the fifth straight year, affected by a large drop in Type C fuel oil sales for power generation.

Fuel oil sales in FY2016 will decrease by 2.5% from the previous year due primarily to a naphtha sales decline and a Type C fuel oil demand drop accompanying an increase in the number of restarted nuclear reactors, slipping below 180 GL for the first time in 47 years. In FY2017, fuel oil sales will decline by 1.9% due to a substantial drop in Type C fuel oil sales for power generation amid further progress in the restart of nuclear reactors, as well as gasoline and kerosene sales falls, for the fifth straight year of decrease, sinking to 70% of a peak in FY1996.

Gasoline sales in FY2016 will level off despite retail price drops as fuel efficient vehicles including hybrid cars and mini-vehicles spread further. In FY2017, gasoline sales will decrease by 1.0% due primarily to the further spread of fuel efficient vehicles.

Naphtha sales will be affected by a production trend in the petrochemical industry. They will decline by 6.1% on an ethylene production cut in FY2016 before levelling off in FY2017.

Kerosene sales in FY2016 will decrease by 2.0% despite lower winter temperatures than in the previous year as consumers growingly switch to electricity and city gas. In FY2017, they will drop by 2.3% as fuel switching continues.

Diesel oil sales in FY2016 will level off with a 0.2% gain as the effect of transportation and fuel efficiency improvements for trucks is offset with that of robust freight traffic. They will level off again in FY2017 with a 0.2% increase.

Type A fuel oil sales will decline by 0.9% in FY2016 and by 1.5% in FY2017 despite an industrial production recovery as industrial and commercial users switch to other fuels and make progress in energy conservation in view of environmental conservation.

Type B fuel oil and C sales for industrial uses will decline on progress in fuel switching and energy conservation. Those for power generation will plunge by 12.4% in FY2016 and by 27.1% in FY2017 on an increase in the number of restarted nuclear reactors. Liquefied petroleum gas sales will continue a downtrend (down 3.4% in FY2016 and down 0.1% in FY2017) as industrial and buildings sector users growingly switch to electricity and city gas. The decline will decelerate in FY2017 on an industrial production increase.

Crude oil throughput will decrease in line with fuel oil sales drops (down 2.1% in FY2016 and down 1.2% in FY2017).

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

	Historical				Projections		Year-to-year changes		
	FY2010	FY2013	FY2014	FY2015	FY2016	FY2017	FY2015	FY2016	FY2017
Fuel oil sales (GL)	196.0	193.6	182.7	180.5	176.1	172.8	-1.2%	-2.5%	-1.9%
Gasoline	58.2	55.5	53.0	53.1	53.1	52.6	0.3%	0.0%	-1.0%
Naphtha	46.7	45.7	43.9	46.2	43.4	43.4	5.3%	-6.1%	0.0%
Jet fuel	5.2	5.1	5.3	5.5	5.5	5.5	3.1%	-0.4%	0.0%
Kerosene	20.4	17.9	16.7	15.9	15.6	15.3	-4.3%	-2.0%	-2.3%
Diesel oil	32.9	34.1	33.6	33.6	33.7	33.8	0.1%	0.2%	0.2%
Heavy fuel oil A	15.4	13.4	12.3	11.9	11.8	11.6	-3.6%	-0.9%	-1.5%
Heavy fuel oils B and C	17.3	21.9	17.9	14.2	13.0	10.6	-20.7%	-8.8%	-18.0%
For electric utilities	7.7	14.4	10.8	8.2	7.2	5.2	-24.1%	-12.4%	-27.1%
For other users	9.7	7.5	7.2	6.1	5.8	5.4	-15.6%	-3.9%	-6.9%
LPG sales (Mt)	16.5	15.5	15.4	14.7	14.2	14.2	-4.5%	-3.4%	-0.1%
Crude oil throughput (GL)	208.9	200.4	189.0	189.1	185.0	182.8	0.0%	-2.1%	-1.2%

Renewable energy power generation

Approved FIT capacity indicates cumulative cost burden of JPY56 trillion on consumers.

In June 2016, the revised FIT Act was promulgated, paving the way for new systems or mechanisms to be introduced in April 2017 for the approval of facilities for the FIT system and the determination of FITs.

In response to these moves, the ongoing cancellation of FIT approvals is curbing a rapid increase in approved non-residential solar photovoltaics capacity for the FIT system. Nevertheless, we will have to continue to see a rapid renewable energy expansion boosting the FIT cost burden on consumers for the immediate future. If all approved FIT capacity at 87.0 gigawatts (including 79.9 GW for solar PV and 2.8 GW for wind) as of the end of February 2016 is in operation, the cumulative cost burden on consumers over 20 years, including that for capacity for transition[1], will total JPY56 trillion[2]. The cost burden for lighting services mainly for households will come to more than JPY850 billion per year. The sum far exceeds JPY100 billion in premium coupons [3] under consideration for the second supplementary budget for FY2016 to stimulate local consumption and support local livelihood. The cost burden will boost the electricity rate by JPY3.2 per kilowatt-hour, or 14% for residential electricity use and 19% for industrial use.

Particularly, the fast expansion of solar PV featuring higher FITs has boosted the total cost burden. As approved megasolar facilities are completed and launch operation, the cost burden increase will be realized. The revised FIT Act is expected to promote the maximum expansion of renewable power generation and curb the cost burden on consumers.

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[1] Transition capacity means the capacity that was completed before the FIT system launch and transitioned to the system after the launch.

[2] The FIT duration for transition capacity is taken into account. The marginal avoidance cost is set at JPY10.9/kWh, based on the "renewable energy FIT system" on the website of the Agency for Natural Resources and Energy. The capacity utilization rate is assumed as 20% for wind, 12% for solar PV, 70% for geothermal heat, 45% for hydro and 70% for biomass.

[3] Asahi Shimbun Digital, July 1, 2016

Figure 2 | FIT cost burden over 20 years
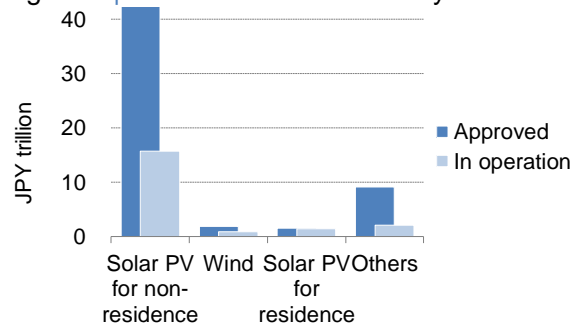
(Note) Approved and operating capacity at the end of February 2016.

Renewable power generation capacity in operation will reach 65 GW.

Although some of the approved non-residential solar PV capacity including megasolar facilities may be cancelled, the completion of facilities under construction will bring the total renewable power generation capacity in operation to 65 GW at the end of FY2017. Particularly, non-residential solar PV capacity in operation will expand to 37.9 GW at the end of FY2017, accounting for a majority share of renewable capacity in operation. Meanwhile, wind power generation capacity in operation will be limited to 3.8 GW at the end of FY2017 because a wind farm takes about five years to be built.

Figure 3 | Renewable power generation capacity (in operation)
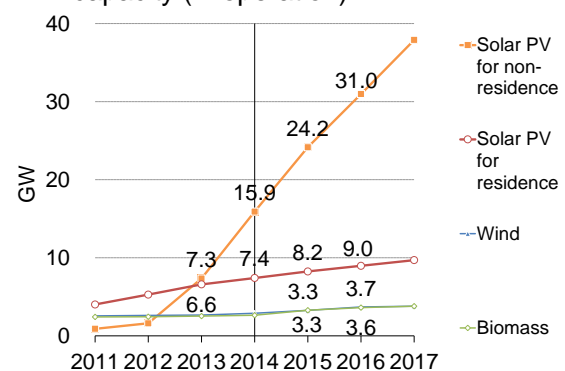
As massive renewable power generation capacity under construction launches operation, renewable power generation in FY2017 will reach 121.8 TWh accounting for more than 10% of Japan's total power generation.

Impacts of nuclear power plants' restart

The Takahama Unit 1 and 2 reactors were allowed to operate for up to 60 years. The Ikata Unit 3 reactor will soon become the fifth reactor to restart under new regulations in Japan.

The Nuclear Regulation Authority in June 2016 permitted Kansai Electric Power Co.'s Takahama Unit 1 and 2 nuclear reactors to operate for up to 60 years. Shikoku Electric Power Co.'s Itaka Unit 3 reactor will restart soon.

As well as the restart of nuclear reactors, reconstruction in Fukushima Prefecture is making progress. Evacuation order zone population in the prefecture will decline from more than 80,000 in August 2013 to slightly more than 20,000 within the current fiscal year as evacuation orders are lifted. Decontaminated soil was partially transported to a site planned for an interim storage facility, making a step forward.

Figure 4 | Population in evacuation order zones
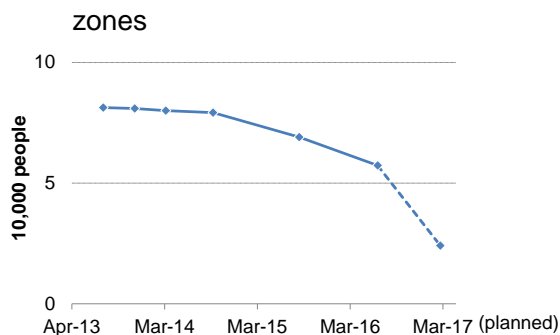
This chapter assesses the impacts of different paces for restarting nuclear reactors on the so-called three Es -- economy, energy and environment. It assumes three cases for the restart in consideration of progress in screening under regulation standards, the presence or absence of large-scale construction and restart application timings and a hypothetical case based on a power generation mix for 2030 as presented in the Long-term Energy Supply and Demand Outlook by the Ministry of Economy, Trade and Industry, depicting a total of four pictures for FY2017.

In the Reference Scenario, a total of seven reactors will have been restarted by the end of FY2016. In FY2017, one reactor will be restarted every month on average. By the end of FY2017, a total of 19 reactors will thus have been restarted. In the year, they will be in service for nine months on average, generating

119.8 TWh of electricity equivalent to 42% of the FY2010 level before the Great East Japan Earthquake seriously affected Japan's nuclear power generation.

In the High Case, a total of nine reactors will have been restarted by the end of FY2016. In FY2017, about 1.5 reactors will be restarted every month on average. By the end of FY2017, a total of 25 reactors will thus have been restarted. In the year, they will be in service for eight months on average, generating 151.2 TWh, up 26% from the Reference Scenario.

In the Low Case, a total of five reactors will have been restarted by the end of FY2016. In FY2017, about 0.5 reactors will be restarted every month on average. By the end of FY2017, a total of 12 reactors will thus have been restarted. In the year, they will be in service for five months on average, generating 39.1 TWh, down 26% from the Reference Scenario.

Figure 5 Assumed numbers of restarted nuclear reactors
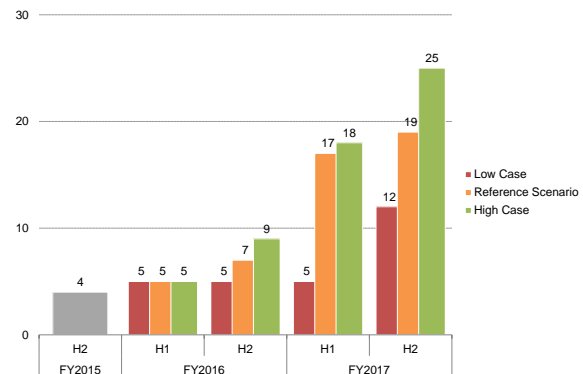
In the Best Mix Case based on the Long-term Energy Supply and Demand Outlook, the FY2017 power generation mix includes 23% for renewables, 20% for nuclear and 57% for fossil fuels. Nuclear power generation in FY2017 is assumed at 195 TWh, the most among the four cases and up 63% from the Reference Scenario.

Restarting nuclear reactors will have great impacts on the Japanese economy, which will spill over to overseas markets.

Restarting nuclear reactors will boost the Japanese economy by bringing about fossil fuel and electricity cost drops.

Compared with the Low Case, oil imports will be 4.2 gigalitres less in the Reference Scenario and 5.8 GL less in the High Case. LNG imports will be 8.8 million tons less in the Reference Scenario and 12.1

Mt less in the High Case. The LNG import reduction by Japan as the world's largest LNG importer will help ease the supply-demand balance in the international LNG market further.

Compared with the Low Case, the electricity unit cost will be JPY400/MWh less in the Reference Scenario and JPY600/MWh less in the High Case. If a 1 GW nuclear reactor operates at its full capacity for one year at an electric utility that generates and purchases a total of 100 TWh, the utility's electricity unit cost will decline by JPY400/MWh and its fossil fuel costs by 60 billion yen. Even at a time when international energy prices are lower than a few years earlier, restarting nuclear reactors in Japan is expected to have still great impacts on the international energy market.

The Best Mix Case features the highest electricity cost due to higher FIT costs.

Fossil fuel imports in the Best Mix Case will be JPY1.2 trillion less than in the Low Case. The Best Mix Case features the largest real GDP growth among the four cases. The energy self-sufficiency rate will be 9 percentage points higher and CO_2 emissions will be 114 Mt-CO_2 less. Due to the higher FIT cost, however, the electricity unit cost in the Best Mix Case will be the highest among the four cases at JPY6,900/MWh, JPY600/MWh more than in the Low Case (still lower than JPY9,100/MWh as estimated based on the target in the Long-term Energy Supply and Demand Outlook).

Over a short term through FY2017, the impacts of electricity cost growth on the economy may not emerge substantially. Over a long term, however, electricity cost growth will cut consumers' purchasing power, hurt Japan's industrial competitiveness and reduce Japan's attractiveness as an investment target, putting downward pressure on the Japanese economy. No one should forget that problems are left for achieving the balanced best mix for 2030.

Table 10 | Impacts of restarting nuclear power plants (FY2017)

	FY2010	FY2017			
		Low Case	Reference Scenario	High Case	Best Mix Case
Cumulative number of restarted nuclear reactors[1] [FY2016]	..	[5]	[7]	[9]	..
FY2017	..	12	19	25	..
Average period for operation (months)	..	5	9	8	..
Electricity generation by nuclear (TWh)	288.2	39.1	119.8	151.2	195.0

		FY2010	FY2017 (changes from **FY2010**)				FY2017 (changes from the **Low Case**)		
			Low Case	Reference Scenario	High Case	Best Mix Case	Reference Scenario	High Case	Best Mix Case
Economy	Electricity unit cost[2] (JPY/kWh)	4.9	+1.5	+1.1	+0.9	+2.0	-0.4	-0.6	+0.6
	Fuel cost	3.8	+0.4	-0.0	-0.2	-0.4	-0.4	-0.6	-0.8
	FIT purchasing cost	0.2	+1.9	+1.9	+1.9	+3.3	-	-	+1.4
	Total fossil fuel imports (JPY trillion)	18.1	-4.1	-4.7	-4.9	-5.4	-0.5	-0.7	-1.2
	Oil	12.3	-3.3	-3.5	-3.5	-3.7	-0.2	-0.2	-0.4
	LNG	3.5	-0.3	-0.6	-0.8	-1.0	-0.4	-0.5	-0.7
	Trade balance (JPY trillion)	5.3	-5.5	-5.0	-4.8	-4.5	+0.5	+0.7	+1.0
	Real GDP (JPY2005 trillion)	512.7	+24.3	+24.7	+24.9	+25.3	+0.5	+0.6	+1.0
	Gross national income (JPY trillion)	480.5	+33.8	+34.4	+34.6	+35.0	+0.6	+0.8	+1.2
Energy	Primary energy supply								
	Oil (GL)	232.3	-31.0	-35.2	-36.8	-40.1	-4.2	-5.8	-9.0
	Natural gas (Mt of LNG equivalent)	73.3	+8.5	-0.3	-3.7	-9.4	-8.8	-12.1	-17.9
	LNG imports (Mt)	70.6	+9.0	+0.3	-3.1	-8.9	-8.8	-12.1	-17.9
	Self-sufficiency rate	17.8%	-6.9p	-3.4p	-2.1p	+2.1p	+3.4p	+4.8p	+9.0p
Environment	Energy-related CO_2 emissions (Mt-CO_2)	1,139	-7	-45	-60	-121	-38	-52	-114
	Changes from FY2013	[-7.8%]	[-8.4%]	[-11.4%]	[-12.6%]	[-17.6%]	..	..	..

Reference Scenario: Seven nuclear power plants restart by the end of FY2016.

      About one plant restarts every month in FY2017 and 19 plants in total restart by the end of FY2017.

Low Case: Five nuclear power plants restart by the end of FY2016.

      About 0.5 plants restart every month in FY2017 and 12 plants in total restart by the end of FY2017.

High Case: Nine nuclear power plants restart by the end of FY2016.

      About 1.5 plants restart every month in FY2017 and 25 plants in total restart by the end of FY2017.

Best Mix Case: A hypothetical case reflecting the power generation mix (22%-24% of renewables, 20%-22% of nuclear, etc.)

      in the Long-term Energy Supply and Demand Outlook by METI (2015).

1. Thirty-nine reactors operated at the end of 2010.

2. Sum of fuel cost, FIT purchasing cost and grid stabilizing cost divided by total power generation.

Assessing oil price's impacts on Japan

Are low oil prices good or bad?

The crude oil price (import CIF price) for Japan remained above $100/bbl for more than three years until October 2014. Later, however, it declined rapidly due mainly to the loosening supply-demand balance, sinking to $30/bbl in February 2016. The average price in FY2015 fell by $40/bbl or 45% from the previous year. Due to the yen's depreciation, however, the yen-denominated price posted a 40% drop.

Crude oil prices exert impacts on Japan and the world through diverse paths. The deceleration of emerging economies and a decline in financial market risk tolerance behind low oil prices also have impacts on Japan (Figure 6).

Figure 6 | Crude oil prices and their impacts on Japan
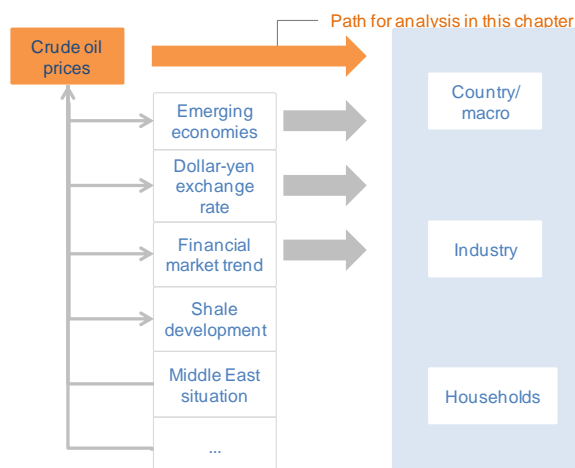
However, the crude oil price plunge is directly good news for the whole of Japan that depends on imports for almost all oil supply. Nevertheless, disadvantages of low oil prices are seemingly emphasized. Why? In this chapter, we attempt to sharply assess Japan's present situation producing such paradox by:
(1) Focusing on the impacts of crude oil price,
(2) Analyzing the three aspects of country/macro economy, industry and households comprehensively, and
(3) Using quantitative indicators as much as possible.

To widely assess the impacts of crude oil price fluctuations, we refrained from limiting assessment methods. This chapter summarizes an analysis using energy-related statistics, corporate financial statements, econometric models, newspaper reports, existing studies and others without limiting periods and methods to look into the impacts of crude oil price fluctuations from various angles. Attention must be paid to the fact that this analysis is not a pooled one.

[Country/macro economy]A $10/bbl fall leads real GDP to expand by JPY700 billion.

A $10/bbl decline in the crude oil price and a $1.4/MBtu fall in the LNG price affected by crude oil price lead Japan's real GDP to expand by JPY700 billion or 0.1%. This is because the price changes allow Japan to reduce fossil fuel imports in value by JPY1.9 trillion yen to improve the trade balance.

In the corporate sector, drops in raw material, fuel and electricity costs expand earnings, leading to employment environment improvements. Some 11,000 new jobs can be created.

Meanwhile, an energy investment cut accompanying resources price falls is feared to affect supply capacity. If Japanese companies sell overseas energy resources interests to reform their business portfolios and improve earnings due to the crude oil price fall, it may exert negative impacts on efforts to achieve the target Japanese-developed share of Japan's oil and natural gas imports (40% in 2030) as set by the government.

[Industry]The crude oil price fall will boost profit by JPY1.1 trillion only for sectors where impacts of the price fall are great. Furthermore, electricity cost drops will lead to JPY500 billion in additional profit.

Industrial sectors where the crude oil price fall has positive effects on earnings are represented by those consuming massive oil, including transporters (maritime, air and ground transporters) and manufacturers (petrochemical, rubber and paper makers). In these sectors where positive effects are great, the crude oil price fall worked to boost operating profit by some JPY1 trillion yen through fuel cost drops in FY2015.

Figure 7 | Crude oil price plunge's major impacts on corporate earnings
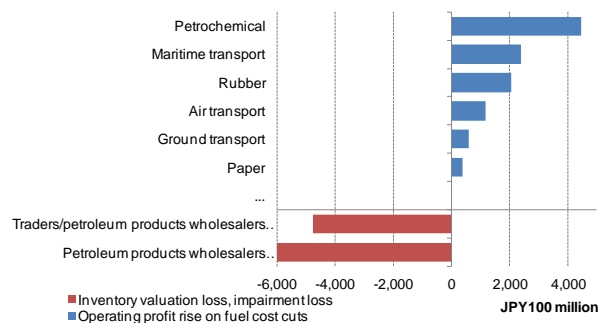
Note: The petrochemical sector covers five major petroleum products wholesalers and six major chemical companies. The rubber sector covers three major rubber makers and 14 others. The maritime transport sector covers two major shipping companies and two others. The ground transport sector covers three major railway and bus firms and 25 others, and four major vehicle transport firms and 22 others. The paper sector covers four major paper manufacturers and 16 others.

Sources: Estimated or prepared from these companies' financial statements for the year to March 2016

The transport industry is estimated to have taken advantage of the crude oil price plunge for boosting profit by JPY410 billion, including more than JPY200 billion for the maritime transport sector that was offset with losses on weak shipping fares amid the loosening ship supply-demand balance and other factors. A profit rise through the crude oil price plunge for the air transport sector is estimated at more than JPY100 billion. If an air fare surcharge cut leads to an increase in air travellers, the sector's profit may increase further. A profit rise for major ground transport companies including railway, bus and truck firms is estimated at more than JPY50 billion. The ground transport sector's profit rise, if including that for small and medium-sized firms, could expand to JPY400 billion.

In the manufacturing industry, the crude oil price plunge could have pushed up profit by JPY680 billion. The petrochemical sector might have exploited the crude oil price plunge for cutting refining and manufacturing fuel costs to boost operating profit by JPY440 billion, although its net profit might have been affected by inventory valuation losses and asset impairment losses regarding resources development. For rubber manufacturers that use naphtha and other materials for producing tires and paper manufacturers that use heavy fuel oil, the crude oil price plunge might have contributed JPY240 billion to profit by lowering raw material and fuel costs.

The crude oil price plunge influences electricity rates through a fuel cost adjustment system to reflect crude oil and LNG price fluctuations in rates. The electricity unit cost for the corporate sector in FY2015 dropped by 5% from FY2014 including its first half when crude oil prices topped $100/bbl. The unit cost fall might have reduced the sector's electricity costs by JPY500 billion.

Meanwhile, trading companies and petroleum products wholesalers with massive upstream oil and natural gas interests might have had to incur JPY480 billion in losses on energy asset impairment. Major petroleum products wholesalers might have booked some JPY600 billion in inventory valuation losses as crude oil prices at the end of FY2015 declined from levels in the beginning of the year. Asset impairment and inventory valuation losses might have totalled JPY1 trillion. These losses do not directly cause any cash outflow but push profit down on an accounting basis.

[Households]Energy costs decline to boost purchasing power.

The crude oil price plunge supports households by cutting energy costs. In FY2015, household energy spending decreased by JPY34,000. A one-way air fare surcharge for flights to Europe and the United States plunged from JPY25,000 in April 2014 to zero in July 2016.

Final goods price falls that result from a fossil fuel import value decline through raw material cost declines can boost household purchasing power. A $10/bbl crude oil price fall can increase real household purchasing power by 0.3%.

From advantages to risks

The crude oil price plunge has slowly and gradually exerted positive impacts on companies and households through fuel and energy cost drops. Over a short term, however, earnings deteriorate for the energy industry and companies investing in upstream energy resources development. In response, investors become sensitive to avoiding risks. Therefore, people easily feel that the crude oil price plunge's disadvantages are greater than its advantages. Our analysis summarized both positive and negative impacts. Overall, however, the crude oil price plunge's positive impacts on the Japanese economy are greater than its negative impacts.

However, crude oil prices have risen back to a $40-50/bbl range while repeating seesawing. If crude oil prices rise further, the past advantages will transform into disadvantages.

Table 10 | Low oil prices' impacts on Japan's economy

	Positive impacts	Negative impacts

Country, macro economy	A $10/bbl decline has the following impacts:
	○ Real GDP growth: +JPY700 billion (+0.1%)
	○ Trade balance improvement: +JPY1.4 trillion
	  Fossil fuel imports: -JPY1.9 trillion
	○ Employment growth: +11,000 persons
	○ Industrial production growth: +0.3 points
		✖ The Bank of Japan inflation target becomes difficult to achieve.
		✖ An energy development investment cut will adversely affect supply capacity[1].
		  World: JPY80 trillion in FY2014
		  →JPY65 trillion in FY2015
		  Japan: JPY2.5 trillion in FY2013 →
		  JPY1.2 trillion in FY2016
		✖ Concern on a decline in the Japanese-developed share of Japan's energy imports through companies' business portfolio reform
		✖ Falling economic efficiency of energy conservation and alternative energy consumption

Industry	○ Operating profit growth on fuel cost decline: +JPY1.5 trillion [2]
	  Transport: +JPY410 billion
	  Manufacturing: +JPY680 billion
	○ Operating profit growth on electricity cost decline: +JPY500 billion [3]
	  Corporate electricity unit cost: -5% in FY2015
	○ Gasoline price falls encourage consumers to go out and go shopping
	○ Demand growth in energy consuming/importing countries
	  U.S.-bound vehicle exports: +6.3% in FY2015
	○ Lower costs for acquisition of upstream interests and for upstream development
	  Acquiring Australian offshore oilfield development, Texan shale gas and other interests
		✖ Accounting appraisal losses: -JPY1 trillion
		  Petroleum products wholesalers: JPY600 billion in inventory valuation loss
		  Trading firms/petroleum products wholesalers: JPY480 billion in energy asset impairment loss
		✖ Demand decline in resources producing/exporting countries
		✖ Japanese stock price falls (treasury shares, shareholdings) led by drops in U.S. stocks including many mining firms

Households	A $10/bbl decline has the following impacts
	○ Real wage hike: +JPY10,000 (+0.3%)
	○ Real purchasing power improvement on general price falls: +0.3%
	○ Energy spending decline: JPY296,000 in FY2014 → JPY262,000 in FY2015
	  (-JPY34,000, -11%)
	  Gasoline: -JPY13,000
	  Electricity: -JPY10,000
	  Kerosene: -JPY6,000
	  City gas: -JPY3,000
	  LPG: -JPY2,000
	○ Jet fuel surcharge decline
	  Flights to Europe/U.S.: JPY25,000 (one way) in April 2014 → zero in July 2016
		✖ Japanese stock price falls (shareholdings) led by drops in U.S. stocks including many mining firms

All figures are approximate.
*1: Energy White Paper for FY2015
*2: Actual growth in FY2015 operating profit from FY2014
*3: Estimated from "Corporate Goods Price Index" by the Bank of Japan and "Handbook of Energy & Economic Statistics in Japan" by EDMC (Energy Data and Modelling Centre). No renewable energy surcharge is included.