

## Economic and Energy Outlook of Japan through FY2016

*Japanese economy on its way for recovery with help from oil prices.  
Appropriate domestic energy policy measures are required.*

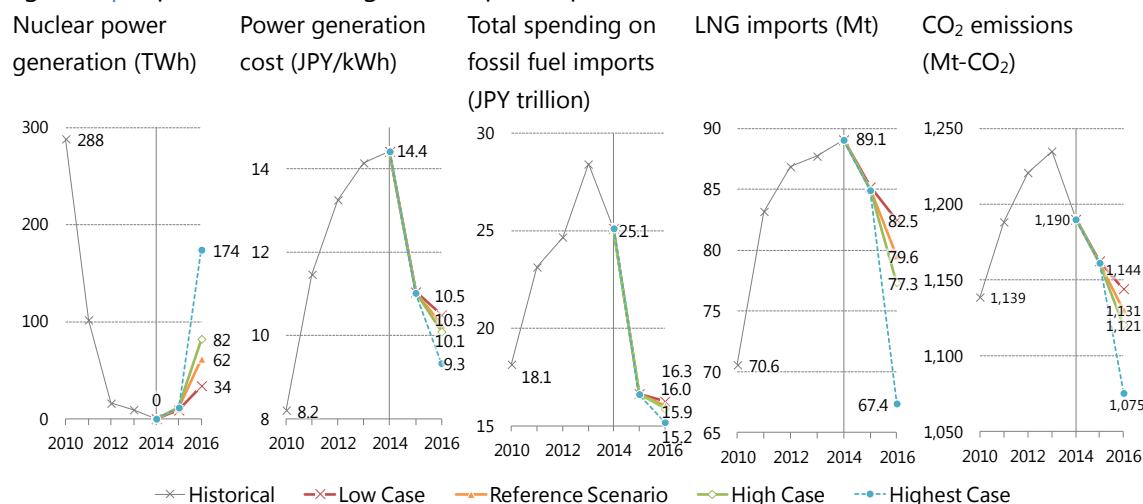
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### Executive summary

#### Nuclear power generation | Restart under new control rules is under way

- In November 2015, the #2 unit of the Sendai Nuclear Power Station has restarted its commercial operations. It is the second unit to restart under the new regulation standards, following the #1 unit, which restarted last September. 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 FY2016.
- The [Reference Scenario] assumes the restarts of three more nuclear power units to proceed in FY2015. By the end of FY2016, 12 units will have restarted, on average at the pace of approximately one unit every second month. They will be in service on average for only seven months during FY2016, for a total electricity generation reaching 61.8 TWh, which is 21% of the pre-earthquake FY2010 level. Compared to FY2010, total spending on fossil fuel imports decreases by JPY2.1 trillion because of energy saving and lower fossil fuel prices, while the average power generation cost rises by about JPY2,100/MWh. Relative to the same period, the self-sufficiency rate remains lower by 6.1% point at 11.7%.
- In the [High Case], which assumes a total of 18 units to restart by the end of FY2016, total fossil fuel imports spending decreases by JPY0.4 trillion relative to the [Low Case] where only six units are assumed to restart. In this comparison, the average power generation cost is lowered by about JPY400/MWh, the self-sufficiency rate improves by 2.1% point and the energy-related CO<sub>2</sub> emissions decrease by 24 Mt-CO<sub>2</sub> (2.1%) whilst GDP increases by JPY0.3 trillion (0.05%).
- The hypothetical [Highest Case] assumes that 25 units for which applications for conformity tests have been submitted, excluding Oma Power Station which is under construction, do generate electricity with a capacity factor of 80% in FY2016. Under this Case, compared to the [Low Case], total fossil fuel imports spending decreases by JPY1.1 trillion, the average power generation cost is lowered by about JPY1,200/MWh, the self-sufficiency rate is improved by 6.2% point and the energy-related CO<sub>2</sub> emissions are decreased by 69 Mt-CO<sub>2</sub> (6.0%) with GDP increases by JPY0.8 trillion (0.14%).
- The restart of Sendai Nuclear Power Station is only the first step of the reutilisation of nuclear power. There are many issues ahead to be addressed in order to realise a balanced energy mix.

Figure 1 | Impacts of restarting nuclear power plants



### Lower oil price and its positive impacts | Lower energy burden for households and boosts for business

- Lower crude oil price brings benefits for households. During the period of higher crude oil prices, households of colder climate regions spent twice as much on energy as those of warmer climate regions. The discrepancy diminishes to 1.8 times in FY2016. As the future of crude oil prices is uncertain, colder climate regions should remain alert against the risk of higher oil prices.
- If the oil and LNG prices become lower by \$10/bbl and by \$1.4/MBtu, respectively, they will contribute to a positive growth cycle for consumption and investment and Japan's GDP will increase by 0.4% (JPY1.9 trillion). The virtuous influence will reach domestic demand type industries that do not consume much in terms of fossil fuels, such as oil, and will increase the total production value by JPY3.4 trillion and employment by 220,000 persons. On the other hand, all this is vulnerable to a possible hike of oil and LNG prices. In order to prepare for such eventuality, the promotion of an appropriate economic growth strategy, distribution policies and energy policies is needed.

### Executive summary of outlook through FY2016 [Reference Scenario]

#### Macro economy | Japanese economy grows by 0.9% and 1.5% due to improvements of domestic demand

- Japan sees its economic recovery strengthening towards the latter part of FY2015 with the economy growing on average at 0.9% during the period. Private consumption gradually recovers due to improved employment status and higher wages; private investment improves supported by higher corporate profits induced by lower oil prices; and exports benefit from the yen's depreciation. For FY2016, the economic expansion continues and GDP grows at 1.5% for the period, led by a strong domestic demand.

#### Energy supply and demand | In FY2015, energy use decreases to below 470 Mtoe (first time in 25 years) and it will continue to decrease in FY2016

- Total primary energy supply in FY2015 decreases due to the slow recovery in domestic production of the manufacturing sector. Because of a continued economic expansion and return of electricity

demand, the decline of energy supply of FY2016 will slow down with the level slightly less than the previous year despite the continuing energy saving. The restart of nuclear power plants will sharply reduce the oil and natural gas consumption for power generation.

- In FY2016, final consumption increases in buildings sector by 0.4% due to economic recovery and temperature effect. Industry sector's consumption decreases because of continued energy conservation and reduced production in energy-intensive petrochemical industry. Transport sector consumes less due to improved fuel efficiency and the effect of the previous leap year. The overall consumption will mark six consecutive years of decrease.

### **Energy sales | City gas and electricity grow. Fuel oil declines after respite**

- Electricity sales by utilities decrease slightly in FY2015, because of stumbling production, slow economic recovery, cooler summer and warmer winter. In FY2016, sales for lighting services, mainly to households, increase for the first time since the Great East Japan Earthquake. This is because of a return to normal temperatures and a relaxed consciousness towards electricity savings. Sales for power services, mainly large-scale power users, increase, reflecting better economic conditions.
- City gas sales in FY2015 slightly decrease because of a delayed production recovery in the manufacturing sector. In FY2016, sales to industry will increase reflecting the recovery of production activities and fuel switching while all the sales except for electric utilities will also increase. The temperature factor will also push the sales up. The overall sales will renew the highest-level marked five years ago.
- Despite lower oil prices and the additional effect of a leap year, total fuel oil sales show an overall decrease in FY2015, primarily in response to a huge decline in the use of Type C fuel oil for power generation. In FY2016, sales for Type A and Type C fuel oil products will decrease because of fuel switching and the use of naphtha will decrease because of a reduced ethylene production. Consequently, this leads to overall sales to be less than 180 GL, the lowest level in 47 years.

### **Renewable power generation | Operational capacities will reach 60 GW. The cumulative cost burden could be JPY55 trillion**

- The rapid 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 the cancellation of approval for contracts/permits without secured land and/or facilities, setup grid connection-ready capacities or strengthened power control. Despite such situation, the operating capacity by the end of FY2016 will reach 60 GW.
- Coincidentally, the unavoidable burden expands also. The cumulative cost burden for 20 years could be JPY55 trillion if all of the approved 87.7 GW (of which 82.1 GW is solar PVs) by the end of July 2015 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 household and 19% for industrial consumers.

### **CO<sub>2</sub> emissions | Reduce for three consecutive years, FY2016 lower than FY2010 level**

- Energy-related CO<sub>2</sub> emissions reached a historical high of 1,235 Mt-CO<sub>2</sub> in FY2013 but will decrease for three consecutive years through FY2016. The restart of nuclear power plants combined with the increase in renewable energy and energy conservation will considerably diminish oil and natural gas

consumption, lowering the emission amount down to 1,131 Mt-CO<sub>2</sub> in FY2016. CO<sub>2</sub> emissions will be 8.5% less than in FY2013 and 0.7% less than before the earthquake (FY2010).

**Table 1 | Summary of Reference Scenario**

	Historical				Projections		Year-to-year changes		
	FY2010	FY2012	FY2013	FY2014	FY2015	FY2016	FY2014	FY2015	FY2016
Primary energy supply (Mtoe) <sup>1</sup>	513.3	483.6	488.5	473.1	469.0	468.6	-3.2%	-0.9%	-0.1%
Oil <sup>2</sup> (GL)	232.3	242.8	234.5	217.6	212.2	203.6	-7.2%	-2.5%	-4.0%
Natural gas <sup>2</sup> (Mt of LNG equiv.)	73.3	88.6	90.1	90.5	86.7	81.8	0.4%	-4.1%	-5.7%
LNG imports (Mt)	70.6	86.9	87.7	89.1	85.0	79.6	1.5%	-4.5%	-6.4%
Coal <sup>2</sup> (Mt)	184.7	183.4	194.6	190.0	189.6	190.2	-2.4%	-0.2%	0.3%
Nuclear (TWh)	288.2	15.9	9.3	0.0	10.6	61.8	-100%	..	484%
Renewables excl. large hydro (TWh)	22.8	67.9	76.0	87.6	102.8	115.7	15.2%	17.3%	12.6%
Final energy consumption (Mtoe)	339.4	321.7	321.3	312.7	311.6	309.0	-2.7%	-0.4%	-0.8%
Industry <sup>3</sup>	158.3	148.4	151.0	147.3	146.6	145.0	-2.4%	-0.5%	-1.1%
Buildings	98.0	92.9	90.9	88.2	87.6	87.9	-2.9%	-0.8%	0.4%
Transport	83.1	80.4	79.5	77.1	77.4	75.9	-3.0%	0.3%	-1.9%
Petroleum products	176.2	165.5	163.9	157.9	157.4	153.3	-3.7%	-0.3%	-2.6%
Natural gas and city gas	34.3	34.9	34.4	34.3	34.1	34.6	-0.3%	-0.5%	1.4%
Coal and coal products	35.9	34.3	35.5	34.9	34.7	34.8	-1.6%	-0.8%	0.5%
Electricity	89.8	84.6	84.5	82.7	82.5	83.3	-2.1%	-0.3%	1.0%
Electricity sales (TWh)	926.6	870.9	871.5	851.4	849.3	857.9	-2.3%	-0.2%	1.0%
City gas sales <sup>4</sup> (Billion m <sup>3</sup> )	39.28	40.33	39.82	40.16	40.01	40.53	0.9%	-0.4%	1.3%
Fuel oil sales (GL)	196.0	197.8	193.6	183.0	180.9	175.1	-5.5%	-1.1%	-3.2%
Energy-related CO <sub>2</sub> emissions (Mt)	1,139	1,221	1,235	1,190	1,162	1,131	-3.6%	-2.4%	-2.7%
(FY2013=100)	92.2	98.9	100.0	96.4	94.1	91.5	..	..	..
Crude oil, import, CIF (\$/bbl)	84	114	110	89	52	53	-19.0%	-41.4%	0.9%
LNG, import, CIF (\$/t)	584	866	837	800	433	382	-4.5%	-45.8%	-11.7%
(\$/MBtu)	11.3	16.7	16.1	15.3	8.3	7.3	-4.5%	-45.8%	-11.7%
Steam coal, import, CIF (\$/t)	114	127	108	93	76	76	-14.2%	-17.7%	0.3%
Coking coal, import, CIF (\$/t)	175	173	135	109	89	88	-19.6%	-18.0%	-1.0%
Nominal GDP (JPY trillion)	480.5	474.4	482.4	489.6	501.0	511.3	1.5%	2.3%	2.1%
Real GDP (JPY2005 trillion)	512.7	519.5	529.8	524.7	529.3	537.1	-1.0%	0.9%	1.5%
Industrial production (2010=100)	99.4	95.8	99.0	98.5	98.3	99.8	-0.5%	-0.2%	1.5%
Exchange rate (JPY/\$)	86.1	82.6	100.0	109.2	122.1	124.8	9.3%	11.8%	2.2%

Notes:

1. Mtoe = 10<sup>13</sup> 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. Industry includes non-energy use.

4. Conversion factor: 1 m<sup>3</sup> = 10,000 kcal

Table annex | Impacts of restarting nuclear power plants

	FY2010	FY2016				
		Low Case	Reference Scenario	High Case	Highest Case	
Cumulative number of restarted nuclear reactors <sup>1</sup>	[FY2015]	..	[3]	[5]	[5]	..
	FY20016	..	6	12	18	25
Average period for operation (months)	..	8	7	6	..	..
Electricity generation by nuclear (TWh)	288.2	34.0	61.8	82.2	174.1	..

	FY2010	FY2016 (changes from FY2010)				FY2016 (changes from the Low Case)			
		Low Case	Reference Scenario	High Case	Highest Case	Reference Scenario	High Case	Highest Case	
<b>Economy</b>									
Power generation cost <sup>2</sup> (JPY/kWh)	(8.2)	+2.3	+2.1	+1.9	+1.1	-0.2	-0.4	-1.2	
Total fossil fuel imports (JPY trillion)	18.1	-1.9	-2.1	-2.3	-3.0	-0.2	-0.4	-1.1	
Oil	12.3	-2.0	-2.0	-2.1	-2.3	-0.1	-0.1	-0.4	
LNG	3.5	+0.4	+0.3	+0.2	-0.3	-0.1	-0.3	-0.7	
Trade balance (JPY trillion)	5.3	-7.3	-7.1	-6.9	-6.3	+0.2	+0.4	+1.0	
Real GDP (JPY2005 trillion)	512.7	+24.2	+24.4	+24.5	+25.0	+0.2	+0.3	+0.8	
Gross national income (JPY trillion)	493.8	+41.1	+41.3	+41.4	+41.9	+0.2	+0.3	+0.8	
<b>Energy</b>									
Primary energy supply									
Oil (GL)	232.3	-27.1	-28.8	-30.1	-35.6	-1.8	-3.0	-8.5	
Natural gas (Mt of LNG equivalent)	73.3	+11.4	+8.4	+6.2	-3.7	-2.9	-5.2	-15.1	
LNG imports (Mt)	70.6	+11.9	+9.0	+6.8	-3.2	-2.9	-5.2	-15.1	
Self-sufficiency rate	17.8%	-7.3p	-6.1p	-5.2p	-1.2p	+1.2p	+2.1p	+6.2p	
<b>Environment</b>									
Energy-related CO <sub>2</sub> emissions (Mt-CO <sub>2</sub> )	1,139	+6	-8	-18	-63	-14	-24	-69	
Changes from FY2013	[-7.8%]	[-7.3%]	[-8.5%]	[-9.3%]	[-12.9%]	..	..	..	

Reference Scenario: Commercial operation resumes in autumn 2015, followed by one unit restarting about every second month.

Low Case: Commercial operation delayed compared to the Reference Scenario, with the other units to restart about one year later.

High Case: Commercial operation resumes in autumn 2015, followed by one unit restarting about every month (thanks to a more efficient assessment process).

Highest Case: A hypothetical case where 25 units generate electricity with an 80% capacity factor.

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

2. Power generation cost in FY2010 is for the general electric utilities, estimated based on their profit-and-loss statements.