

Economic and Energy Outlook of Japan through FY2016

Is low oil price a silver bullet?

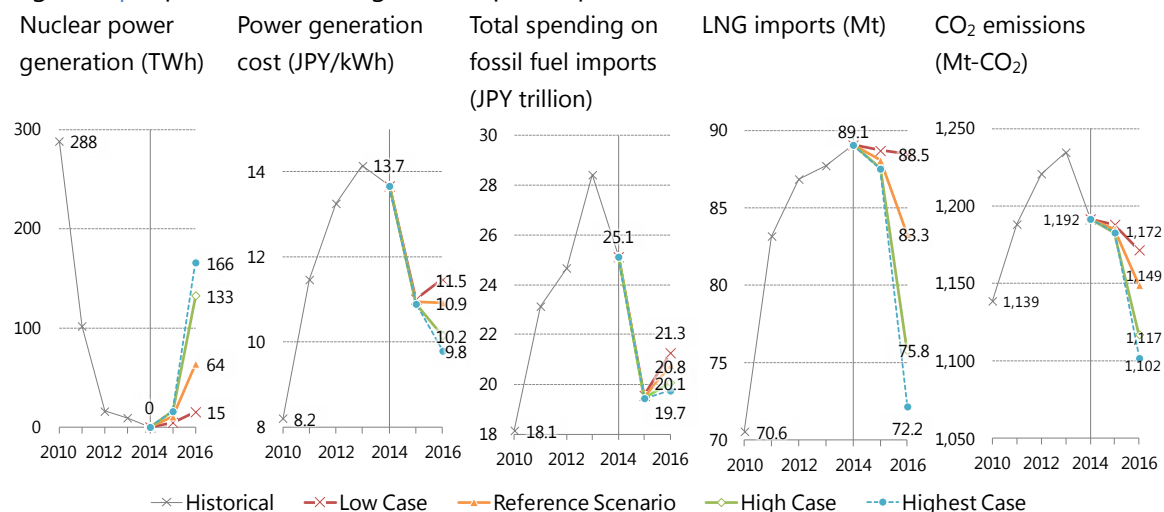
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Executive summary of special topics

Restart of nuclear power generation | First restart under new control rules. Streamlining of the restarts is important ▶ pp.23-25

- The Sendai Power Station received a final approval in May 2015 that it conforms to the new regulation standards. It will be the first case to restart under the new rules that took effect in July 2013. It will be in commercial operations after a thorough pre-service inspection and the restart of its reactors. This paper analyses the effects 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 other nuclear power units to proceed in FY2015 following the return to operation of the Sendai Power Station late this summer or early fall. By the end of FY2016, 13 units will restart and they will be in service on average for six months during FY2016, for a total electricity generation reaching 63.9 TWh, which is 22% of the pre-earthquake FY2010 level. Compared to FY2010, total spending on fossil fuel imports increases by JPY2.6 trillion, increasing the average power generation cost by about JPY2,700/MWh. Relative to the same period, the self-sufficiency rate decreases from 18.0% by 6.4% point whilst the energy-related carbon dioxide (CO₂) emissions increase by 10 Mt-CO₂.
- In the [High Case] which assumes a total of 17 units to restart by the end of FY2016, total fossil fuel imports spending decreases by JPY1.2 trillion relative to the [Low Case] where only three units are assumed to restart. In this comparison, the average power generation cost is lowered by about JPY1,300/MWh, the self-sufficiency rate improves by 5.1% point and the energy-related CO₂ emissions decrease by 55 Mt-CO₂.
- The hypothetical [Highest Case] assumes that 24 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 JPY1.5 trillion, the average power generation cost is lowered by about JPY1,700/MWh, the self-sufficiency rate is improved by 6.5% point and the energy-related CO₂ emissions are decreased by 70 Mt-CO₂.
- Since the Great East Japan Earthquake, many issues such as the worsening of the balance of trade (mainly due to increasing fossil fuel imports for power generation), the lowering of the self-sufficiency rate and the increase in CO₂ emissions, have emerged. Even with current international energy prices at much lower level than one year ago, the extent to which nuclear power plants can restart and operate has huge impacts and serious implications regarding the Japanese economy, energy security and environment (three Es).

Figure 1 | Impacts of restarting nuclear power plants



Higher energy prices and related risks | Need to stay alert as lower prices may be temporary ▶pp.26-27

As Japan is heavily dependent on fossil fuel-fired thermal power generation, the sudden decline in oil prices has been well received and considered as a blessing. In FY2014, JPY3.3 trillion was saved in import value compared to the previous year. Of which, the drop in US\$ based fossil fuel prices contributed to a saving of JPY4.2 trillion in import value. On the other hand, the currency depreciation over the same period increased it by JPY2.4 trillion. Lower import volumes also contributed to the drop in import value.

The possibility that international oil price will rise again remains. Each additional \$10/bbl in oil prices raises total fossil fuel imports spending by JPY1.9 trillion, reduces Japan's GDP by 0.4% and worsens its GNI per capita by JPY15,000. The need to establish a robust energy supply and demand structure for Japan is required in order to achieve stability in economic growth without continuously be at the mercy of international hick-ups.

Executive summary of outlook through FY2016 [Reference Scenario]

Macro economy | Japanese economy grows by 1.7% and 1.9% due to improvements of domestic demand in FY2015 and FY2016 ▶pp.7-8

Japan sees its economic recovery strengthening towards the latter part of FY2015 with the economy growing on average at 1.7% during the period. Private consumption gradually recovers due to improved employment status; 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 1.9% for the period, led by a strong domestic demand.

Energy supply and demand | Whilst total energy increases in FY2015 induced by economic recovery, it will decrease in FY2016

Total primary energy supply in FY2015 increases for the first time in two years due to economic recovery and weather conditions. Despite a continued economic expansion for FY2016, energy

supply will shrink slightly due to the effect of energy conservation. The restart of nuclear power plants and an increase in renewable energy will sharply reduce the oil and natural gas consumption. ▶pp.11-12

- Total final energy consumption increases also in FY2015 for the first time in five years. The energy consumption in all the sectors (i.e. industry, residential, commercial and transport) increases due to a decreasing effect from the previous year's rise in VAT and weather conditions. In FY2016, final consumption decreases in all sectors, except industry and the overall consumption will dip below the FY2014 level. ▶pp.13-14

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

- Electricity sales by utilities increase in FY2015, partially offsetting the large decline of the previous year. Sales for lighting services, mainly to households, increase for the first time since the Great East Japan Earthquake. Sales for power services, mainly large-scale power users, increase for the first time in two years, reflecting better economic conditions. The continued economic expansion through FY2016 will further augment total sales for two consecutive years with sales for power services to reach their largest level since the earthquake. ▶pp.15-16
- City gas sales in FY2015 will reach a historical high induced by the recovery in manufacturing sector's production activities, a more active service industry and the combined impact of a leap year and of a colder winter. For a second consecutive year, the historical high in total sales of FY2015 will be surpassed in FY2016. Sales to industry will lead the trend reflecting not only the anticipated economic expansion but also some anticipatory production to cover for the demand increase that will precede the increase in the VAT, scheduled for April 2017. ▶pp.17-18
- Total fuel oil sales show an overall small decrease while gasoline sales increase for the first time in five years due to economic recovery and lower crude oil prices. In FY2016, however, sales for all fuel oil products will decrease to less than 180 GL, the lowest level in 47 years due to energy conservation and fuel switching. ▶pp.19-20

Renewable power generation | Operational capacities will reach 63 GW. The cumulative cost burden could be JPY50 trillion ▶pp.21-22

- The rapid expansion of the past for renewable power generating capacity, supported by the Feed-in Tariff system, is slowly subsiding due to the cancellation of approval for contracts without secured land and/or facilities, setup grid connection-ready capacities or strengthened power control. Despite such situation, the capacities in operation by the end of FY2016 will reach 63 GW. Coincidentally, the unavoidable burden expands also. The cumulative cost burden for 20 years could be JPY50 trillion if all of the approved 99 GW (of which 80 GW is solar PVs) by the end of February 2015 become operational. This is equivalent to an increase of JPY2,900/MWh above the rates in place just before FIT started – an increase of 12% for household and 17% for industrial consumers.

CO₂ emissions | Reduce for three consecutive years ▶pp.11-12

- Energy-related CO₂ emissions reached a historical high of 1,235 Mt-CO₂ in FY2013 but will decrease for three consecutive years through FY2016. The restart of nuclear power plants combined with the increase in renewable energy will considerably diminish oil and natural gas consumption, lowering the emission amount down to 1,149 Mt-CO₂ in FY2016. Total energy consumption will be less than before the earthquake but CO₂ emissions will remain high.

Table 1 | Summary of Reference Scenario

| | Historical | | | | Projections | | Year-to-year changes | | |
|---|------------|--------|--------|--------|-------------|--------|----------------------|--------|--------|
| | FY2011 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 |
| Primary energy supply (Mtoe) ¹ | 514.2 | 484.9 | 488.4 | 473.7 | 477.4 | 477.1 | -3.0% | 0.8% | -0.1% |
| Oil ² (GL) | 232.3 | 242.8 | 234.5 | 217.6 | 214.8 | 205.8 | -7.2% | -1.3% | -4.2% |
| Natural gas ² (Mt of LNG equivalent) | 73.3 | 88.6 | 89.9 | 90.6 | 90.1 | 85.3 | 0.8% | -0.6% | -5.3% |
| LNG imports (Mt) | 70.6 | 86.9 | 87.7 | 89.1 | 88.1 | 83.3 | 1.5% | -1.1% | -5.4% |
| Coal ² (Mt) | 184.7 | 183.4 | 194.6 | 190.1 | 191.4 | 191.7 | -2.3% | 0.7% | 0.1% |
| Nuclear (TWh) | 288.2 | 15.9 | 9.3 | 0.0 | 10.6 | 63.9 | -100% | .. | 500% |
| Final energy consumption ³ (Mtoe) | 339.4 | 321.8 | 321.6 | 311.6 | 313.2 | 311.3 | -3.1% | 0.5% | -0.6% |
| Industry ⁴ | 158.3 | 148.6 | 151.4 | 146.7 | 147.0 | 147.0 | -3.1% | 0.2% | 0.0% |
| Buildings | 98.0 | 92.7 | 90.8 | 88.0 | 88.8 | 88.2 | -3.1% | 0.9% | -0.6% |
| Transport | 83.1 | 80.4 | 79.5 | 77.0 | 77.3 | 76.0 | -3.2% | 0.5% | -1.8% |
| Petroleum products | 176.2 | 165.7 | 164.0 | 157.7 | 157.0 | 153.7 | -3.8% | -0.4% | -2.1% |
| Natural gas and city gas | 34.3 | 34.7 | 34.3 | 34.1 | 34.7 | 35.4 | -0.6% | 1.9% | 1.9% |
| Coal and coal products | 35.9 | 34.3 | 36.2 | 34.3 | 34.7 | 34.7 | -5.3% | 1.0% | 0.1% |
| Electricity | 89.8 | 84.6 | 84.5 | 83.0 | 84.3 | 84.9 | -1.8% | 1.5% | 0.7% |
| Electricity sales (TWh) | 926.6 | 870.9 | 871.5 | 851.4 | 865.0 | 874.5 | -2.3% | 1.6% | 1.1% |
| City gas sales ⁵ (Billion m ³) | 39.28 | 40.33 | 39.82 | 40.16 | 40.97 | 41.69 | 0.9% | 2.0% | 1.8% |
| Fuel oil sales (GL) | 196.0 | 197.8 | 193.6 | 183.0 | 182.2 | 176.0 | -5.5% | -0.4% | -3.4% |
| Energy-related CO ₂ emissions (Mt) | 1,139 | 1,221 | 1,235 | 1,192 | 1,185 | 1,149 | -3.5% | -0.5% | -3.1% |
| (FY2013=100) | 92.2 | 98.9 | 100.0 | 96.5 | 96.0 | 93.1 | .. | .. | .. |
| Crude oil, import, CIF (\$/bbl) | 84 | 114 | 110 | 89 | 64 | 69 | -19.0% | -28.3% | 8.6% |
| LNG, import, CIF (\$/t) | 584 | 866 | 837 | 800 | 470 | 502 | -4.5% | -41.3% | 6.9% |
| Steam coal, import, CIF (\$/t) | 114 | 127 | 108 | 93 | 84 | 89 | -14.3% | -9.5% | 6.0% |
| Coking coal, import, CIF (\$/t) | 175 | 173 | 135 | 109 | 91 | 98 | -19.6% | -16.5% | 7.6% |
| Nominal GDP (JPY trillion) | 480.5 | 474.6 | 483.1 | 490.6 | 506.1 | 516.2 | 1.6% | 3.2% | 2.0% |
| Real GDP (JPY2005 trillion) | 512.7 | 519.8 | 530.6 | 525.7 | 534.8 | 545.1 | -0.9% | 1.7% | 1.9% |
| Industrial production index (2010=100) | 99.4 | 95.8 | 98.9 | 98.5 | 101.2 | 104.6 | -0.5% | 2.7% | 3.4% |
| Exchange rate (JPY/\$) | 86.1 | 82.6 | 100.0 | 109.2 | 121.8 | 125.0 | 9.3% | 11.5% | 2.7% |

Notes:

1. Mtoe = 10¹³ 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 CO₂ emissions in FY2014 are estimation.

4. Industry includes non-energy use.

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

Introduction

The Japanese economy has taken substantial time to recover after a VAT increase in April 2014 and is getting back on a recovery path. In 1Q2015, gross domestic product grew at a large annualised rate of 3.9% in real terms for the second straight quarter of rise. Private consumption posted a moderate recovery, while private non-residential investment indicated a recovery sign supported by robust corporate earnings. Exports showed a recovery trend under the yen's continued weakness.

In the international energy arena, the Brent oil price slipped below \$50 per barrel in January 2015 for the first time since March 2009. The spot liquefied natural gas price for Northeast Asia fell to \$6.6 per million British thermal units. In Japan, the Advisory Committee for Natural Resources and Energy put forward a projected 2030

electricity generation mix in April 2015, indicating that nuclear should account for 20-22% of power generation in the year. However, all nuclear power plants in Japan have remained offline for more than 21 months since mid-September 2013. For May 2015, all of the general electric utilities raised electricity rates since a renewable energy surcharge hike more than offset fossil fuel price drops.

International oil and LNG prices are creeping up. If they rise rapidly again, it will squeeze corporate earnings and increase household burdens.

With such present situation and risks in mind, we have projected the Japanese economy and energy supply and demand through FY2016, and analysed implications of the various projections.

Major assumptions in the Reference Scenario

World Economy

We assume that the world economy will continue a moderate recovery. The U.S. economy will see overseas demand's deceleration under a strong dollar while being supported by private consumption expanding in line with an oil price decline and a fall in the unemployment rate. The European economy, though featuring the Greek debt problem as a matter of concern, will achieve a moderate recovery backed by low oil prices, the weak euro and low interest rates. The Asian economy will see China's economic growth deceleration. India's growth, however, will surpass China's in 2016, while the Association of Southeast Asian Nations will log firm growth rate of about 5%. The world economy is assumed to grow 2.8% and 3.5% in FY2015 and in FY2016, respectively.

Oil, LNG and coal import prices

We assume that the supply-demand balance will remain loose in the oil market after the

Organization of the Petroleum Exporting Countries decided again not to reduce production at its meeting in June. The oil import CIF price for Japan, however, will rise moderately in response to a rapid fall in the number of oil drilling rigs in the United States in FY2016. The price is assumed at \$64/bbl for FY2015 and \$69/bbl for FY2016. The LNG import CIF price is projected at \$9.1/MBtu for FY2015 and \$9.7/MBtu for FY2016. The supply-demand balance for coal will slightly tighten. The steam coal price is assumed at \$84 per tonne for FY2015 and \$89/t for FY2016. The coking coal price is projected at \$91/t for FY2015 and \$98/t for FY2016.

Exchange rate

We assume the average dollar-to-yen exchange rate at JPY121.8/\$ for FY2015 and JPY125.0/\$ for FY2016.

Taxes

We assume that the VAT will be raised to 10% in April 2017 and that the petroleum and coal tax will be increased to JPY2,800 per kilolitre for crude oil and petroleum products, JPY1,860/t for gaseous hydrocarbon and JPY1,370/t for coal in April 2016.

Nuclear power generation

Based on progress in the assessment of nuclear power plants' conformity with new regulation standards, pre-operation tests and other procedures, we assume that the Sendai Power Station will resume commercial operation late summer or early fall of 2015 to kick off a gradual restart of nuclear power plants in Japan. A total of five reactors will restart in FY2015, generating 10.6 terawatt-hours of electricity. By the end of FY2016, a total of 13 reactors will restart, generating 63.9 TWh in the year.

Electricity supply and demand

Based on discussions at the Electricity Supply and Demand Verification Subcommittee, we assume that each 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 demand for space cooling will rise in a warmer late summer for FY2015 than for the previous year before temperatures are normal in the rest of the year and the next year. This means a colder winter than in the previous year (-1.3 degrees Celsius) before temperatures are at the same levels as a year earlier.

Macro economy

In FY2015, the Japanese economy will get back on a recovery path and grow by 1.7% primarily due to robust domestic demand for the first positive growth in two years.

Among private demand components, private consumption will grow year on year in all quarters of FY2015, supported by asset effects coupled with wage hikes. Private non-residential investment will increase as corporate earnings improve further on expanding domestic demand and exports. Private demand as a whole will contribute 1.8% to economic growth. Among public demand components, public investment will fall for the first time in four years, while social security and other government spending will increase. Public demand as a whole will make no contribution to economic growth. Exports will expand as the yen remains weak with U.S. and Asian economies growing briskly. Imports will increase despite a drop in fossil fuel imports as other imports grow. External demand will work to lower the economic growth rate by 0.1%. Nominal GDP will top JPY500 trillion for the first time in eight years.

The trade deficit will narrow to JPY1.8 trillion. Fossil fuel imports will decrease by JPY8.9 trillion from the peak in FY2013 to JPY19.5 trillion due to the oil price plunge. The

consumer price index will rise by 0.3% due to the weak yen, monetary easing, an economic recovery and other factors, despite the oil price decline.

In FY2016, the Japanese economy will grow by 1.9% on robust domestic demand including continuously firm private consumption and non-residential investment.

Of private demand, consumption will expand thanks to a further fall in the unemployment rate and wage hikes. Non-residential investment will also increase, backed by robust corporate earnings in manufacturing and services industries. Private demand will work to expand GDP by 1.7%. Among public demand components, social security and other government spending will increase while public investment will contract further. Public demand as a whole will contribute 0.1% to economic growth. Exports will continue expanding as the yen remains weak with overseas economies recovering. Imports will rise in line with domestic demand growth. External demand as a whole will work to boost GDP by 0.1%. The trade deficit will expand to JPY3.4 trillion due to an upturn of oil prices. The consumer price index will increase by 0.8% due primarily to a contracting GDP gap.

Table 2 | Macroeconomic indicators

| | Historical | | | | Projections | | Year-to-year changes | | |
|---|------------|--------|--------|--------|-------------|--------|----------------------|--------|--------|
| | FY2010 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 |
| Real GDP (JPY2005 trillion) | 512.7 | 519.8 | 530.6 | 525.7 | 534.8 | 545.1 | -0.9% | 1.7% | 1.9% |
| Private demand | 377.1 | 390.7 | 400.0 | 391.1 | 398.8 | 407.2 | -2.2% | 2.0% | 2.1% |
| Private consumption | 299.7 | 309.5 | 317.2 | 307.3 | 312.1 | 317.1 | -3.1% | 1.5% | 1.6% |
| Private residential investment | 12.5 | 13.7 | 15.0 | 13.2 | 13.5 | 14.2 | -11.7% | 1.9% | 5.5% |
| Private non-residential investment | 64.9 | 68.8 | 71.5 | 71.8 | 73.5 | 75.4 | 0.4% | 2.3% | 2.7% |
| Public demand | 118.5 | 120.8 | 124.5 | 125.4 | 125.3 | 125.9 | 0.7% | -0.1% | 0.5% |
| Government consumption | 97.9 | 100.6 | 102.2 | 102.6 | 103.3 | 104.1 | 0.4% | 0.7% | 0.8% |
| Public investment | 20.7 | 20.3 | 22.4 | 22.8 | 22.0 | 21.8 | 2.0% | -3.4% | -1.0% |
| Net exports of goods and services | 17.2 | 8.6 | 7.3 | 11.2 | 12.2 | 13.5 | 54.7% | 8.7% | 10.2% |
| Exports of goods and services | 83.9 | 81.4 | 85.0 | 91.9 | 97.5 | 101.7 | 8.0% | 6.1% | 4.3% |
| Imports of goods and services | 66.8 | 72.9 | 77.8 | 80.6 | 85.3 | 88.2 | 3.7% | 5.8% | 3.5% |
| Nominal GDP (JPY trillion) | 480.5 | 474.6 | 483.1 | 490.6 | 506.1 | 516.2 | 1.6% | 3.2% | 2.0% |
| Balance of trade (JPY trillion) | 5.3 | -8.2 | -13.8 | -9.1 | -1.8 | -3.4 | -33.5% | -80.5% | 91.9% |
| Exports | 67.8 | 63.9 | 70.9 | 74.7 | 80.8 | 84.7 | 5.4% | 8.2% | 4.9% |
| Imports | 62.5 | 72.1 | 84.6 | 83.8 | 82.5 | 88.1 | -0.9% | -1.5% | 6.7% |
| Fossil fuels | 18.1 | 24.7 | 28.4 | 25.1 | 19.5 | 20.8 | -11.6% | -22.4% | 6.6% |
| Oil | 12.3 | 16.2 | 18.7 | 15.2 | 12.4 | 13.3 | -18.4% | -18.6% | 7.2% |
| LNG | 3.5 | 6.2 | 7.3 | 7.8 | 5.0 | 5.2 | 5.9% | -35.1% | 3.7% |
| Domestic corporate goods price index (2010=100) | 100.2 | 100.5 | 102.4 | 105.3 | 103.4 | 104.3 | 2.8% | -1.7% | 0.8% |
| Consumer price index (2010=100) | 99.9 | 99.5 | 100.4 | 103.4 | 103.7 | 104.5 | 2.9% | 0.3% | 0.8% |
| GDP deflator (2005=100) | 93.7 | 91.3 | 91.0 | 93.3 | 94.6 | 94.7 | 2.5% | 1.4% | 0.1% |

Notes: GDP components may not add up to the total GDP due to minor data deviations.

Industrial production

Crude steel production supported by high valued-added product exports will level off from the previous year in FY2015. It will rise back to 110 million tonnes in FY2016.

In FY2015, exports of high value-added steel products will grow under the weak yen, including those to Southeast Asia. However, domestic demand in the first half of the year slipped below the year-before level. Crude steel production will be below 110 million tonnes for the second straight year, logging a 0.3% drop from the previous year. In FY2016, robust external demand and domestic demand growth under an economic recovery will lead crude steel production to surpass 110 Mt for the first time in three years, scoring a 0.7% increase.

Ethylene plants will operate at their full capacity with capacity cut in FY2015-2016.

In FY2015, ethylene production capacity will fall on a plant shutdown in May, with regular plant check-ups being less than in the previous year. As users switch from imports to domestic products, production decline will be limited to 0.6%. In FY2016, ethylene production capacity will decline on a plant shutdown in the beginning of the year. However, ethylene plants will continue to operate at their full capacity in response to robust domestic and overseas demand. Production in the year will fall by 3.4%.

Cement production will increase to 62 million tonnes in FY2015 and 63 Mt in FY2016 as an economic recovery is coupled with export growth.

Cement production in the first half of FY2015 will decline year on year. In the whole of FY2015, cement production will rise by 1.5% from the previous year to 62 million tonnes thanks to a rebound in residential and non-residential investment, steady demand for reconstruction from the Great East Japan Earthquake and export growth under the weak yen. In FY2016,

cement production will increase by 1.6% from the previous year to more than 63 Mt, the highest in nine years since FY2007, due to robust residential and non-residential investment.

Paper and paperboard production will level off with paper production failing to grow in FY2015. Production will rise in FY2016 for the first time in three years due to extra demand before the next VAT hike.

In FY2015, paperboard production will increase mainly for processed food products and delivery services, while paper production will fall in line with a long-term shift from paper to electronic media. Paper and paperboard production will level off with a mere 0.1% fall from the previous year. In FY2016, paperboard production will expand on brisk private consumption. Paper production will also rise due to a last-minute demand increase before the next VAT hike scheduled for April 2017. Paper and paperboard production will go up by 1.0%.

Automobile production will increase to 9.63 million in FY2015, supported by strong exports. It will rise further to 9.8 million in FY2016 on robust domestic and external demand.

Although domestic automobile demand will decline year on year due to revisions to the mini-vehicle tax and tax cuts for eco-friendly vehicles in the first half of FY2015, it will increase for the whole of the year in a rebound from a plunge caused by the VAT hike in April 2014. Exports will also expand thanks to the continuously weak yen, despite production bases' overseas shift. Automobile production in FY2015 will score a small rise of 0.4% from the previous year. In FY2016, automobile production will expand by 1.7% to 9.8 million units as a private consumption recovery and a last-minute demand rise before the next VAT hike are coupled with export growth.

Table 3 | Industrial activities

| | Historical | | | | Projections | | Year-to-year changes | | | |
|---|--|--------|--------|--------|-------------|--------|----------------------|--------|--------|-------|
| | FY2011 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 | |
| Production | Crude steel (Mt) | 110.8 | 107.3 | 111.5 | 109.8 | 109.5 | 110.4 | -1.5% | -0.3% | 0.7% |
| | Ethylene (Mt) | 7.00 | 6.26 | 6.76 | 6.69 | 6.65 | 6.42 | -1.1% | -0.6% | -3.4% |
| | Cement (Mt) | 56.1 | 59.5 | 62.4 | 61.1 | 62.1 | 63.0 | -2.0% | 1.5% | 1.6% |
| | Paper and paperboard (Mt) | 27.3 | 25.7 | 26.7 | 26.3 | 26.3 | 26.5 | -1.4% | -0.1% | 1.0% |
| | Automobiles (Million) | 8.99 | 9.55 | 9.91 | 9.59 | 9.63 | 9.80 | -3.2% | 0.4% | 1.7% |
| Production indices | Mining and manufacturing (2010=100) | 99.4 | 95.8 | 98.9 | 98.5 | 101.2 | 104.6 | -0.5% | 2.7% | 3.4% |
| | Food | 98.2 | 96.7 | 98.9 | 96.2 | 97.0 | 98.2 | -2.7% | 0.9% | 1.2% |
| | Chemicals | 99.7 | 96.5 | 98.3 | 95.3 | 97.3 | 97.6 | -3.1% | 2.1% | 0.3% |
| | Non-ferrous metals | 98.9 | 96.6 | 97.3 | 97.9 | 98.7 | 100.2 | 0.6% | 0.8% | 1.5% |
| | General and electrical machinery, etc. | 101.3 | 93.2 | 97.6 | 100.0 | 105.1 | 112.0 | 2.4% | 5.2% | 6.5% |
| Tertiary industry activity index (2005=100) | | 97.8 | 99.2 | 100.4 | 98.8 | 99.9 | 100.8 | -1.6% | 1.1% | 0.9% |

Note: Chemicals include chemical fibre.

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

Primary energy supply will increase in FY2015 for the first time in two years thanks to an economic recovery before it will fall slightly in FY2016 on continued energy conservation efforts, despite an economic expansion.

Primary energy supply in FY2015 will increase by 0.8% from the previous year for the first rise in two years thanks to an economic recovery and temperature factors. The increase, however, will be limited to a quarter of the equivalent of the decrease in the previous year due to the further penetration of energy-efficient equipment. In FY2016, primary energy supply will log a small fall of 0.1% due to continued energy conservation efforts although industrial production will continue expanding. Oil and natural gas will decline substantially as more nuclear power plants are restarted with renewable energy use expanding.

Oil in FY2015 will see a slower decline (1.3%) than in the previous year due to a decelerating switch from oil to other fuels for power generation and the first rise in gasoline demand in five years. In FY2016, demand for oil, especially for power generation will post a sharper decline of 4.2% as nuclear power plants are restarted. Oil dependency – its share of total primary energy supply – will slip below 40% for the first time in 55 years.

Overall natural gas consumption in FY2015 will decline by 0.8% from the record high in the previous year for the first drop since the Great East Japan Earthquake in 2011. Demand for power generation will decrease in the year with nuclear and renewable energy power generation

increasing though city gas demand will be firm. Natural gas in FY2016 will fall by 5.3% for the second straight year of decline as natural gas-fired power generation decreases substantially on the restart of nuclear power plants. Still, natural gas in the year will be 17% higher than in FY2010 before the earthquake.

Coal in FY2015 will increase by 0.7% from the previous year as coal-fired power plants operate stably as a base electricity source. In FY2016, coal will post a slight increase of 0.2% as demand for industrial uses expands on a rebound in production by manufacturers such as steelmakers and cement producers.

Nuclear power generation in FY2015 will be limited to 10.6 TWh as seen in FY2013, although the first nuclear power plant will resume commercial operation in late summer or early fall of 2015. As more nuclear power plants restart operation in FY2016, nuclear will post the largest growth among energy sources in the year. Nuclear power generation, however, will still be limited to 63.9 TWh or a quarter of the FY2010 level before the earthquake.

Energy self-sufficiency rate will rebound to 11.6% thanks to the restart of nuclear power plants in FY2016. However, the level will still be 6.4 percentage points lower than 18.0% for FY2010 before the earthquake.

Energy-related carbon dioxide emissions in FY2016 will drop for the third straight year after peaking at 1,235 Mt in FY2013. The restart of nuclear power plants and the expansion of renewables will allow oil and natural gas to decline, reducing the emissions to 1,149 Mt in FY2016, still more than in FY2010 before the earthquake.

Table 4 | Primary energy supply

| | Historical | | | | Projections | | Year-to-year changes | | |
|---|------------|--------|--------|--------|-------------|--------|----------------------|--------|--------|
| | FY2011 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 |
| Primary energy supply (Mtoe) | 514.2 | 484.9 | 488.4 | 473.7 | 477.4 | 477.1 | -3.0% | 0.8% | -0.1% |
| Coal | 119.2 | 117.7 | 126.1 | 124.4 | 125.3 | 125.5 | -1.3% | 0.7% | 0.2% |
| Oil | 212.0 | 221.6 | 214.5 | 199.0 | 196.5 | 188.2 | -7.2% | -1.3% | -4.2% |
| Natural gas | 95.6 | 116.4 | 117.9 | 119.4 | 118.4 | 112.1 | 1.3% | -0.8% | -5.3% |
| Hydro | 18.2 | 16.7 | 16.9 | 17.7 | 18.7 | 18.7 | 4.2% | 5.7% | 0.2% |
| Nuclear | 60.7 | 3.4 | 1.9 | 0.0 | 2.2 | 13.2 | -100% | .. | 500% |
| Others | 8.7 | 9.2 | 11.0 | 13.3 | 16.4 | 19.3 | 20.7% | 23.4% | 18.2% |
| Self-sufficiency rate | 18.0% | 7.0% | 7.0% | 7.4% | 8.6% | 11.6% | 0.4p | 1.3p | 2.9p |
| Energy intensity (FY2005=100) | 94.1 | 87.5 | 86.4 | 84.6 | 83.8 | 82.1 | -2.1% | -1.0% | -1.9% |
| Energy-related CO ₂ emissions (Mt) | 1,139 | 1,221 | 1,235 | 1,192 | 1,185 | 1,149 | -3.5% | -0.5% | -3.1% |
| (FY2013=100) | 92.2 | 98.9 | 100.0 | 96.5 | 96.0 | 93.1 | .. | .. | .. |

Note: "Others" include geothermal, new energies, etc.

Heat contents have been revised since FY2013.

Final energy consumption

Final energy consumption in FY2015 will increase for all of industry, buildings and transport. The total will expand for the first time since the Great East Japan Earthquake. In FY2016, final energy consumption will fall back in other sectors than industry.

Final energy consumption in FY2015 will increase in all of the industrial, residential, commercial and transportation sectors due to active production and freight traffic under an economic recovery as well as temperature factors. Total consumption will rise by 0.5% for the first increase in five years. Nevertheless, the FY2015 consumption level will be still 7% less than in FY2010 before the Great East Japan Earthquake. In FY2016, final energy consumption will turn down on energy conservation efforts and slip below the FY2014 level, posting a 0.6% fall from FY2015. Energy consumption will decline in the residential, commercial and transportation sectors while levelling off in the industrial sector where production will expand.

The industrial sector will score a small increase of 0.2% in FY2015 due to a rebound in production including vehicles and electrical machinery. City gas, electricity and coal will increase by 0.4-0.5 million tonnes of oil equivalent, while oil will decline due to progress in fuel switching. Although production will expand further in FY2016, the sector will level off due to energy conservation and an ethylene production cut.

The residential sector will post a 0.7% increase in FY2015, the first rise since the earthquake, due to temperature factors and price drops. Electricity will expand substantially as

air-conditioning demand increases on temperature factors. City and liquefied petroleum gases will also rise due to greater demand for space and water heating. Kerosene, however, will decline on consumers' switch to other fuels. The sector will fall in FY2016 by 1.0% from the previous year due to energy conservation effects, slipping below the FY2014 level. Nevertheless, electricity will increase slightly on steady demand for all-electric homes. City gas will decline under the long-continuing trends including a decline in the average family size and the penetration of energy-efficient equipment. Kerosene and LPG will decrease because of fuel switching.

The commercial sector will expand in FY2015 by 1.2% from the previous year due to the economic recovery and temperature factors. Electricity will rise for the first time in two years because of air-conditioning demand growth. City gas will increase on the diffusion of gas air-conditioning and cogeneration systems. In contrast, kerosene and heavy fuel oil A will continue declining due to fuel switching. In FY2016, the commercial sector will log a small fall of 0.2% on progress in energy conservation for air-conditioning and lighting equipment.

The transportation sector will increase in FY2015 by 0.5% from the previous year for the first rise in three years due to gasoline and diesel oil prices fall following the crude oil price plunge, abnormal weather in the previous year and the fading impact of the VAT increase in April 2014. In FY2016, the sector will fall back with a 1.8% decline on a peaking of automobile ownership, fuel efficiency improvements under fuel-efficient vehicles' growing share, and the improvement of transportation efficiency.

Table 5 | Final energy consumption

| | Historical | | | Estimation | Projections | | Year-to-year changes | | |
|---------------------------------|------------|--------|--------|------------|-------------|--------|----------------------|--------|--------|
| | FY2010 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 |
| Final energy consumption (Mtoe) | 339.4 | 321.8 | 321.6 | 311.6 | 313.2 | 311.3 | -3.1% | 0.5% | -0.6% |
| Industry | 158.3 | 148.6 | 151.4 | 146.7 | 147.0 | 147.0 | -3.1% | 0.2% | 0.0% |
| Buildings | 98.0 | 92.7 | 90.8 | 88.0 | 88.8 | 88.2 | -3.1% | 0.9% | -0.6% |
| Residential | 54.7 | 51.6 | 50.1 | 48.6 | 48.9 | 48.4 | -3.1% | 0.7% | -1.0% |
| Commercial | 43.4 | 41.1 | 40.7 | 39.4 | 39.9 | 39.8 | -3.1% | 1.2% | -0.2% |
| Transport | 83.1 | 80.4 | 79.5 | 77.0 | 77.3 | 76.0 | -3.2% | 0.5% | -1.8% |
| Coal and coal products | 35.9 | 34.3 | 36.2 | 34.3 | 34.7 | 34.7 | -5.3% | 1.0% | 0.1% |
| Petroleum products | 176.2 | 165.7 | 164.0 | 157.7 | 157.0 | 153.7 | -3.8% | -0.4% | -2.1% |
| City and natural gases | 34.3 | 34.7 | 34.3 | 34.1 | 34.7 | 35.4 | -0.6% | 1.9% | 1.9% |
| Electricity | 89.8 | 84.6 | 84.5 | 83.0 | 84.3 | 84.9 | -1.8% | 1.5% | 0.7% |
| Others | 3.2 | 2.5 | 2.6 | 2.4 | 2.5 | 2.6 | -4.9% | 1.5% | 3.5% |

Note: Industry includes non-energy use.

Electricity sales and power generation mix (electric utilities)

Electricity sales for lighting services will increase in FY2015 for the first time since the Great East Japan Earthquake. Sales for power services including those for large industrial users will also increase on an industrial production recovery.

Electricity sales in FY2015 will increase by 1.6% from the previous year when a substantial decline emerged on a plunge in production by manufacturers. Sales for lighting services will score a 1.5% rise, the first upturn since the Great East Japan Earthquake, due primarily to steady demand for all-electric homes and temperature factors. Those for power services will also expand by 1.6% thanks to a manufacturing production recovery and electricity rate drops under lower fuel prices. Particularly, sales to

large industrial users will post a 2.1% increase as they increase in all major industries other than the paper-pulp industry that is expected to cut production.

Electricity sales will continue growing with a 1.1% increase in FY2016 as an economic expansion is coupled with a decline in the electricity saving trend that will come on a supply-demand balance improvement through the restart of nuclear power plants. Sales for lighting services will log a small rise of 0.1% on an increase in the number of contracts. Those for power services will expand by 1.6%, approaching 600 TWh for the first time in six years. Particularly, machinery manufacturers will make great contributions to the electricity sales growth by expanding production.

Table 6 | Electricity sales (electric utilities)

| | Historical | | | | Projections | | Year-to-year changes | | |
|--|------------|--------|--------|--------|-------------|--------|----------------------|--------|--------|
| | FY2010 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 |
| Total (TWh) | 926.6 | 870.9 | 871.5 | 851.4 | 865.0 | 874.5 | -2.3% | 1.6% | 1.1% |
| Lighting services | 304.2 | 286.2 | 284.3 | 273.1 | 277.1 | 277.5 | -4.0% | 1.5% | 0.1% |
| Power services | 622.4 | 584.7 | 587.2 | 578.3 | 587.8 | 597.0 | -1.5% | 1.6% | 1.6% |
| of which: Large-scale industrial users | 283.2 | 267.4 | 269.3 | 266.8 | 272.4 | 279.7 | -0.9% | 2.1% | 2.7% |
| Mining and manufacturing | 234.4 | 221.3 | 222.8 | 220.4 | 224.8 | 231.5 | -1.1% | 2.0% | 3.0% |
| Chemicals | 28.1 | 26.3 | 26.6 | 26.3 | 26.7 | 27.0 | -1.1% | 1.4% | 1.1% |
| Iron and steel | 36.3 | 36.0 | 37.3 | 36.6 | 36.8 | 38.2 | -1.9% | 0.3% | 4.0% |
| Machinery | 74.6 | 69.0 | 69.2 | 69.0 | 71.0 | 73.5 | -0.4% | 2.9% | 3.6% |

Note: Power services and total include specified-scale demand.

Nuclear power plants will resume operation in FY2015. Fossil fuels' share of total power generation in FY2016 will fall to 78%, the lowest since the Great East Japan Earthquake.

In FY2015, new energies' share of electricity generation will rise by 1.4 percentage points from the previous year due to the further penetration of non-residential solar photovoltaics. Nuclear will rise to 1.1% as commercial operations are resumed in late summer or early fall. LNG will post the largest

fall of 1.5 points as it is gradually withdrawn from the dominant base electric source position given in emergency response to the earthquake. The share for oil, etc. will decline by 0.9 points. Oil-fired power generation, however, will maintain a certain share as it plays a role in adjusting power generation to peak demand. Coal-fired power plants will stably operate as a base electricity source, though seeing a 0.3-point fall in their share of total power generation.

In FY2016, nuclear and new energies will further expand their shares. Fossil fuel-fired will drop to 78%, the lowest since the earthquake. The share,

however, will still be 16 points higher than before the earthquake. LNG will log the largest decline of 4.2 points like as in the previous year.

Table 7 | Power generation mix (electric utilities)

| | Historical | | | | Projections | | Year-to-year changes | | |
|---|------------|--------|--------|--------|-------------|--------|----------------------|--------|--------|
| | FY2010 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 |
| Electricity generated and purchased (TWh) | 1,028 | 962.7 | 963.5 | 936.8 | 953.0 | 964.4 | -2.8% | 1.7% | 1.2% |
| Share | | | | | | | Year-to-year changes | | |
| Hydro | (9%) | (8%) | 8% | 9% | 9% | 9% | +0.4p | +0.3p | -0.1p |
| Fossil fuel-fired thermal | (62%) | (88%) | 88% | 87% | 84% | 78% | -0.9p | -2.7p | -6.6p |
| Coal | (25%) | (28%) | 30% | 30% | 30% | 30% | +0.5p | -0.3p | -0.3p |
| Natural and city gases | (29%) | (43%) | 44% | 46% | 45% | 40% | +2.3p | -1.5p | -4.2p |
| Oil, etc. | (8%) | (18%) | 14% | 11% | 10% | 8% | -3.8p | -0.9p | -2.1p |
| Nuclear | (29%) | (2%) | 1% | 0% | 1% | 7% | -1.0p | +1.1p | +5.4p |
| New energies and others | (1%) | (2%) | 2% | 4% | 6% | 7% | +2.6p | +1.4p | +1.3p |

Note: Only for general electric utilities until FY2012.

City gas sales (city gas utilities)

City gas sales will set a record high each in FY2015 and FY2016, led by those for industrial uses.

City gas sales in FY2015 will increase by 2.0% from the previous year to a record high of more than 41 billion cubic metres due to a production recovery mainly for manufacturers, the services sector's invigoration, leap-year effects and colder winter weather than the previous year. Furthermore, the penetration of city gas-fuelled cogeneration systems including stationary fuel cells after the Great East Japan Earthquake will accelerate, contributing to sales growth. In FY2016, city gas sales will increase by 1.8% as industrial production expands to meet a last-minute demand increase before the VAT hike in April 2017. Led by those to industry, city gas sales will expand to 41.7 billion m³, setting a record high for the second straight year.

Sales to the residential sector in FY2015 will increase by 1.2% thanks to leap-year effects, temperature factors and the further penetration of household fuel cells and other city gas using equipment. In FY2016 when temperatures will stay unchanged from the previous year, sales to the sector will log a small fall of 0.4% in line with the diffusion of highly efficient water heating systems. The residential sector's share of total city gas sales will decline to a record low of 23% from more than 50% in and before FY1990.

Sales for commercial and other uses in FY2015 will increase sharply (by 2.6% for commercial uses and 2.9% for other uses) due to a recovery in the services sector including commercial facilities, office buildings and restaurants, a decline in the electricity-saving trend and

greater air-conditioning demand caused by leap-year and temperature effects, despite improvements in the efficiency of gas using equipment. In FY2016, they will expand further (by 0.9% for commercial uses and 0.7% for other uses) as the penetration of new gas equipment such as micro gas engines and gas heat pumps is combined with existing gas equipment's growing operations. Sales for other uses will hit a record high since hospitals, public facilities and other facilities introduce cogeneration systems in line with their growing consciousness of emergency electricity sources after the earthquake.

Sales for industrial uses in FY2015 will increase by 2.2% from the previous year to a record high of 23.2 billion m³, rewriting the record for the first time in three years. Sales for manufacturing will expand by 2.8% due to rising capacity factors for gas engines, gas boilers and other existing gas equipment, growing new gas demand accompanying industrial furnaces' fuel switching, and lower gas prices. However, sales for power generation will decline by 2.6% as the operating rate falls at a large city gas-fired power unit (the seventh unit at the Kashima power station). Sales for industrial uses will grow steadily in FY2016, scoring a 3.0% increase. Whilst sales for power generation will post a limited increase of 0.6% as more nuclear power plants restart, those for manufacturing will log a robust expansion of 3.3%. Overall city gas sales for industrial uses will reach 23.9 billion m³, rewriting the record for the second straight year. Industrial gas sales' share of total city gas sales will rise to 57% from only 26% in FY1990.

Table 8 | City gas sales (city gas utilities)

| | Historical | | | | Projections | | Year-to-year changes | | |
|---------------------------------|------------|--------|--------|--------|-------------|--------|----------------------|--------|--------|
| | FY2010 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 |
| Total (Billion m ³) | 39.28 | 40.33 | 39.82 | 40.16 | 40.97 | 41.69 | 0.9% | 2.0% | 1.8% |
| Residential | 9.79 | 9.80 | 9.55 | 9.58 | 9.69 | 9.66 | 0.3% | 1.2% | -0.4% |
| Commercial | 4.75 | 4.52 | 4.49 | 4.34 | 4.45 | 4.49 | -3.4% | 2.6% | 0.9% |
| Industrial | 21.61 | 22.92 | 22.20 | 22.74 | 23.23 | 23.92 | 2.5% | 2.2% | 3.0% |
| For general industries | 20.18 | 21.03 | 20.26 | 20.07 | 20.62 | 21.30 | -0.9% | 2.8% | 3.3% |
| For electric utilities | 1.43 | 1.89 | 1.94 | 2.68 | 2.61 | 2.62 | 37.9% | -2.6% | 0.6% |
| Others | 3.13 | 3.09 | 3.58 | 3.50 | 3.60 | 3.62 | -2.2% | 2.9% | 0.7% |

Notes: Converted at 1 m³ = 41.8605 MJ (10,000 kcal)

Fuel oil and LPG sales, and crude oil throughput

The sales volume decline in FY2015 will decelerate due to the oil price plunge and other factors. In FY2016, sales volume will slip below 180 billion litres for the first time in 47 years as fuel oil C for power generation decline substantially.

The downward trend of fuel oil sales volume will weaken in FY2015 due to the oil price plunge and leap-year effects, posting a 0.4% drop from the previous year. In FY2016, sales volume will decline by 3.4% with all fuel oil categories posting drops on progress in energy conservation and fuel switching, slipping below 180 GL for the first time in 47 years.

Gasoline sales in FY2015 will increase by 0.6% from the previous year for the first rise in five years as a rebound from a plunge under the previous year's bad weather is coupled with a price drop and leap-year effects. In FY2016, however, gasoline sales will fall back with a 1.8% drop due to a long-term penetration of hybrid and other fuel-efficient vehicles and growth in the mini-vehicle fleet.

Naphtha sales that depend on ethylene production will post a slight decrease of 0.1% in FY2015. In FY2016, they will log a sharp decline of more than 1 GL or 2.3%. The decline, however, will be slower than for overall fuel oil sales since naphtha is less affected by energy conservation and fuel switching than other petroleum products. Naphtha's share of total fuel oil sales will expand to 24% in FY2016.

Kerosene sales in FY2015 will drop by 1.0% from the previous year on progress in switching from kerosene to other fuels, although colder winter weather may stimulate kerosene demand. In FY2016, sales will post an even faster drop of 3.6% with temperatures remaining unchanged

from the previous year, slipping below 16 GL for the first time in 46 years.

Diesel oil sales in FY2015 will score a slight rise of 0.1% due to a freight traffic increase amid an economic recovery and lower prices, although those for industrial uses will decrease on fuel switching. In FY2016, diesel oil sales will limit their fall to 0.1% despite continuous improvements in truck transportation and fuel efficiencies as freight traffic expands.

Heavy fuel oil A sales will decline by 3.9% and 5.4% in FY2015 and in FY2016, respectively, due to switching to other fuels and progress in energy conservation under environmental conservation measures, although manufacturers' production will expand.

Heavy fuel oils B and C sales in FY2015 will fall by 2.0% from the previous year on progress in fuel switching and energy conservation mainly in the industrial sector. In FY2016, they will post the largest decline among fuel oil categories of 16.2% to a 57-year low as demand for these fuels falls rapidly on the restart of more nuclear power plants. Their share of total fuel oil sales will drop to a record low of 8%.

LPG sales will level off in FY2015 despite a long-term trend of switching to other fuels as building sector demand increases on temperature factors. They will post a small fall of 0.1% in FY2016 as the switching makes progress in both industrial and building sectors. Sales volume will thus remain around 15.5 million tonnes.

Crude oil throughput will post faster declines (0.7% in FY2015 and 3.7% in FY2016) than fuel oil sales as drops are large for petroleum products other than naphtha and LPG. Imports account for a greater share for naphtha and LPG than for other petroleum products.

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

| | Historical | | | | Projections | | Year-to-year changes | | |
|---------------------------|------------|--------|--------|--------|-------------|--------|----------------------|--------|--------|
| | FY2010 | FY2012 | FY2013 | FY2014 | FY2015 | FY2016 | FY2014 | FY2015 | FY2016 |
| Fuel oils (GL) | 196.0 | 197.8 | 193.6 | 183.0 | 182.2 | 176.0 | -5.5% | -0.4% | -3.4% |
| Gasoline | 58.2 | 56.2 | 55.5 | 53.0 | 53.3 | 52.3 | -4.5% | 0.6% | -1.8% |
| Naphtha | 46.7 | 43.2 | 45.7 | 43.9 | 43.9 | 42.8 | -4.0% | -0.1% | -2.3% |
| Jet fuel | 5.2 | 4.0 | 5.1 | 5.3 | 5.3 | 5.3 | 5.7% | -0.2% | -0.6% |
| Kerosene | 20.4 | 18.9 | 17.9 | 16.7 | 16.5 | 15.9 | -7.0% | -1.0% | -3.6% |
| Diesel oil | 32.9 | 33.4 | 34.1 | 33.6 | 33.6 | 33.6 | -1.5% | 0.1% | -0.1% |
| Heavy fuel oil A | 15.4 | 13.8 | 13.4 | 12.4 | 11.9 | 11.2 | -8.0% | -3.9% | -5.4% |
| Heavy fuel oils B and C | 17.3 | 28.4 | 21.9 | 18.1 | 17.7 | 14.9 | -17.3% | -2.0% | -16.2% |
| For electric utilities | 7.7 | 19.4 | 14.4 | 10.8 | 10.6 | 8.0 | -25.1% | -1.5% | -24.8% |
| For other users | 9.7 | 9.0 | 7.5 | 7.3 | 7.1 | 6.9 | -2.2% | -2.8% | -3.5% |
| LPG (Mt) | 16.5 | 16.6 | 15.5 | 15.4 | 15.4 | 15.4 | -0.7% | 0.0% | -0.1% |
| Crude oil throughput (GL) | 208.9 | 197.6 | 200.4 | 189.0 | 187.6 | 180.6 | -5.7% | -0.7% | -3.7% |

Renewable energy power generation

Renewable energy power generation capacity will reach 63 GW with approved facilities' cost burden on consumers totalling JPY50 trillion.

Japan's feed-in-tariff, or FIT, system, in which utilities purchase electricity generated with renewable energies at fixed prices, has entered its fourth year. Great expectations are placed on renewables that represent purely domestic resources and emit no carbon dioxide. A long-term energy supply and demand outlook by the Advisory Committee for Natural Resources and Energy projects renewables to account for 22-24% of electricity generation in 2030. Meanwhile, various relevant challenges have emerged.

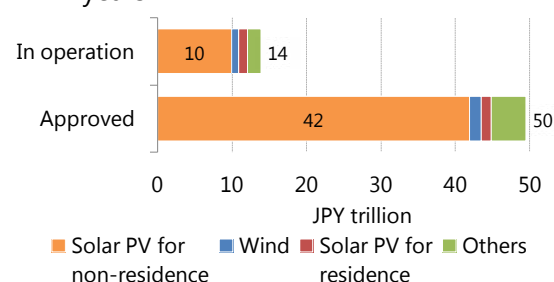
Any rapid penetration of renewable energy power generation sharply expands the cost burden on consumers. As the system has been revised to cancel FIT approval for projects for which land and equipment have yet to be secured, set power utilities' connection capacities, expand the scope of systems subject to output curtailment and enhance such control, any extremely rapid increase in capacity approved under the FIT system has been held down.

If 99.0 GW in renewable energy power generation capacity approved by the end of February 2015 (including 79.7 GW for solar PV and 4.5 GW for wind) is all put into operation, however, the cost burden on consumers over 20 years may total JPY50 trillion¹. The burden amounts to a hike of JPY2,900/MWh in

¹ The marginal avoidance cost is estimated at JPY10,400/MWh based on the renewable energy FIT system on the website of the Agency for Natural Resources and Energy. The capacity factor is assumed at 20% for wind power, 12% solar PV, 70% for geothermal energy, 45% for hydro and 70% for biomass. The remaining FIT periods for capacity introduced before the FIT system launching are taken into account.

electricity rates – 12% for the residential sector and 14% for the industrial sector compared with those before the FIT. Particularly, the rapid expansion of solar PV generation subject to higher tariffs is pushing up the burden. As approved facilities are completed and put into operation, the estimated burden increase will come about.

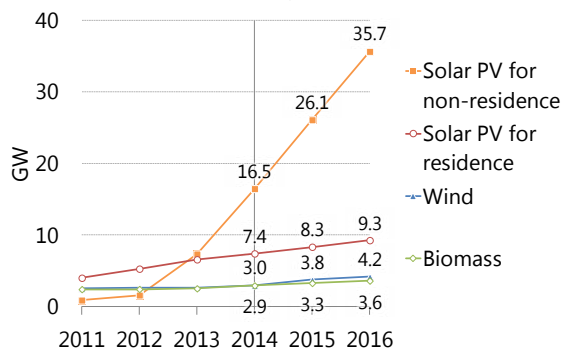
Figure 2 | Cumulative burden of FIT over 20 years



Note: As of February 2015.

Power generation output control has been enhanced to counter the massive diffusion of variable solar PV and wind power generation that destabilises power grids. Concern about the enhanced output control affecting profitability of power generation could prompt business operators to cancel generators approved under the FIT system or slow down new approval mainly for non-residential solar PV. However, available renewable energy power generation capacity subject to the FIT system will expand from 40.5 GW in March 2015 to 62.9 GW at the end of FY2016 as generators under construction are completed. Particularly, non-residential solar PV will increase to 35.7 GW accounting for a majority of the total. Capacity totals 5 GW for wind for which environmental assessment is ongoing or has been completed. Given long lead times required before operation, however, the capacity of wind starting operation by the end of FY2016 will be limited to 1.2 GW. Renewable energy power generation in FY2016 will total 118.1 TWh (including 47.2 TWh by solar PV, 7.4 TWh by wind and 38.0 TWh by small and medium-scale hydro), accounting for some 10% of Japan's total power generation.

Figure 3 | Installed capacity in operation of renewable power generation



Notes: As of the end of fiscal year. Excludes small and medium-scale hydro, etc.

Discussions are ongoing on how best to revise the FIT system to correct the bias for solar PV. Wind power generation costs less than other renewables while featuring volatility. Grid measures to solve the volatility must be expanded before wind power generation is promoted. Geothermal power generation has failed to diffuse due to constraints regarding environmental assessment and location, while fuel procurement is limited for biomass power generation. Both geothermal and biomass are stable electricity sources on which great hopes are placed. However, a challenge is how to cut costs further.

While great hopes are placed on renewable energy, the problem is how to balance the diffusion of renewable energy power generation with restrictions on the burden on consumers.

Impacts of nuclear power plants' restart

The Sendai Power Station becoming the first nuclear power plant to restart under new regulation standards, with attention paid to other plants.

In May 2015, Kyushu Electric Power Co.'s Sendai Power Station received approval for its operational safety programmes, the last of the three approvals required for nuclear power plants under Japan's new regulation standards. The other two are permission for a change in the reactor installation license and approval of the construction work plans. It is the first nuclear power station to obtain all three approvals under the new standards put into force in July 2013. The power station will have to start up its reactors and pass a pre-service inspection before launching commercial operations.

This chapter assumes four cases for the restart of nuclear power plants in consideration of progress in screening under regulation standards, the presence or absence of large-scale construction and application timings, and assesses their respective impacts. In the Reference Scenario, three to five reactors are assumed to gradually restart operations every about half year on average after the Sendai Power Station launches commercial operations late summer or early fall of 2015. Therefore, a total of five reactors are assumed to restart operations by the end of FY2015, being in service for three months on average and

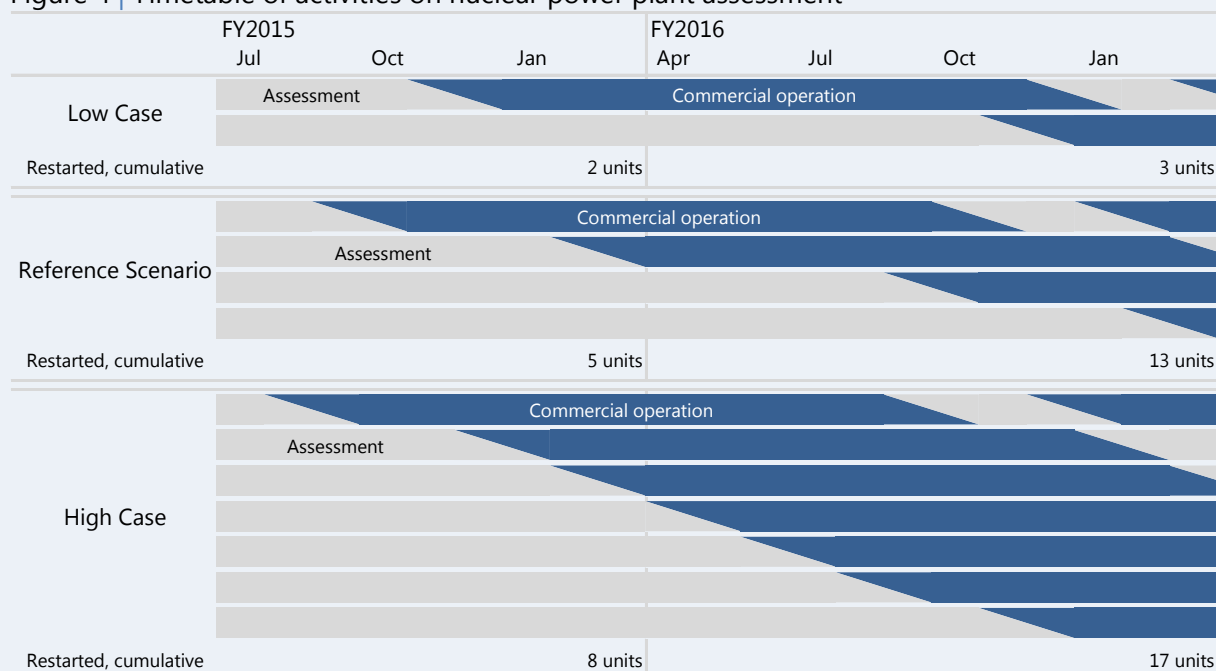
generating 10.6 TWh of electricity in the year. Thirteen reactors will be in service at the end of FY2016, operating for six months on average and generating 63.9 TWh in the year. The electricity generated will be limited to 22% of the FY2010 level before the Great East Japan Earthquake.

In the High Case, one reactor per month is assumed to restart operations on average with screening procedures streamlined. Eight reactors will thus restart operations by the end of FY2015. A total of 17 reactors will restart operations by the end of FY2016, operating for 10 months on average and generating 132.7 TWh (double the Reference Scenario level) in the year.

In the Low Case, the initial restart is assumed to come slightly later than in the Reference Scenario. Subsequent restart will come in some one year after the initial one. Two reactors will be restarted by the end of FY2015. Three will be in operations by the end of FY2016, operating for eight months on average and generating 15.3 TWh (76% less than in the Reference Scenario) in the year.

In the hypothetical Highest Case, 24 reactors for which applications for regulation standard conformity tests have been submitted, excluding one at the Oma Nuclear Power Station now under construction, are assumed to operate at 80% of their capacity factor in FY2016.

Figure 4 | Timetable of activities on nuclear power plant assessment



In the Reference Scenario, Japan's fossil fuel imports in FY2016 will increase by JPY2.6 trillion from FY2010. The average power generation cost will rise by JPY2,700/MWh. The energy self-sufficiency rate will fall by 6.4 percentage points while energy-related carbon dioxide emissions will increase by 10 Mt.

FY2016 fossil fuel imports in the High Case will be JPY1.2 trillion less than in the Low Case. The average power generation cost will be JPY1,300/MWh less. GDP will be 0.1% more. The energy self-sufficiency rate will be 5.1 percentage points higher. CO₂ emissions will be 55 Mt less.

FY2016 fossil fuel imports in the Highest Case will be JPY1.5 trillion less than in the Low Case. The average power generation cost will

be JPY1,700/MWh less. GDP will be 0.2% more. The energy self-sufficiency rate will be 6.4 percentage points higher. CO₂ emissions will be 70 Mt less.

In June 2015, an application for regulation standard conformity tests for the No. 3 unit of the Hamaoka Nuclear Power Station was submitted, bringing the total number of reactors subject to such applications to 25. Since the Great East Japan Earthquake, growing fossil fuel imports for power generation have deteriorated the trade balance, lowered the energy self-sufficiency rate and expanded CO₂ emissions. Even at present when international energy prices have declined, nuclear power generation can play a major role in improving the 3Es – the economy, energy security and environment.

Table 10 | Impacts of restarting nuclear power plants

| | | FY2010 | FY2016 | | | |
|--|--|---------|------------------------------|--------------------|-----------|--------------|
| | | | Low Case | Reference Scenario | High Case | Highest Case |
| Cumulative number of restarted nuclear reactors ¹ | [FY2015] | .. | [2] | [5] | [8] | .. |
| | FY20016 | .. | 3 | 13 | 17 | 24 |
| | Average period for operation (months) | .. | 8 | 6 | 10 | .. |
| | Electricity generation by nuclear (TWh) | 288.2 | 15.3 | 63.9 | 132.7 | 165.9 |
| | | FY2010 | FY2016 (Changes from FY2010) | | | |
| | | | Low Case | Reference Scenario | High Case | Highest Case |
| Economy | Power generation cost ² (JPY/kWh) | (8.2) | +3.3 | +2.7 | +2.0 | +1.6 |
| | Total fossil fuel imports (JPY trillion) | 18.1 | +3.1 | +2.6 | +1.9 | +1.6 |
| | Oil | 12.3 | +1.2 | +1.0 | +0.8 | +0.7 |
| | LNG | 3.5 | +2.0 | +1.7 | +1.2 | +1.0 |
| | Trade balance (JPY trillion) | 5.3 | -9.2 | -8.7 | -8.1 | -7.9 |
| | Real GDP (JPY2005 trillion) | 512.7 | +32.1 | +32.3 | +32.7 | +32.9 |
| | Gross national income (JPY trillion) | 493.8 | +46.3 | +46.7 | +47.3 | +47.5 |
| Energy | Primary energy supply | | | | | |
| | Oil (GL) | 232.3 | -23.7 | -26.7 | -30.7 | -32.6 |
| | Natural gas (Mt of LNG equivalent) | 73.3 | +17.2 | +12.0 | +4.6 | +0.9 |
| | LNG imports (Mt) | 70.6 | +17.9 | +12.7 | +5.3 | +1.6 |
| | Self-sufficiency rate | 18.0% | -8.5p | -6.4p | -3.4p | -2.0p |
| Environment | Energy-related CO ₂ emissions (Mt-CO ₂) | 1,139 | +33 | +10 | -22 | -37 |
| | Changes from FY2013 | [-7.8%] | [-5.1%] | [-6.9%] | [-9.5%] | [-10.8%] |

Reference Scenario: The first commercial operation resumes in late summer or early fall 2015.

Restarts of three to five plants follow in every about six months.

Low Case: The first restarts delay a bit compared with the Reference Scenario. The second group restarts about one year later.

High Case: The first commercial operation resumes in late summer or early fall 2015.

Then one plant restarts about a month on average thanks to more efficient assessment.

Highest Case: A hypothetical case in which 24 applicant plants for the assessment generate electricity with 80% of 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.

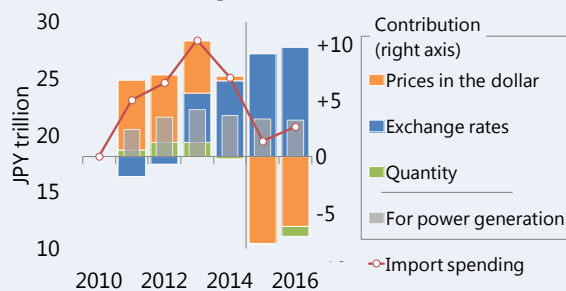
Assessing risk of rising energy prices

A replaced key factor for pushing up energy import spending

Fossil fuels are the largest import item for Japan. Since the Great East Japan Earthquake, their import spending has risen to a record high due to price rises and growing fossil fuel-fired power generation, helping plunge the country into a trade deficit.

The rapid oil price decline since the summer of 2014 has come as a blessing for Japan that now depends heavily on fossil fuel-fired power generation. In FY2014, the average oil import price fell by \$21/bbl from the previous year to a four-year low of \$89/bbl. A drop in the LNG import price, which reflects any oil price change in about three months after the change, was limited to 5%. Even so, the fuel price decline worked to reduce Japan's fuel import spending in the year by JPY4.2 trillion from the previous year (under prices in May 2015, the reduction in the FY2014 fuel import spending would have been JPY13.0 trillion).

Figure 5 | Changes in fossil fuel import spending and contribution [compared with FY2010]



Note: The Reference Scenario in and after FY2015

The yen hit a record high of 75 to the dollar in 2011 and depreciated to the FY2014 average of JPY109/\$. The weakening yen worked to raise the fuel import spending in FY2014 by JPY2.4 trillion, becoming the largest factor to push up the fuel import spending. The fuel import volume's contribution to the fuel import spending increase from FY2010 turned negative

in FY2014 as fuel consumption for non-power generation decreased.

Prepare for the risk of rising energy price rises

OPEC refrained from indicating any intent to cut oil production at its meeting in June as well, working to cap oil prices. Meanwhile, a speculated stagnation in shale oil production expansion and other factors have led oil market participants to become alert to a possible upturn of energy prices. Therefore, we assessed the impacts of the oil price's \$10/bbl rise from the Reference Scenario in the projection period.

In FY2016 as the second year of the oil price upturn, a JPY1.9 trillion increase in fuel imports and other changes will lower Japan's real GDP by 0.4%. Gross national income per capita will fall by JPY15,000. Japan's vulnerability to energy price rises has grown more serious due to its excessive dependence on fossil fuel-fired power generation as well as the yen's sharp depreciation expected to cause disadvantages.

If the renewed energy price rises are coupled with a sluggish restart of nuclear power plants and a greater penetration of renewable energy power generation, electricity costs including fossil and nuclear fuel expenses and FIT purchasing costs may increase by JPY1.0 trillion from JPY8.0 trillion in the Reference Scenario to JPY9.0 trillion (the government has adopted a target of reducing electricity costs in FY2030 by 2-5% from JPY9.7 trillion in FY2013).

In order to achieve stable growth without being shaken by overseas developments, Japan should continuously take effective measures instead of being complacent with present low energy prices. Over a short term, an effective measure is to steadily restart nuclear power plants. Over a medium to long term, Japan will have to pursue energy conservation and the best energy mix, promote the penetration of cheap domestically produced energy sources and diversify energy sources and procurement means.

Table 11 | Impacts of changes in energy price

| | | FY2015 | | | FY2016 | | |
|---------|------------------------------------|--------------------|------------------|---------|--------------------|------------------|---------|
| | | Reference Scenario | High Prices Case | Changes | Reference Scenario | High Prices Case | Changes |
| Prices | Crude oil import, CIF (\$/bbl) | 64 | 71 | +11.7% | 69 | 79 | +14.4% |
| | LNG import, CIF (\$/t) | 470 | 505 | +7.5% | 502 | 561 | +11.8% |
| Economy | Real GDP (JPY2005 trillion) | 534.8 | 534.2 | -0.1% | 545.1 | 542.9 | -0.4% |
| | GNI per capita (JPY thousand) | 4,186 | 4,175 | -0.3% | 4,262 | 4,246 | -0.4% |
| | Balance of trade (JPY trillion) | -1.8 | -3.4 | +89.4% | -3.4 | -5.4 | +57.3% |
| | Fossil fuel imports | 19.5 | 21.3 | +9.2% | 20.8 | 23.0 | +11.0% |
| | Consumer price index (2010=100) | 103.7 | 103.9 | +0.2% | 104.5 | 105.0 | +0.4% |
| Energy | Primary energy supply (Mtoe) | 477.4 | 475.6 | -0.4% | 477.1 | 472.9 | -0.9% |
| | Oil (GL) | 214.8 | 213.2 | -0.7% | 205.8 | 202.9 | -1.4% |
| | Natural gas (Mt of LNG equivalent) | 90.1 | 89.9 | -0.2% | 85.3 | 84.5 | -1.0% |

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