The Energy White Paper is a report submitted to the Diet annually based on Article 11 of the Basic Act on Energy Policy outlining energy measures taken during the previous fiscal year.

In addition to the routine topics explained every year (energy trends and measures taken during the previous fiscal year concerning energy supply and demand), the Energy White Paper 2014 seeks to deepen public understanding by explaining various energy-related problems with data and information based on the Strategic Energy Plan decided upon at the April 11, 2014 Cabinet meeting. As introduced in the Energy White Paper 2012, measures being taken in the aftermath of the accident at Tokyo Electric Power Company (TEPCO)’s Fukushima Daiichi Nuclear Power Plants (NPS) and trends in energy-related policies established thereafter are also introduced.

Part 1 Energy-Related Conditions and Key Measures

Chapter 1 Background situation to the Strategic Energy Plan
   Section 1 Structural Issues Faced by Japan
   Section 2 TEPCO’s Fukushima Nuclear Accident and Issues that Become Apparent since the Time of the Accident

Chapter 2 The Great East Japan Earthquake and the Review of Japan’s Energy Policies
   Section 1 Responses to the Great East Japan Earthquake and the Accident at TEPCO’s Fukushima Nuclear Accident
   Section 2 Key Energy-Related Measures Taken After the Great East Japan Earthquake and the Accident at TEPCO’s Fukushima Nuclear Accident

Part 2 Energy Trends
   (Collection of basic data outlining energy supply and demand within and outside Japan and primary and secondary energy trends)

Part 3 Measures Taken in FY2013 Concerning Energy Supply and Demand (Outline of Individual Measures and Budgets, etc.)
Section 1 Structural Issues Faced by Japan

(1) Fundamental vulnerability of the energy supply system due to high dependency on overseas energy resources

- Japan’s primary energy self-sufficiency rate has declined significantly compared to the level prior to the Great East Japan Earthquake (2010: 19.9%), and was as low as 6.0% in 2012. This is the second lowest level among the 34 OECD countries.

[Comparison of Primary Energy Self-Sufficiency Rates of the OECD Countries (2012)]

- First: Norway (677.4%)
- Second: Australia (235.4%)
- Third: Canada (166.2%)
- Eighth: United States (85.0%)
- 14th: United Kingdom (60.7%)
- 15th: France (52.9%)
- 20th: Germany (40.1%)
- 27th: Spain (25.8%)
- 30th: South Korea (18.0%)
- 33rd: Japan (6.0%)
- 34th: Luxembourg (2.9%)
(2) Mid- to long-term changes in the energy demand structure through population decrease and technological innovation, etc.

- The Japanese population is projected to decline to approximately 97 million by 2050 and is also expected to age rapidly.
- Mid- to long-term changes in the energy demand structure are also underway due to technological innovations, such as improving automobile fuel efficiency, the rational use of energy through the development of next-generation vehicles, and the expansion of usage of energy resources.

### Changes in the Japanese Population and the Aging of the Population

#### Example of Improvement in Gasoline-Fueled Passenger Cars

#### Changes in Average Fuel Efficiency

- Elderly population ratio: Percentage of total population aged 65 and over

[Source] Created based on Cabinet Office data

- Changes in the average 10-15 mode fuel efficiency of gasoline fueled passenger cars

[Source] Created based on the data from the Ministry of Land, Infrastructure, Transport and Tourism
(3) Instability of resource prices due to increased energy demand in emerging countries, etc. [i]

- Global energy demand is expected to expand mainly in developing countries and to increase by a factor of 1.3 from 2011 to 2035, with 90% or more of the demand increase attributable to growth in non-OECD countries such as China, India and Middle East countries.

- Resource prices have been on a long-term upward trend and have become more sensitive to changes in international circumstances as a result of demand fluctuations caused by the expansion of energy demand mainly in developing countries, regional conflicts and changes in economic conditions.

### Expansion of Energy Demand in Emerging Countries

<table>
<thead>
<tr>
<th>Year</th>
<th>Energy Demand (Oil Equivalent)</th>
<th>Non-OECD</th>
<th>OECD (excl. Japan and the US)</th>
<th>Japan</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>9.799 billion tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>12.71 billion tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2035</td>
<td>16.9 billion tons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Proven Recoverable Reserves of Oil, Natural Gas, and Coal

<table>
<thead>
<tr>
<th>Resource</th>
<th>Proven recoverable reserves</th>
<th>Minable years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>1.7 trillion barrels</td>
<td>53 years</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>187 trillion m³</td>
<td>56 years</td>
</tr>
<tr>
<td>Coal</td>
<td>860.9 billion tons</td>
<td>109 years</td>
</tr>
</tbody>
</table>

(Note) Proven recoverable reserves: Reserves proven to exist and considered to be economically recoverable

Minable years: Result of dividing proven recoverable reserves by annual production volume

[Source] Created based on the “World Energy Outlook 2013” (IEA)
(3) Instability of resource prices due to increased energy demand in emerging countries, etc. [ii]

- Resource prices have been on a long-term upward trend and have become more sensitive to changes in international circumstances as a result of demand fluctuations caused by the expansion of energy demand mainly in developing countries, regional conflicts and changes in economic conditions.

[Source] West Texas Intermediate (WTI) Prices are based on the CME Group’s Website and Arab Light Official Selling Prices are based on data released by Saudi Aramco.
Chapter 1 Background Situation to the Strategic Energy Plan

Section 1 Structural Issues Faced by Japan (cont.)

### Changes in price for unit calorific value by fuel

**Crude Oil**
- Historic high (CIF price): 90,048 yen/t (January 2014)
- 81,089 yen/t (September 2008)
- 70 yen/L (March 2014)
- 92 yen/L (August 2008)
- 53 yen/L (March 2011)
- 17 yen/L (January 2000)
- +17 yen/L

**Natural Gas (LNG)**
- 53,809 yen/t (March 2011)
- 88,098 yen/t (March 2014)
- 81,089 yen/t (January 2008)

**Steam Coal**
- 15,983 yen/t (2008/8)
- 10,810 yen/t (2014/3)
- 3,641 yen/t (2000/1)
- 10,634 yen/t (2011/3)
- +178 yen/t

[Source] Created based on the “Trade Statistics of Japan” (Ministry of Finance) and data from the Institute of Energy Economics, Japan
(4) Increasing global greenhouse gas emissions

Global emissions of energy-derived carbon dioxide are expected to increase by another 20% from 2011 to 2035 (30 billion tons to 35.7 billion tons) due to strong energy demand in developing countries, with expected energy demand increasing by a factor of 2.2 in India and 1.3 in China.

[Source] Created based on the “World Energy Outlook 2013” (IEA)
(1) Concerns over serious damage caused by the TEPCO’s Fukushima Nuclear Accident and the safety of nuclear power generation

The Great East Japan Earthquake led to a serious accident at TEPCO’s Fukushima Nuclear Accident, making it impossible to cool nuclear reactors due the loss of power supply. Approximately 135,000 people who formerly lived in areas surrounding the nuclear power plants still cannot return to their homes.

### Current Status of Fukushima

**[Total number of evacuees nationwide]**

- Approx. 157,000 people (December 2012) ➔ Approx. 135,000 people (March 2014)

**[Number of evacuees from areas subject to evacuation orders, etc.]**

- Approx. 110,000 people (December 2012) ➔ Approx. 102,000 people (March 2014)

**[Development of temporary housing]**

- 16,800 homes [demand fulfillment rate: 99.5%] (March 2014)

**[Management of disaster-related waste, etc. under direct control of the national government]**

Disaster-related waste, etc. has been managed based on the Waste Management Plan for Targeted Areas (partially revised in December 2013).

By the end of March 2014, disaster-related waste, which had been hindering the ability of displaced persons to return to their homes, had been completely removed and transferred to temporary storage sites as planned in Okuma town, Naraha town and Kawauchi village (excluding areas to which residents cannot return for the foreseeable future). The transfer of disaster-related waste was also completed as planned in Minamisoma city, with the exception of some areas.

[Source] Created based on data from the Ministry of the Environment, the Reconstruction Agency, and the Fukushima Prefectural Government

### Current Status of Fukushima Daiichi Nuclear Power Station Unit 4

At the reactor building of Unit 4, debris was removed from the top floor and a cover with fuel handling equipment was installed. Removal of fuel from the spent fuel pool was commenced in November 2013 and is scheduled to be completed by the end of 2014.

Transferred fuel: 924 rods out of 1,533
(as of May 26, 2014)

[Material provided by TEPCO]
Outflow of national wealth and increased supply instability due to higher dependency on fossil fuels [i]

- Japan’s dependency on fossil fuels as a power source is currently 88%, higher than the level at the time of the First Oil Shock (80%).
- Due to the nuclear power plant shutdown, an increase in fuel prices and exchange rate fluctuations, the value of fossil fuel imports increased to 27 trillion yen in 2013, 10 trillion yen more than prior to the earthquake, resulting in Japan’s largest ever trade deficit of 11.5 trillion yen.
(2) Outflow of national wealth and increased supply instability due to higher dependency on fossil fuels [ii]

- If it is assumed that the utilization of thermal power plants has been increased to make up for the loss of electric power caused by the shutdown of nuclear power plants, the increased fuel costs for FY2013 are estimated to be approximately 3.6 trillion yen.

### Estimated Increase Fuel Costs Due to Shutdown of Nuclear Power Plants

- **Electricity production before the earthquake (FY2008 to FY2010 average)**
  - Nuclear power: 274.8 billion kWh
  - Renewable energy, etc.
  - Thermal power: 265.5 billion kWh

- **FY2013 operations**
  - Nuclear power: 9.3 billion kWh
  - Renewable energy, etc.
  - Thermal power

- **Increased fuel costs due to shutdown of nuclear power plants**
  - **FY2013**: 3.6 trillion yen
  - **Breakdown**:
    - LNG: +1.9 trillion yen
    - Oil: +1.8 trillion yen
    - Coal: +0.1 trillion yen
    - Uranium: -0.3 trillion yen

- **[Source]** Estimated by the Agency for Natural Resources and Energy
(2) Outflow of national wealth and increased supply instability due to higher dependency on fossil fuels [iii]

- Mineral fuel imports increased to account for 5.7% of the GDP in 2013, the same level as at the time of the First Oil Shock and exceeding the level in 2008 when resource prices soared. In particular, the percentage for LNG hit a record high.

[Source] Created based on the “National Accounts” (Cabinet Office) and the “Trade Statistics of Japan” (Ministry of Finance)
(3) Higher electricity bills due to a change in the power source mix, and the impact of the international regional differences in energy prices on the macro economy, industry and household economies [i]

- Due to increased fuel prices, etc. after the Great East Japan Earthquake, the average electricity unit price (electric lighting costs) for the average household rose by around 20% and the average electricity unit price (electric power costs) for industrial facilities, such as factories and offices, rose by around 30% across Japan.

Changes in Electricity Charges

![Graph showing changes in electricity charges](image)

[Source] Created based on the “Electricity Demand Report” (Federation of Electric Power Companies in Japan) and the materials concerning the power companies’ final settlement reports, etc.
Higher electricity bills due to a change in the power source mix, and the impact of the international regional differences in energy prices on the macro economy, industry and household economies [ii]

○ Japan’s LNG import price is US$16.6/MMBTU, higher than that of US$4.5/MMBTU for the United States (Henry Hub Price) and US$9.4/MMBTU for Europe (National Balancing Point). (In contrast to U.S. domestic natural gas prices, Japan’s LNG import price is more closely linked to the import price of crude oil and includes liquefaction and transportation costs.)(Note)

(Note) The liquefaction cost is estimated to be US$3~4/MMBTU and the cost of transportation from the United States is estimated to be US$3/MMBTU.

○ These regional disparities in energy prices may bring about significant changes not only in the field of energy but also in industrial activities in various business fields, and may significantly affect economic growth and industrial structures worldwide.

(Dollars/MMBTU*)

Changes in Natural Gas Prices

LNG import price (Japan)

NBP** (Europe)

Henry Hub Price (United States)

Great East Japan Earthquake (March 2011)

* MMBTU: British thermal unit
** NBP: National Balancing Point (British market price)

[Source] Created based on the “Trade Statistics of Japan” and data from the NYMEX and the ICE, etc.
(4) Rapid increase in greenhouse gas emissions in Japan

As a result of the shutdown of nuclear power plants, greenhouse gas emissions from the power sector have increased by 112 million tons compared to FY2010. The increase is equivalent to approximately 10% of Japan’s total greenhouse gas emissions. In the meantime, greenhouse gas emissions from other sectors have decreased by 27 million tons compared to FY2010.
(5) Exposed defects related to supply systems, including power interchange and emergency supply between eastern and western Japan

The Great East Japan Earthquake caused the shutdown of many power generation plants located on the Pacific coast, making it impossible to sufficiently conduct the broad-area operation of power grids. Due to the inability to make up for the power shortage, rolling blackouts were implemented in the service area of TEPCO.

### Power Supply and Demand Immediately after the Earthquake (March 14, 2011)

On March 14, 2011, immediately after the Great East Japan Earthquake, a power shortage of 10 million kW was expected even with power transferred from power companies in the Chubu region and from western Japan to TEPCO via frequency converters (FC; total capacity: million kW). Therefore, rolling blackouts were implemented for the first time (power companies in the Chubu region and western Japan reserved a margin of 14.28 million kW even when transferring power to TEPCO via FCs).

Starting on March 14, rolling blackouts were implemented 32 times in total for about ten days in the service area of TEPCO.

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply capability</td>
<td>31.00</td>
<td>80.95</td>
<td>21.91</td>
<td>24.45</td>
<td>5.06</td>
<td>11.28</td>
<td>4.70</td>
<td>13.55</td>
</tr>
<tr>
<td>Demand <em>(See Note)</em></td>
<td>41.00</td>
<td>66.67</td>
<td>18.36</td>
<td>20.37</td>
<td>4.00</td>
<td>8.36</td>
<td>3.98</td>
<td>11.60</td>
</tr>
<tr>
<td>Supply capability – Demand, etc. (margin)</td>
<td>-10.00 (after power transfer via FCs)</td>
<td>14.28</td>
<td>3.55</td>
<td>4.08</td>
<td>1.06</td>
<td>2.92</td>
<td>0.72</td>
<td>1.95</td>
</tr>
<tr>
<td>Capability margin</td>
<td>-24.4%</td>
<td>21.4%</td>
<td>19.4%</td>
<td>20.0%</td>
<td>26.5%</td>
<td>34.9%</td>
<td>18.1%</td>
<td>16.8%</td>
</tr>
</tbody>
</table>

(Note) Thanks to rolling blackouts, etc., power demand in the service area of TEPCO on March 14 was 29.14 million kW, and the capability margin was 1.86 million kW (6.4%).

*[Source]* Surveyed by the Ministry of Economy, Trade and Industry
(5) Exposed defects related to supply systems, including power interchange and emergency supply between eastern and western Japan [ii]

○ The Great East Japan Earthquake disrupted the supply of city gas and it became necessary to make up for the shortfall with oil and LPG. However, problems hindered the smooth supply of oil and LPG to disaster-stricken areas.

[Supply of Oil and LPG at the Time of the Earthquake]

[Transportation system]
- There was no prior agreement on a scheme under which oil and LPG companies would respond to fuel supply requests from disaster-stricken areas or on oil terminals to be shared in such an event.
- It was difficult to obtain information and ascertain damage, stock, and operating conditions for equipment.

[Supply facilities]
- Damage and breakdowns at refineries and service stations, etc. due to the earthquake and tsunami
  ○ One refinery in the Tohoku region and two refineries in the Kanto region sustained severe damage to their docks, pipes, tanks and tanker shipping points.
  ○ Service stations suffered oil filling equipment shutdowns due to large-scale blackouts and a lack of stock due to interruption of the supply chain. As a result, fuel supply was hindered in disaster-stricken areas and other areas.
- Many of the LPG import bases were damaged and shipment of LPG to disaster-stricken areas became difficult.
  ○ Shortage of independent power generators to enable shipment and supplying of oil even in the event of a blackout
  ○ Shortage of equipment to transport oil from refineries to drums for shipment

[Storage]
- The Oil Stockpiling Act did not have any provisions to enable [i] the release of oil from national oil stockpiles and [ii] the release of oil from private stockpiles under the initiative of the national government (without waiting for applications to be filed by private business operators).
- National oil stockpiles mostly consist of crude oil and are insufficient as preparation for possible deterioration in the production of petroleum products due to a disaster or damage to a long-distance distribution network.

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[Examples of Securing Gasoline and Gas Oil Supplies in Disaster-stricken Areas and in the Kanto Region]

- Emergency measures to secure supply and setting of expanded transportation routes—

[Chapter 1 Background Situation to the Strategic Energy Plan]
(6) Reduced confidence in the government and business operators involved in energy supply
○ Since before the TEPCO’s Fukushima Nuclear Accident, public distrust of energy-related administrative organizations and business operators have grown due to many troubles and scheduling delays related to nuclear energy policy.
○ In addition, while handling the TEPCO’s Fukushima Nuclear Accident and its aftermath, the government and business operators came under heavy criticism for their inadequate information sharing and lack of awareness about the need for communications with the local communities concerned, resulting in a significant decline in public trust in them.

Public Comments on the Establishment of the New Strategic Energy Plan
(Examples of Public Opinions)

• Words are meaningless as long as a structure remains that allows arbitrary manipulation by the national government, the Ministry of Economy, Trade and Industry, and the Agency for Natural Resources and Energy, all of which are responsible for this nuclear accident.
• Public relations activities concerning energy seem no more than propaganda unless information transparency and the existence of a fair third-party organization are ensured.
• After experiencing an accident that had been considered impossible and witnessing the bungled handling of the aftermath, it will be impossible to obtain the understanding of the relevant local residents regardless of the national government’s PR activities concerning nuclear power plants.
Section 2 TEPCO’s Fukushima Nuclear Accident and Issues that Become Apparent since the Time of the Accident (cont.)

(7) Changes in the demand trend - increased introduction of cogeneration and changes in power saving action

○ After the Great East Japan Earthquake, the Japanese economy showed growth, but electric power consumption declined by 8.0% from 2010 to 2012.

○ After the earthquake, energy saving awareness was broadly disseminated and approximately 16.67 million kW of power was saved during the summer of FY2013 when compared with the level in FY2010 (equivalent to 9.3% of the maximum power demand in the summer of FY2010).

(Trillion yen; prices in 2005)
(8) Change in the geopolitical structure of resource-supplying regions, including instability in the Middle Eastern and North African regions

Recent moves in the Middle Eastern and North African regions, such as the so-called “Arab Spring,” have destabilized the political and social structures of these regions, and concerns over the possibility of a crude oil supply shortage have led to instability in the crude oil market.

<Reference>
Crude Oil Exported from the Middle East and North Africa as Percentages of the Global Crude Oil Trade (2012)

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage of Global Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle East</td>
<td>45.7%</td>
</tr>
<tr>
<td>North Africa</td>
<td>5.5%</td>
</tr>
<tr>
<td>Total</td>
<td>51.3%</td>
</tr>
</tbody>
</table>

Middle East: Saudi Arabia, Iran, Iraq, Kuwait, UAE, Qatar, and Oman
North Africa: Algeria, Egypt, and Libya

[Source] Created based on the “BP Statistics 2013”
Changes in the Global Energy Supply-Demand Structure Caused by the Shale Revolution

[Europe]
- Decline in gas demand due to increased coal consumption
- Expansion of gas imports from the Middle East and decrease in gas imports from Russia
- Introduction of various pricing methods
- Energy security enhancement efforts

[Russia]
- Pressure to reduce natural gas prices in Europe and stagnation in the gas supply
- Cultivation of the Japanese, Chinese and Korean markets
- Possibility of increased exports resulting from conventional and unconventional crude oil development

[China]
- Increased natural gas imports from Turkmenistan
- Acquisition of upstream interests in North America
- Increase in crude oil imports from the Middle East

[Japan]
- Diversification of natural gas suppliers
- Ensuring the existence of other options, including coal, etc.

[North America (the United States and Canada)]
- Increased natural gas supply
- Surplus coal exports to Europe
- Shift to net exporter of gas

[Middle East (Qatar, etc.)]
- Further cultivation of the European and Asian markets
- Decreased crude oil exports to the United States (2.7 mbd to 1.7 mbd)
- Further expansion of crude oil exports to Asia (mainly China and India) (to China: from 2.6 mbd to 2.9 mbd)

[Africa]
- Decrease in crude oil exports to the United States due to the shale revolution (1.1 mbd to 0.3 mbd)
- Possibility of crude oil (light oil) from Algeria and Nigeria supplying the European and Indian markets

[Mozambique]
- Cultivation of supply destinations

[Australia]
- Cultivation of supply destinations and the need to engage in price negotiations

[South America]
- Possibility of production increases and crude oil exports resulting from development by Argentina (shale oil) and Venezuela (extra heavy oil)

[Asia]
- Expansion of gas imports from the Middle East
- Cultivation of supply destinations and the need to engage in price negotiations

[Source] Created based on the “Medium-term Market Report 2013” (IEA)
(10) The global expansion of nuclear power introduction mainly in developing countries

- The idea of accelerating the use of nuclear power will become increasingly popular, from the viewpoint of energy security, mainly in Asian countries, where energy demand is expected to further increase in the future.

Worldwide 2030 Nuclear Power Generation Forecast (as estimated by the IAEA)

- **Western Europe**
  - Current capacity: 114 million kW
  - 2030 Low-end forecast: 68 million kW (0.6 times)
  - 2030 High-end forecast: 124 million kW (1.1 times)

- **Eastern Europe**
  - Current capacity: 49 million kW
  - 2030 Low-end forecast: 79 million kW (1.6 times)
  - 2030 High-end forecast: 104 million kW (2.1 times)

- **Middle East and South Asia**
  - Current capacity: 6 million kW
  - 2030 Low-end forecast: 27 million kW (4.5 times)
  - 2030 High-end forecast: 54 million kW (9 times)

- **Africa**
  - Current capacity: 2 million kW
  - 2030 Low-end forecast: 5 million kW (2.5 times)
  - 2030 High-end forecast: 10 million kW (5 times)

- **East Asia**
  - Current capacity: 83 million kW
  - 2030 Low-end forecast: 147 million kW (1.8 times)
  - 2030 High-end forecast: 268 million kW (3.2 times)

- **North America**
  - Current capacity: 116 million kW
  - 2030 Low-end forecast: 101 million kW (0.87 times)
  - 2030 High-end forecast: 143 million kW (1.2 times)

- **South East Asia and Pacific region**
  - Current capacity: 0 kW
  - 2030 Low-end forecast: 0 kW
  - 2030 High-end forecast: 4 million kW

- **South America**
  - Current capacity: 4 million kW
  - 2030 Low-end forecast: 7 million kW (1.8 times)
  - 2030 High-end forecast: 15 million kW (3.8 times)

World Nuclear Power Generation Capacity
- Current capacity: 373 million kW
- 2030 Low-end forecast: 435 million kW (1.2 times)
- 2030 High-end forecast: 722 million kW (1.9 times)

(Note) Nuclear power generation capacity is an IAEA estimate (August 2013).

[Source] Created based on the “Energy, Electricity and Nuclear Power Estimates for the Period up to 2050, 2013 Edition” (IAEA)
Part1 Chapter 2 The Great East Japan Earthquake and the Review of Japan’s Energy Policies

Section 1 Responses to the Great East Japan Earthquake and TEPCO’s Fukushima Nuclear Accident

(1) Initiatives for Decommissioning Fukushima Daiichi Nuclear Power Station Units 1-4

(i) Revision of the roadmap
   • The revision of the Mid- and Long-term Roadmap, including the acceleration of the schedule, was conducted in June 2013 so as to commence removal of the fuel from the spent fuel pool and of fuel debris as soon as possible.

(ii) Measures taken in response to contaminated water issue
   • The Basic Guidelines for the Contaminated Water Issue at TEPCO’s Fukushima Nuclear Accident was decided by the Nuclear Emergency Response Headquarters in September 2013, and the Contaminated Water and Decommissioning Issues Team was established the same month.
   • Additional Measures for Contaminated Water and Decommissioning Issues at TEPCO’s Fukushima Daiichi Nuclear Power Station were decided upon by the Nuclear Emergency Response Headquarters in December 2013, compiling preventive and multilayered measures for the contaminated water issue, including the acceleration of the construction of welded-type tanks and the verification of purification technologies.
   • The functions of the conning tower in relation to contaminated water and decommissioning issues were integrated by consolidating the Council for the Decommissioning of TEPCO’s Fukushima Daiichi Nuclear Power Station into the Inter-Ministerial Council for Contaminated Water and Decommissioning Issues.

(iii) Partial revision of the Nuclear Damage Compensation Facilitation Corporation Act
   A bill to partially revise the Nuclear Damage Compensation Facilitation Corporation Act was submitted to the ordinary session of the Diet in February 2014 with the aim of adding the assistance in the decommissioning of damaged reactors to the services to be conducted by the Nuclear Damage Compensation Facilitation Corporation.

(iv) Removal of fuel from the spent fuel pool at Unit 4
   The removal was commenced in November 2013. It is intended that work will be completed by the end of 2014.

(2) Nuclear Damage Compensation

(i) Interim guidelines for determining the scope of nuclear damage by the Dispute Reconciliation Committee for Nuclear Damage Compensation
   The fourth supplement to the interim guidelines was compiled in December 2013. The supplement clarifies the scope of compensation for houses and the coverage of non-economic damages where evacuation orders are not lifted for a prolonged period of time.

(ii) Approval of partial alteration of the Comprehensive Special Business Plan
   In January 2014, the national government approved the New Comprehensive Special Business Plan, which incorporates nuclear damage compensation by the entirety of the Tokyo Electric Power Company Group, implementation of Fukushima reconstruction initiatives through such means as a project to dispatch 100,000 working staff members, and measures for the stable restoration and decommissioning of damaged reactors. As of May 2014, TEPCO has paid a total of approximately 3.8 trillion yen in compensation.
Part1 Chapter 2 The Great East Japan Earthquake and the Review of Japan’s Energy Policies

Section 1 Responses to the Great East Japan Earthquake and TEPCO’s Fukushima Nuclear Accident

(3) Assistance for Nuclear Disaster Victims

(i) Measures to ensure returnees’ safety and security
The Cabinet Decision entitled “For Accelerating the Reconstruction of Fukushima after the Nuclear Disaster” (December 2013) specifies comprehensive and multilayered measures to support residents’ voluntary activities.

(ii) Decontamination
Based on the plan for decontamination of special areas, decontamination work has been completed in four out of ten cities and municipalities (as of March 2014). Regarding areas in which municipalities are to take the initiative in decontamination work, 94 municipalities in eight prefectures established implementation plans and have carried out decontamination (as of March 2014).

(iii) Fukushima International Research Industry Hub Scheme Workshop (“Fukushima Innovation Coast” Scheme Workshop)
The Fukushima International Research Industry Hub Scheme Workshop was established to discuss the possibility of local economies, research and development necessary for the decommissioning, and the creation of new industry and job opportunities for the purpose of building industrial clusters and reconstructing industrial infrastructure in the Hamadori area of Fukushima.

(4) Nuclear regulation

(i) Initiatives to restore the public trust in nuclear regulation administration
In March 2014, the Japan Nuclear Energy Safety Organization was integrated with the Nuclear Regulation Authority to enhance the expertise of the latter. The number of officials increased from 473 (in March 2013) to 1,025 (in March 2014).

(ii) Review of the regulatory standards based on the Nuclear Reactor, etc. Regulation Act and compliance examinations
New regulatory standards for nuclear reactors were established and enacted in July 2013, together with strengthened measures to be taken in the event of severe accidents and the introduction of a system incorporating the latest technical knowledge. Compliance with the new regulatory standards is mandatory for both newly constructed and existing facilities (backfitting). Compliance examinations based on the new regulatory standards for nuclear reactors have commenced, and applications have been filed by 10 nuclear entities for 17 plants. (*)

*On May 20, 2014, the Japan Atomic Power Company filed an application for verification of compliance with the new regulatory standards for its Tokai No. 2 Power Station with the Nuclear Regulation Authority. This means that as of May 21, 2014, applications had been filed by 11 nuclear entities for 18 plants.

(iii) Crisis management (emergency response initiatives)
In October 2013, the national government, nuclear business operators, and local communities jointly conducted the Comprehensive Nuclear Emergency Drill, targeting the Sendai Nuclear Power Station.
Part 1 Chapter 2 The Great East Japan Earthquake and the Review of Japan’s Energy Policies

Section 2 Key Energy-Related Measures Taken After the Great East Japan Earthquake and TEPCO’s Fukushima Nuclear Accident

(1) Comprehensive policy with the goal of securing a stable supply of resources
   (i) Reinforcement of relations with resource-supplying nations and promotion of participation in upstream projects
      • In light of the urgent need to reduce fuel costs, the Immediate Action Plan for Fuel Cost Reduction was compiled in April 2013.
      • As a result of resource diplomacy led by the Prime Minister, all LNG projects, involving Japanese firms obtained approval from the U.S. government.
      • Relations with resource-supplying nations in Africa have been reinforced through the Japan-Africa Ministerial Meeting for Resources Development and TICAD V, held in May and June 2013, respectively.
      • The national government offers support by providing funding for highly profitable but highly risky projects through the Japan Oil, Gas and Metals National Corporation (JOGMEC), for projects such as the shale gas project in Canada.
   (ii) Promotion of development of domestic resources
      • Based on the “Basic Plan on Ocean Policy” (April 2013 Cabinet decision), the Plan for the Development of Marine Energy and Mineral Resources was revised in December 2013.
      • Regarding the deep methane hydrate, the results of the methane hydrate gas production experiment at sea conducted in March 2013 were analyzed and efforts have been made to address technical challenges, such as a means for long-term stable production. Regarding the shallow methane hydrate, a wide-area survey to assess the reserve amount was commenced in FY2013 and 225 locations where this type of methane hydrate is likely to exist were confirmed off the coast of Joetsu and the west of Noto Peninsula.

(2) Realization of an advanced energy-conserving society
The tight electricity supply after the Great East Japan Earthquake taught us the significance of promoting energy conservation measures to maintain balance between supply and demand, such as measures to handle peak electricity demand, and energy conservation measures targeting the consumer (commercial and residential) sector in which energy consumption is increasing rapidly. Against this background, the Act on the Rational Use of Energy was revised in May 2013 to add the following.
   (i) Introduction of the Top Runner Program for construction materials
      The coverage of the Top Runner Program was expanded to include construction materials (insulation materials, windows, etc.) capable of contributing to improving energy conservation by buildings to promote energy conservation in buildings and houses where significant energy conservation effects are expected.
   (ii) Introduction of a system to facilitate demand side measures to handle peak electricity demand
      A system was put in place to enable proper evaluation under the Act on the Rational Use of Energy of measures taken on the demand side to handle peak electricity demand, such as the utilization of storage batteries or the Building Energy Management System (BEMS), in addition to conventional energy saving measures.
(3) Acceleration of the introduction of renewable energy:

(i) Use of renewable energy in FY2013

The adoption of the feed-in-tariff system in 2012 facilitated a steady introduction of renewable energy, and renewable energy equipment generating a total of 6.381 million kW (up 29% from the previous fiscal year) had begun operating by the end of February 2014. The charge under the FY2013 feed-in-tariff system was 0.40 yen/kWh, totaling 350 billion yen.

(ii) Developments and conclusion of the deliberations on the FY2014 procurement price by the Procurement Price Calculation Committee

Regarding photovoltaic power generation, the procurement price for FY2014 for the non-residential sector was reduced from 36 yen/kWh to 32 yen/kWh to reflect a decrease in system costs (solar panels, power conditioners, etc.), and the procurement price for the residential sector was also reduced by one yen to 37 yen/kWh. As offshore wind power generation is more costly than onshore wind power generation and has inherent risks, the purchase price for offshore wind power generation was newly determined to be 36 yen/kWh (before tax).

(iii) Establishment of the Renewable Energy Ministerial Meeting

The Renewable Energy Ministerial Meeting was established to strengthen the national government’s “conning tower” functions and promote collaboration between the relevant ministries and agencies. The first meeting was held on April 11, 2014.

(4) Re-establishment of the nuclear energy policy

(i) Final disposal

• The Radioactive Wastes WG was established in May 2013 to discuss initiatives for the final disposal of high-level radioactive waste, and the Geological Disposal Technology WG was established in October 2013 to verify and reevaluate the technological reliability of geological disposal. In addition, the Final Disposal Ministerial Meeting was held in December 2013. As a result, it was decided the national government would lead initiatives to promote the disposal of high-level radioactive waste.

• The national government is committed to resolving the problem of the final disposal of high-level radioactive waste to avoid leaving the burden to future generations. While promoting efforts assuming geological disposal, the government will secure reversibility and retrievability so that future generations will be able to select the best disposal method if a better solution is found in the future. Additionally, the government will seek understanding on the site selection by suggesting locations that are scientifically considered to be better suited.

(ii) To ensure continued voluntary nuclear safety improvement efforts

At meetings of the WG on Voluntary Efforts & Continuous Improvement of Nuclear Safety held from July 2013 to March 2014, discussions were held regarding continued voluntary nuclear safety improvement efforts. The WG compiled its recommendations, stating that correct understanding of accident risks and implementation of necessary countermeasures must be the top managerial issues for the nuclear business and the establishment of a risk management system to enable such actions should be the basic premise for operating a nuclear business.

* See Part 1, Chapter 2, Section 1 (pp. 21–22) for other matters concerning the re-establishment of the nuclear energy policy.
(5) Environmental arrangement for efficient and stable use of fossil fuels

(i) Improvement of power generation efficiency
The national government is promoting technological development aimed at achieving world leadership in power generation efficiency (advanced ultra-supercritical power generation technology, coal gasification cogeneration, etc.) with due consideration for the environment.

(ii) Bid tendering required in principle for new construction, expansion or replacement of power sources
Based on discussions by the WG on Tendering Systems of Thermal Power Supply, which was established in 2012, the Guidelines for the Operation of New Thermal Power Supply Tendering Systems were revised to improve the efficiency and transparency of tendering procedures.

(iii) Expediting and clarifying environmental assessments
The required period for an environmental assessment for the replacement of a power source was reduced by around one year, and environmental assessments for new construction or expansion of power sources are also carried out in such a way as to reduce the required period.

(6) Promotion of reforms in the supply structure

(i) Electricity system reform
Electricity system reform has been promoted as a three stage process aimed at achieving three purposes: the securing of a stable electricity supply, suppressing electricity rates to the maximum extent possible, and the expansion of customer options and business opportunities.

The amended Electricity Business Act was enacted at the 185th extraordinary session of the Diet. The revision specifies measures necessary for the expansion of the cross-regional coordination of transmission operators, first stage of the reforms, and roadmap related to electricity system reform that are to be achieved by 2020.

A bill for the Act for Partial Revision of the Electricity Business Act that specifies measures necessary for the full retail competition, the second stage of the reforms, was submitted to the 186th ordinary session of the Diet.

(ii) Gas system reform
In November 2013, the Gas System Reform Subcommittee was established under the Strategic Policy Committee of the Advisory Committee for Natural Resources and Energy with the goal of building a gas system that ensures a low-cost, safe, and stable supply of gas and of presenting various options, including new services, to customers.

The Subcommittee had held six meetings by March 2014 and obtained the opinions of gas companies on such topics as the expansion of the liberalization of the retail business, and improvement of access to and promotion of the development of supply infrastructure.
(7) Enhancement of resilience of the domestic energy supply networks

The national government will take measures with regard to both software and hardware in an effort to minimize damage in the event of a large-scale disaster and achieve early restoration of oil and LPG supplies.

(i) Initiatives to strengthen the hardware side

- Assistance in strengthening the disaster response capabilities of oil supply bases and increasing the national stockpile of petroleum products (introduction of emergency generators, etc. at refineries and core service stations, reinforcement of shipping facilities for petroleum products against earthquakes and countermeasures against tsunamis, etc.)
- Deployment of mobile power generator vehicles to LPG import bases and secondary bases and development of core LPG stations, etc. (to supply LPG locally in the event of a disaster)

(ii) Initiatives on the software side

- The Cabinet Office and oil companies jointly conducted a drill concerning the Oil Supply Coordination Plan in Case of a Disaster (prepared by oil companies based on the Oil Stockpiling Act) (June 2013).

(8) Other

(i) Examination of electricity rate increases

Power companies’ applications for electricity rate increases in the regulatory sector are strictly examined during a neutral and objective review by the Expert Committee on Reviewing Electricity Rates to determine whether said power companies made their utmost efforts to streamline operations before filing applications.

<Applications for electricity rate increases filed by power companies (FY2013)>:

- Tohoku (application for an increase of 11.41% in February 2013; approval of an increase of 8.94% in August 2013; implementation on September 1, 2013)
- Shikoku (application for an increase of 10.94% in February 2013; approval of an increase of 7.80% in August 2013; implementation on September 1, 2013; Hokkaido (application for an increase of 10.20% in April 2013; approval of an increase of 7.73% in August 2013; implementation on September 1, 2013)
- Chubu (application for an increase of 4.95% in October 2013; approval of an increase of 3.77% in April 2014; implementation on May 1, 2014)

(ii) Electricity supply and demand measures

Although all power companies expected that they would be able to ensure capability margins exceeding 3% during the summer of FY2013, nine power companies, excluding the Okinawa Electric Power Company, took such measures as requesting power conservation without a numerical target in preparation for possible tight electricity supplies in the event of a large-scale power outage.

All power companies also expected that they would be able to ensure capability margins exceeding 3% during the winter of FY2013, but there were risks of unexpected blackouts or constraints in power interchanges. Therefore, nine power companies, excluding the Okinawa Electric Power Company, took such measures as requesting power conservation without a numerical target in preparation for a tight electricity supply. The Hokkaido Electric Power Company further requested power conservation in its service area with a numerical target of a decrease of 6% or more from the level in FY2010.
Fuel cell vehicles, which are scheduled to be launched in 2015, are promising next-generation vehicles that will contribute to the improvement of energy security and reduction of environmental loads with their long ranges and shorter fill times, in addition to offering the same performance as existing gasoline-fueled vehicles.

Japanese auto manufacturers have been unveiling their respective concept cars and accelerating their preparations for the launch of their fuel cell vehicle models in 2015. The development of hydrogen refueling stations to supply hydrogen fuel also began in FY2013 ahead of the launch of the fuel cell vehicles.

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**Expansion of the introduction of stationery fuel cells**

A stationary fuel cell generates electricity using hydrogen extracted from town gas and LPG and utilizes the heat generated in that process to heat rooms and supply hot water. The device is one of the best distributed energy systems available due to its high energy efficiency and contributes to effective energy conservation and reduction of CO₂ emissions.

- **Fuel cells for residential use (Ene-Farm)**
  - **Dissemination and performance upgrades**
    
    Ene-Farm, the first fuel cell for domestic use in the world, was launched in 2009 and achieves in excess of 90% energy efficiency by effectively utilizing electricity and heat generated in the process of power generation. Various efforts have been made to achieve the goal of introducing 5.3 million units by 2030, and overseas business expansion commenced in April 2014.

- **Fuel cells for business and industrial use**
  - **Development and demonstration**
    
    Development of large fuel cells to be used at tertiary industry offices and primary and secondary industries' facilities have also been promoted, utilizing technology developed during the process of developing fuel cells for residential use. Demonstration of commercialization is now underway and products will be brought to market within several years.

**Efforts to bring about the most rapid dissemination of fuel cell vehicles in the world**

Fuel cell vehicles, which are scheduled to be launched in 2015, are promising next-generation vehicles that will contribute to the improvement of energy security and reduction of environmental loads with their long ranges and shorter fill times, in addition to offering the same performance as existing gasoline-fueled vehicles.

- **Launch of fuel cell vehicle models and development of hydrogen refueling stations**
  - **Development and demonstration**
    
    Japanese auto manufacturers have been unveiling their respective concept cars and accelerating their preparations for the launch of their fuel cell vehicle models in 2015. The development of hydrogen refueling stations to supply hydrogen fuel also began in FY2013 ahead of the launch of the fuel cell vehicles.

- **Expansion of usage**
  - **Development and demonstration**
    
    The development of fuel cell buses and forklifts is also underway utilizing fuel cell technologies used for fuel cell vehicles. The 2020 Tokyo Olympic and Paralympic Games are the best opportunity to show the potential of hydrogen energy, and efforts will be steadily promoted to take advantage of this opportunity.
Steps toward realization of a hydrogen society (3)

### Expectations for hydrogen power generation

The use of hydrogen energy is expected to expand to hydrogen power generation, not only limited to fuel cells for domestic use, which were launched in advance of the rest of the world in 2009, and fuel cell vehicles scheduled to be launched in 2015. To achieve this, technological development is being promoted in various ways to ensure a massive supply of hydrogen at low cost.

#### Development of hydrogen storage and transportation technologies

**Organic chemical hydride method**

- **Applied research**
- **Development and demonstration**

Technology to harness the reaction between hydrogen and toluene, thereby enabling storage and transportation of hydrogen in a liquid state at normal temperature and pressure.

**Hydrogen liquefaction method**

- **Applied research**
- **Development and demonstration**

Technology to liquefy hydrogen at cryogenic temperatures, thereby enabling storage and transportation of hydrogen in a liquid state.

### Offshore wind power generation

#### Floating offshore wind power generation off the coast of Fukushima prefecture

At present, a demonstration research project regarding a large floating offshore wind power generation system is ongoing off the coast of Fukushima Prefecture. This project aims to build a safe, reliable and highly economical floating offshore wind power generation system suited to Japan’s weather and hydrographic conditions and find means of coexisting with the fisheries industry, thereby creating the world’s first floating offshore wind farm.

- **Progress so far**
  In November 2013, as the first stage of the construction work, one 2 MW floating offshore wind power generation equipment unit and a floating offshore substation (transformer unit) were installed and demonstration operations commenced (approx. 20 km off the coast of Fukushima Prefecture).

- **Future plans**
  In the second stage of construction work, two 7 MW floating offshore wind power generation equipment units, which will be the largest in the world with a diameter of 160 meters, are scheduled to be installed by FY2015.
Examples of Column Topics

Development of biomass fuel production

○ Development of production technologies for algae-derived fuels

High expectations are placed on industrial production of liquid fuel utilizing algae as a new raw material, free from competition with food production. At present, a large-scale culturing experiment is underway utilizing a complete aeration process under outdoor sunlight. Efforts will be continued to achieve mass production of algae-derived fuels using less energy at low cost in the future.

○ Production of bio jet fuel using wood-based biomass

Technological development for the production of liquid fuel using biomass has been promoted, with the aim of building a low-cost production process for bio jet fuel through the combined development of gasification furnaces for biomass burning and catalysts suited to jet fuel synthesis.

Regional efforts utilizing waste oil

Development of biodiesel fuels using waste oil and dissemination thereof

Biodiesel fuels that can be produced from a wide range of raw materials, such as waste oil and rape seeds, are expected to be utilized as locally produced recyclable energy for local consumption.

○ Efforts of Obihiro city in Hokkaido

Obihiro City in Hokkaido has been engaged in a biodiesel production project, seeking to develop distribution infrastructure and ensure distribution routes for raw materials (waste oil) and products (biodiesel), with the assistance of the national government. The city set the following numerical targets for distribution of biodiesel-fuel-blended light oil (B5 light oil)

- Performance in 2012: Approx. 800kL
- Target for 2015: 5,000kL
- Target for 2020: 20,000kL

The city has been making serious efforts to increase the amounts collected by introducing large waste oil collection vehicles and installing bases for collection of small amounts in various locations.
Development of innovative storage batteries

Lithium-ion batteries are widely utilized in smartphones, tablet computers, electric vehicles, etc. but have performance limitations in terms of energy density and durability. Therefore, development of innovative storage battery technologies beyond the extension of conventional ones will be furthered with the aim of applying said technologies to electric vehicles in the future to achieve a range equivalent to that of gasoline-fueled vehicles.

Experimental research at the SPring-8 and J-PARC

As a result of experiments at the SPring-8, the world’s top performance synchrotron radiation facility, and the Japan Proton Accelerator Research Complex (J-PARC) conducted to understand the basic principle of electrochemical reactions in storage batteries, Japan has become the first country in the world to observe changes in the crystalline structures of electrode materials.

Based on this knowledge, efforts will continue to be made to develop innovative storage batteries by 2030.

Utilization of large storage batteries for the operation of power grids

Demonstration project using large storage batteries to be installed at substations in Hokkaido and the Tohoku Region

Japan has the world’s most advanced large storage battery technologies. Strategic utilization of such technologies may make it possible to absorb power variations inherent to photovoltaic and wind power generation. A demonstration project commenced in FY2013 to thoroughly verify the possible expansion of the feasible amount of renewable energy by utilizing the world’s largest storage batteries at power companies’ substations in power grids.

- In Hokkaido, a 60,000 kWh-level storage battery (redox flow battery) will be installed at the Minamihayakita Substation.
- In the Tohoku region, a 20,000 kWh-level storage battery (lithium-ion battery) will be installed at the Nishisendai Substation.