CONTENTS

1. Preface ........................................................................................................................... 2
2. Profile of Petroleum Association of Japan ............................................................... 3
3. Oil Supply and Demand in Japan ............................................................................... 7
4. Energy Policy in Japan ............................................................................................... 13
5. Oil Stockpiling and New Emergency Response Measures ........................................ 20
6. Japan’s Petroleum Resource Development .............................................................. 25
7. Regulatory Reform and Petroleum Industry .............................................................. 27
8. Petroleum Product Distribution and Marketing ....................................................... 32
9. Toward a Fundamental Reexamination of Petroleum-related Taxes ...................... 36
10. Reinforcement of Corporate Structure ................................................................... 41
11. Thorough Safety Measures ..................................................................................... 43
12. Preparation for Major Oil Spill Incidents ................................................................. 45
13. Environmental Measures in the Oil Refining Sector .............................................. 47
14. Quality Improvement in Automotive Fuels ............................................................... 50
15. The Global Warming Issue and Oil ........................................................................ 53
16. Utilization of Biomass Fuel ..................................................................................... 59
17. Efficient Use of Oil ................................................................................................. 62
18. Efforts toward Developing New Technologies ......................................................... 65
  ◆ Stable Oil Supply to End Consumers even at a Time of Disaster .......................... 67
Appendix: ......................................................................................................................... 69

- Location of Refineries and Crude Distillation Capacity in Japan
- Overview of the Japanese Petroleum Industry
- Main Product Specifications in Japan
- Web Address of PAJ’s Oil Statistics Website
Prices of crude oil (Dubai) at the beginning of 2012 were at the level of 105 US dollars per barrel (US$/Bbl), reflecting the enactment of the National Defense Authorization Act in the United States at the end of 2011 to tighten sanctions against Iran, etc. Then the prices jumped to the level of 110 US$/Bbl early in January and, triggered by Iran’s threat to blockade the Straits of Hormuz in late January, crude oil prices further increased and reached the level of 120 US$/Bbl in late February. Then, the prices gradually declined and temporarily dropped below the level of 90 US$/Bbl due to reignited concerns about the debt problems in Europe, etc. However, even after certain prospects for the debt problem were in sight at the European Union summit meeting at the end of June, oil prices continued rising above the level of 115 US$/Bbl by the middle of September. After that the prices stayed in a range between 105 and 110 US$/Bbl. As a result, Japan’s average crude oil price (CIF) in 2012 was 114.8 US$/Bbl, up about 6 US$ versus 2011. On a yen basis, the CIF was 57,493 yen/kiloliter (¥/KL), 2,843 ¥/KL higher on average than the previous year.

In relation to such movements of crude oil prices, gasoline retail prices (regular gasoline on a national average) in the domestic market in 2012 had started at 143.2 ¥/KL, and advanced to 158.3 ¥/KL in early spring. Then the prices dropped temporarily below the level of 140 ¥/KL early in July, reflecting the decline in crude oil prices until late June. After that the prices basically remained in a range between 140 and 150 ¥/KL.

Regarding domestic petroleum product demand for 2012, Heavy Fuel Oil C for power generation continued showing high growth as it had in 2011 due to the shutdown of nuclear power plants. Diesel fuel demand surpassed that in the previous year, attributable to reconstruction in the quake-hit areas getting into full swing, and gasoline also showed a slight increase. Consequently, total fuel oil demand for 2012 exceeded that of the previous two years annual demand.

As for the business environment surrounding the petroleum industry, the whole picture of the nation’s future form of energy has not been clarified due to the government’s vacillating energy policy. Under such circumstances, each oil company has announced a reduction in its refining capacity or the closure of its refineries in order to achieve the installation ratio of heavy oils cracking units based on the Law Concerning Sophisticated Methods of Energy Supply Structures.

Taking into account the lessons learned from the Great East Japan Earthquake, the Oil Stockpiling Act was amended to add such provisions as the revision of the government stockpiling release requirements, the formulation of a cooperation plan among oil companies at a time of disaster, and the expansion of the government’s oil product stockpiling. This will enable a more flexible response to release the government’s oil stockpile, which had originally been assumed to be released during an oil supply disruption from oil producing countries, at a time of domestic disaster. In addition, the petroleum industry itself is enhancing its disaster response capabilities, from the hardware side, at the industry’s core petroleum supply chain facilities like refineries and oil terminals. Also, the industry is enhancing its software measures such as preparing a system for collecting and transmitting information such as product inventory and shipping status of each oil terminal, operating status of each service station, and is sharing information with local governments for fuel supply to their essential facilities.

This brochure has been created to provide consumers as well as stakeholders with a better understanding of the current situation and the future efforts of the petroleum industry in Japan. We hope this brochure will help to give you a sound understanding of oil and the petroleum industry in Japan.
Petroleum Association of Japan (PAJ), incorporated in November 1955, is composed of 14 oil refiners and primary oil distributors (Motouri) in Japan.

PAJ deals with all matters concerning the refining and marketing of petroleum products. The main activities are:
1. Publishing information on important issues for the petroleum industry
2. Advocating the industry’s opinions and submitting proposals to the government, business associations, the media and the general public
3. Researching and coordinating activities related to important petroleum issues and providing information on such issues
4. Undertaking governmental subsidy programs such as the “Major Oil Spill Response Program”, including international conferences
5. Enhancing communication and understanding among member companies

I. Basic Policy for Fiscal Year (FY) 2013

Business Activities

Regarding the reexamination of energy policy, there is a real need for advocating that all parties concerned fairly position oil as a core energy source. To that end, it is necessary to have a stable supply of petroleum products and it is also essential to maintain the current petroleum supply chain.

In 2013, taking these into account, PAJ is working on such major issues as seeking the incorporation of the petroleum industry’s opinions into the government’s reexamination of energy policy toward the development of the Basic Energy Plan, and maintaining the petroleum supply chain by securing a stable scale of oil demand, etc., through encouraging broad use of the facilities and systems which use oil.

Furthermore, PAJ is dealing with various issues for improving the business environment as well as for enhancing competitiveness in each business segment. Such issues include addressing the tax reform relevant to the upcoming increase in the consumption tax, strengthening coordination and response capabilities at a time of disaster, advocating “the Capabilities of Oil” and proper execution of various subsidy activities. For the implementation of these business activities, adequate attention will be paid to the efficient management of budgets.

II. Projects and Main Activities in FY2013

1. Addressing issues concerning the petroleum policy in the future
   (1) Make proposals for energy policies focusing on how the petroleum industry should be in the future.
   (2) Manage biomass fuel issues.
   (3) Tackle the global warming issue.

2. Opposing a rise in taxes, urging comprehensive reexamination of petroleum-related taxes and ensuring fairness in taxation among energy sources

3. Strengthening both the domestic and international competitiveness of the petroleum refining industry in Japan
   (1) Take actions toward international issues related to the refining industry and efforts to reinforce further competitiveness.
   (2) Identify issues by analysing the corporate management and financial condition of the petroleum industry.

4. Promoting various uses of petroleum products
   (1) Promote activities to encourage broad use of PAJ’s High Energy Efficiency Oil Utilization Systems.
   (2) Cope with issues related to automotive fuels.
   (3) Conduct research study on qualities of petroleum products which meet environmental requirements.

5. Promoting disaster prevention and environmental pollution control measures
(1) Formulate a response system to such risks as major earthquakes, outbreaks of new-type influenza, etc.
(2) Reinforce disaster prevention measures, increase efforts to mitigate excessive safety and disaster prevention regulations, and enhance voluntary safety management systems.
(3) Maintain and improve the PAJ Major Oil Spill Response Program.
(4) Deal with environmental problems concerning toxic chemical substances, etc.

6. Addressing oil supply and distribution issues
(1) Deal with oil stockpiling issues and emergency response measures.
(2) Enhance services to provide information on oil-related databases and survey reports on domestic and foreign petroleum markets.
(3) Make positive efforts towards formation of a fair and transparent petroleum product market.
(4) Rationalize petroleum product distribution, realize regulatory reform, and promote environmental measures.

7. Promoting activities for a strong foundation for the petroleum industry
(1) Conduct PR activities for better public understanding of the positioning of oil among energy sources.
(2) Make right execution of the government subsidized projects.
(3) Support research and development operations by the Petroleum Industry Technology and Research Institute, Inc. (PITRI).
(5) Deal with labor policy issues concerning the petroleum industry.
(6) Enhance communication among PAJ member companies and collaboration with concerned business organizations.
**Executive**

**President**
Yasushi Kimura  
Representative Director, Chairman of the Board  
JX Nippon Oil & Energy Corporation

**Vice-President**
Jun Arai  
Representative Director, Chief Operating Officer  
Showa Shell Sekiyu K.K.

**Vice-President**
Jun Mutoh  
Representative Director, President  
TonenGeneral Sekiyu K.K.

**Vice-President**
Keizo Morikawa  
President, Representative Director, Chief Executive Officer  
Cosmo Oil Co., Ltd.

**Vice-President**
Takashi Tsukioka  
Representative Director & Chief Executive Officer  
Idemitsu Kosan Co., Ltd.

**Senior Managing Director**
Hideo Matsui  
Managing Director

**Managing Director**
Junichi Hatano  
Managing Director

**Managing Director**
Nobuo Hata

---

**PAJ Member Companies (14)**

- Idemitsu Kosan Co., Ltd.
- EMG Marketing G.K.
- TonenGeneral Sekiyu K.K.
- Toa Oil Co., Ltd.
- Kashima Oil Co., Ltd.
- Taiyo Oil Co., Ltd.
- Fuji Oil Co., Ltd.
- Cosmo Oil Co., Ltd.
- Kyokuto Petroleum Industries, Ltd.
- Mitsui Oil Co., Ltd.
- Showa Yokkaichi Sekiyu Co., Ltd.
- Showa Shell Sekiyu K.K.
- JX Nippon Oil & Energy Corporation
- Seibu Oil Co., Ltd.

**Former Member & Friend of PAJ (1)**

- Kygnus Sekiyu K.K.

---

**Management and Committees**

- General Assembly  
- Auditor

- Board of Directors  
- Board of Standing Directors

- Committee of Managing Directors  
- Policy Planning Committee

- Policy Planning
- Labor Policy

---

**Associated Organizations**

- PAJ Oil Spill Cooperative (POSCO)

- General Service Committee  
- Countermeasure Committee  
- Technical Group

- Oil Statistics Committee

- Refining  
- Marketing

- Japanese National Committee for ISO TC28*

ISO: International Standardization Organization  
TC: Technical Committee

- JIG Japan

JIG: Joint Inspection Group Limited
Oil Supply and Demand in Japan

Structural Decline in Oil Demand

Total petroleum fuel demand for fiscal year (FY) 2011 was about 196.1 million kiloliters (KL), remaining unchanged from the previous year. Though the total fuel demand had exceeded 200 million KL since FY1988, it fell below the 200 million KL mark after FY2009. Though demand for Heavy Fuel Oil B (HFO-B) and Heavy Fuel Oil C (HFO-C) increased significantly, attributable to an increase in power generation caused by the shutdown of nuclear power plants, the demand for other fuels fell below the previous year’s level.

Though total fuel demand from gasoline to HFO-C had fallen below the 200 million KL level during 1980s after the second oil crisis due to a drastic decrease in demand for HFO-C and naphtha for industrial fuel and feedstock, respectively, other fuels demand increased fairly consistently. This upward trend terminated in 2000. Total fuel demand reached a peak of 246.0 million KL in 1999, and a structural downward trend has continued since 2000. Peak demand volumes by fuel were: 61.5 million KL for gasoline in FY2004 and 30.6 million KL for kerosene in FY2002. As for industrial fuels (HFO-B and HFO-C), the peak volume was 111.0 million KL in FY1973.

Major factors for such structural decline in oil demand in Japan are as follows: ① gathering momentum of the oil use reduction policy, ② changes in social structure, and ③ global warming countermeasures.

① Gathering Momentum of the Oil Use Reduction Policy

After suffering the two oil crises, Japan has promoted the so-called “Oil Use Reduction” policy as a core energy policy for lowering oil dependence in Japan. In particular, such policy measures as enhancing nuclear energy, banning new construction of heavy-fuel-fired power plants, and providing LNG with preferential policy treatment have been strongly taken for reducing the consumption of HFO-B and HFO-C for power generation and industrial use. Consequently, a fuel shift from oil to coal or LNG has been progressing in the industrial, household and commercial sectors.

② Changes in Social Structure

With the changes in the structure of society due to continuous population decline caused by a falling birthrate and an aging population in Japan, the petroleum industry confronts a decline in fuel consumption. For example, a diminishing number of customers lowers the use of gasoline and kerosene, and a stagnant volume of transported goods together with advancement of rationalization and efficiency in the transportation industry reduces the consumption of diesel fuel and Fuel Oil A. Regarding the decrease in gasoline demand for automobiles, it is said that the phenomenon of young adults not using cars, mainly in urban areas, has been increasing.

③ Global Warming Countermeasures

Since the reduction of CO₂ emissions became a global issue, reducing consumption of oil as a fossil fuel has been promoted. In response, oil consumption has been lowered by efficiency improvement of energy consumption such as shifting to other energy sources that emit less CO₂ and improving vehicles’ fuel consumption.

Total fuel oil demand for the first half (Apr~Sep) of FY2012 was 92.2 million KL, 4% up from the previous year (89.0 million KL). On a fuel-by-fuel basis, diesel fuel, HFO-B and HFO-C showed an increase. Especially, the demand for HFO-B and HFO-C showed a dramatic increase (14.0 million KL), by 43% from the same period of the previous year, which was brought about by their increased use for electric power generation due to the Great East Japan Earthquake. The fuel demand for electric power will fluctuate depending on the future operating status of nuclear power plants.

It is projected that structural factors for a downward trend in Japan’s petroleum product demand, excluding HFO-B and HFO-C, will not be changed, excluding temporary impacts such as rapid changes in crude oil prices. However, considering the role played by oil during the Great East Japan Earthquake, it is essential to secure a stable scale of oil demand as well as to improve efficiency in petroleum supply in order to maintain the industry’s supply chain in the future.
Oil Supply and Demand in Japan

For FY2011, the domestic yield of crude oil was a mere 820 thousand KL, equivalent to 0.4%, or 1.5 days, of the 196.7 million KL of Japan’s crude processing volume. Japan; therefore, imports almost all crude oil and petroleum products for meeting domestic petroleum product consumption demand.

There are two methods for covering domestic petroleum product demand: One method is to import petroleum products and the other is to import crude oil and refine it to produce petroleum products locally. The latter method, i.e., crude oil importation and domestic refining, has been adopted in Japan.

The method for refining crude oil within the country is called the “Domestic Petroleum Refining System”. This method has various advantages such as being able to reduce procurement costs by importing a massive amount of crude oil with large-scale tankers, to flexibly change production volume of each petroleum product in line with the domestic demand structure, to adjust product qualities which meet domestic environmental standards, etc., and to provide superior ability to cope with an emergency. Therefore, “Domestic Petroleum Refining System” has been adopted as a core pillar of Japan’s petroleum supply system.

For the past 30 years, domestic petroleum demand has been more or less consistently declining and, at the same time, demand for so-called “lighter products” such as gasoline, naphtha and kerosene has been increasing. Oil companies, therefore, have made efforts to follow trends in supply and demand by constructing heavy oil cracking units for increasing output of “lighter products” so as to maintain the balance between supply and demand.

With the advancement of internationalization, oil companies in recent years have tried to use product import and export more flexibly from a strategic viewpoint.

**Crude Oil Import**

The crude import volume by region in FY2011 showed that Middle Eastern oil producing countries accounted for 85.1%. Oil dependency on the Middle East had once dropped to 68% in FY1987 after the oil...
### Changes in Crude Processing Capacity and Capacity Utilization Ratio

<table>
<thead>
<tr>
<th>Year (FY)</th>
<th>Crude Processing Capacity (1,000 bbl/day)</th>
<th>Utilization Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>5,940</td>
<td>5,410</td>
</tr>
<tr>
<td>1975</td>
<td>5,940</td>
<td>85.2</td>
</tr>
<tr>
<td>1980</td>
<td>5,940</td>
<td>70.7</td>
</tr>
<tr>
<td>1985</td>
<td>5,940</td>
<td>66.0</td>
</tr>
<tr>
<td>1990</td>
<td>4,973</td>
<td>62.3</td>
</tr>
<tr>
<td>1995</td>
<td>4,552</td>
<td>77.3</td>
</tr>
<tr>
<td>2000</td>
<td>5,221</td>
<td>79.4</td>
</tr>
<tr>
<td>2005</td>
<td>5,274</td>
<td>79.2</td>
</tr>
<tr>
<td>2007</td>
<td>4,767</td>
<td>87.2</td>
</tr>
<tr>
<td>2008</td>
<td>4,796</td>
<td>82.9</td>
</tr>
<tr>
<td>2009</td>
<td>4,856</td>
<td>82.7</td>
</tr>
<tr>
<td>2010</td>
<td>4,895</td>
<td>78.9</td>
</tr>
<tr>
<td>2011</td>
<td>4,973</td>
<td>74.5</td>
</tr>
<tr>
<td>2012(FY)</td>
<td>4,846</td>
<td>77.7</td>
</tr>
</tbody>
</table>

Source: PAJ

### Petroleum Product Domestic Demand by Usage (FY2011)

<table>
<thead>
<tr>
<th>Usage</th>
<th>Product (Fuel Oil)</th>
<th>Domestic</th>
<th>Export</th>
<th>Total Demand</th>
<th>Closing Inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td>Gasoline</td>
<td>57,136</td>
<td>31,798</td>
<td>2,318</td>
<td>638</td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>91,891</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aviation</td>
<td>Gasoline</td>
<td>3</td>
<td>4,204</td>
<td>4,208</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4,208</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation &amp; Marine</td>
<td>Gasoline</td>
<td>1,602</td>
<td>532</td>
<td>2,134</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2,134</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture &amp; Fisheries</td>
<td>Gasoline</td>
<td>13,883</td>
<td>5,662</td>
<td>19,545</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>19,545</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining &amp; Manufacturing</td>
<td>Gasoline</td>
<td>74</td>
<td>4,134</td>
<td>4,881</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4,881</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City Gas</td>
<td>Gasoline</td>
<td>1,833</td>
<td>1,833</td>
<td>3,666</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3,666</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric Power</td>
<td>Gasoline</td>
<td>255</td>
<td>14,983</td>
<td>15,238</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>15,238</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household &amp; Commercial</td>
<td>Gasoline</td>
<td>196,019</td>
<td>196,044</td>
<td>392,063</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>392,063</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical Feedstock</td>
<td>Gasoline</td>
<td>43,728</td>
<td>235</td>
<td>43,963</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>43,963</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Gasoline</td>
<td>57,214</td>
<td>4,204</td>
<td>57,618</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naphtha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jet Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kerosene</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diesel Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy Fuel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LP Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lube Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>57,618</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: PAJ

### Petroleum Supply and Demand (FY2012)

<table>
<thead>
<tr>
<th>Item</th>
<th>FY 2010</th>
<th>FY 2011</th>
<th>FY 2012</th>
<th>%vs.Pre. Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Import</td>
<td>214,357</td>
<td>209,173</td>
<td>211,026</td>
<td>100.9</td>
</tr>
<tr>
<td>Processed</td>
<td>208,572</td>
<td>196,720</td>
<td>197,359</td>
<td>100.3</td>
</tr>
<tr>
<td>Opening Inventory</td>
<td>10,533</td>
<td>10,483</td>
<td>10,108</td>
<td>96.4</td>
</tr>
<tr>
<td>Production</td>
<td>195,157</td>
<td>185,440</td>
<td>185,283</td>
<td>99.9</td>
</tr>
<tr>
<td>Import</td>
<td>33,100</td>
<td>37,368</td>
<td>38,916</td>
<td>104.1</td>
</tr>
<tr>
<td>Total Supply</td>
<td>228,257</td>
<td>222,808</td>
<td>224,199</td>
<td>100.6</td>
</tr>
<tr>
<td>Domestic</td>
<td>196,019</td>
<td>196,044</td>
<td>197,520</td>
<td>100.8</td>
</tr>
<tr>
<td>Export</td>
<td>30,285</td>
<td>25,347</td>
<td>24,751</td>
<td>97.7</td>
</tr>
<tr>
<td>Total Demand</td>
<td>226,303</td>
<td>221,391</td>
<td>222,271</td>
<td>100.4</td>
</tr>
<tr>
<td>Closing Inventory</td>
<td>10,483</td>
<td>10,108</td>
<td>11,043</td>
<td>109.3</td>
</tr>
</tbody>
</table>

Source: METI
crises; however, the dependency rose again in the 1990s, because non-Middle Eastern oil producing countries such as China and Mexico gradually reduced their export of crude oils in accordance with economic growth in their countries.

Regarding crude oil imports by country, four countries, namely Saudi Arabia (31.1% of total import volume), the United Arab Emirates (22.5%), Qatar (10.2%) and Iran (7.8%), accounted for about 70% of Japan's total crude import volume.

It is extremely important for Japan to maintain and enhance positive relationships with those Middle Eastern countries. However, some of these countries are not always problem-free in terms of their domestic political situations or their relations with the international community. It would have to be said that this is a vulnerable aspect of Japan’s petroleum supply structure.

For Japan, which adopts the “Domestic Petroleum Refining System”, petroleum product import plays a supplemental role. Regarding naphtha, however, about 60% of its domestic demand is served by imported products, because petrochemical companies in Japan independently import naphtha as a petrochemical feedstock. In addition, as domestically refined fuels that are supplied to ocean-going vessels in Japan are classified as exports, such export volume accounts for a large portion in the supply volume of HFO-B and HFO-C. Likewise, the volume of jet fuel that is supplied to international aircraft is regarded as an export, and nearly double its domestic demand is recorded as an export.

In recent years, the export volume of diesel fuel is increasing year by year, though the future trend is uncertain.

### Crude Oil Imports by Source

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>Saudi Arabia 19.9</td>
<td>UAE 10.8</td>
<td>Iran 31.0</td>
<td>Kuwait 8.2</td>
<td>Indonesia 14.7</td>
<td>Neutral Zone 5.3</td>
<td>Others 0.4</td>
<td>Nigeria 1.8</td>
<td>Vietnam 1.9</td>
<td>others 3.5</td>
</tr>
<tr>
<td>1995</td>
<td>Saudi Arabia 19.2</td>
<td>UAE 21.4</td>
<td>Iran 10.7</td>
<td>Kuwait 5.0</td>
<td>Indonesia 6.4</td>
<td>Vietnam 1.9</td>
<td>Others 0.3</td>
<td>Oman 6.1</td>
<td>China 6.5</td>
<td>Others 1.1</td>
</tr>
<tr>
<td>2000</td>
<td>Saudi Arabia 21.6</td>
<td>UAE 25.6</td>
<td>Qatar 9.6</td>
<td>Indonesia 7.4</td>
<td>Neutral Zone 1.7</td>
<td>Others 0.3</td>
<td>Oman 6.1</td>
<td>China 6.5</td>
<td>Others 1.1</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Saudi Arabia 29.2</td>
<td>UAE 24.5</td>
<td>Qatar 9.4</td>
<td>Kuwait 7.2</td>
<td>Neutral Zone 2.0</td>
<td>Others 0.2</td>
<td>Oman 4.6</td>
<td>China 6.5</td>
<td>Others 1.1</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Saudi Arabia 29.2</td>
<td>UAE 20.9</td>
<td>Qatar 11.6</td>
<td>Kuwait 7.0</td>
<td>Neutral Zone 1.9</td>
<td>Neutral Zone 2.0</td>
<td>Others 0.4</td>
<td>Indonesia 3.5</td>
<td>Oman 2.7</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>Saudi Arabia 31.1</td>
<td>UAE 22.3</td>
<td>Qatar 15.2</td>
<td>Kuwait 7.0</td>
<td>Neutral Zone 2.1</td>
<td>Neutral Zone 2.0</td>
<td>Others 0.9</td>
<td>Indonesia 3.5</td>
<td>Oman 2.8</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>Saudi Arabia 30.4</td>
<td>UAE 22.1</td>
<td>Qatar 11.4</td>
<td>Kuwait 7.4</td>
<td>Neutral Zone 2.1</td>
<td>Neutral Zone 2.0</td>
<td>Others 1.6</td>
<td>Vietnam 2.7</td>
<td>Oman 2.8</td>
<td></td>
</tr>
</tbody>
</table>

Source: METI
### Crude Oil Imports by Supplier

<table>
<thead>
<tr>
<th>Year (FY)</th>
<th>National Oil Companies of Oil-producing Countries</th>
<th>Japanese Oil Development Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>Oil Majors: 74.1%</td>
<td>Independent Oil Companies: 8.5%</td>
</tr>
<tr>
<td>1975</td>
<td>70.0%</td>
<td>7.7%</td>
</tr>
<tr>
<td>1980</td>
<td>44.5%</td>
<td>3.3%</td>
</tr>
<tr>
<td>1985</td>
<td>26.1%</td>
<td>3.7%</td>
</tr>
<tr>
<td>1990</td>
<td>27.8%</td>
<td>1.9%</td>
</tr>
<tr>
<td>1995</td>
<td>23.9%</td>
<td>1.5%</td>
</tr>
<tr>
<td>2000</td>
<td>22.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>2005</td>
<td>18.8%</td>
<td>1.8%</td>
</tr>
<tr>
<td>2010</td>
<td>17.8%</td>
<td>3.1%</td>
</tr>
<tr>
<td>2011</td>
<td>18.4%</td>
<td>3.6%</td>
</tr>
<tr>
<td>2012</td>
<td>16.6%</td>
<td>6.3%</td>
</tr>
</tbody>
</table>

Source: METI

### Crude Oil Import Trends and Dependence on OPEC and Middle East

- **Crude Oil Import Volume**
- **Dependence on OPEC**
- **Dependence on Middle East**

Source: METI
Oil Supply and Demand in Japan

**Major Petroleum Products by Importing & Exporting Country**

### Import 2011

- **Gasoline:** 2905, Republic of Korea 90.3%
- **Kerosene:** 1486, Singapore 20.7%
- **Diesel Fuel:** 875, Republic of Korea 98.0%
- **Heavy Fuel:** 7235, Republic of Korea 71.2%

### Export 2011

- **Gasoline:** 600, Singapore 62.3%
- **Kerosene:** 7614, Singapore 30.3%
- **Diesel Fuel:** 7135, Singapore 30.3%
- **Heavy Fuel:** 735, Singapore 30.3%

### Import 2012

- **Gasoline:** 2884, Singapore 3.3%
- **Kerosene:** 1250, Singapore 6.2%
- **Diesel Fuel:** 583, Republic of Korea 100.0%
- **Heavy Fuel:** 8293, Malaysia 57.0%

### Export 2012

- **Gasoline:** 1148, Singapore 56.8%
- **Kerosene:** 410, Singapore 26.6%
- **Diesel Fuel:** 7935, Singapore 18.1%
- **Heavy Fuel:** 8293, Malaysia 57.0%

Source: METI
Japan’s energy policies have changed in response to the diverse requirements of the times. As more than 40 years have passed since the first oil crisis in 1973, it is now necessary not only to secure a stable oil supply but also to promote fair competition, liberalization, and efficiency improvement through deregulation and other measures as well as to consider global environmental issues.

Taking into account changes in the recent energy situation, the Basic Act on Energy Policy, enacted in June 2002, aims at advancing various measures in a comprehensive manner to indicate the broad future direction of energy policy in Japan. This law illustrates the following three basic principles of energy policy (the “3E”): “Energy security through stable supply”, “Environmental consideration”, and “Efficient supply using market mechanisms upon due consideration of the first two principles.” It stipulates the roles and responsibilities of the central government, local governments, and others. The law also provides that taking into account the next decade or so, the Basic Energy Plan should stably map out the basic direction of various measures on energy supply and demand in line with these 3E principles.

The petroleum industry has consistently advocated the following opinions for the simultaneous achievement of the energy policy’s three basic principles (3E): 1. Achieve “the optimum energy mix” suitable for Japan by evaluating the characteristics of each energy source fairly and objectively. 2. Promote effective and efficient use of oil, which constitutes the largest share of the primary energy supply. 3. Emphasize the feasibility of launching nuclear power and renewables such as biomass. 4. Provide an equal footing regarding competitive conditions on taxation, stockpiling obligations, etc. among all energy sources in order to achieve “the optimum energy mix.”

As a result of industry advocacy efforts, the terms “Oil Use Reduction Policy” and “Lesser Dependency on the Middle East”, conventional objectives of Japan’s basic energy policy, were eliminated from the Basic Energy Plan established in October 2003. The plan re-emphasized the significance of oil by stating “oil will remain an important energy source in the future from the viewpoints of economic efficiency and convenience.”

Upon compilation of the Basic Energy Plan, a report titled “Energy Supply and Demand Outlook toward 2030” was drawn up in October 2004. The following points were clearly stated in this report:
1. Oil will remain the central player in primary energy supply in 2030.
2. The introduction of IGCC (Integrated Gasification Combined Cycle) fueled by residuals should be promoted to enhance efficient utilization of oil resources.
3. The whole concept of oil substitution policy, as well as the definition of “new energies” in the energy policy will be reexamined.

After the G8 Hokkaido Toyako Summit in 2008, arguments for developing a low-carbon society have been spreading in the nation. Movements regarding global environmental issues in foreign countries have also become active. Those movements are pressing the energy industry for drastic changes. It is requested to develop future energy policies considering the simultaneous settlement of the global warming issue in addition to ensuring energy security to cope with the recent violent fluctuations of crude oil prices.

Under these circumstances the Ministry of Economy, Trade and Industry (METI) started deliberations, from October 2008, on the reexamination of its alternative energy policy and the increased use of nonfossil energy sources. Unstable conditions have continued such as a steep rise in prices of all fossil fuels
including oil in 2008, but a drop in the prices due to worldwide financial instability after autumn. In these deliberations, therefore, the vulnerability of Japan’s energy supply structure has been pointed out; for example, its dependency on offshore fossil fuels for over 80% of its supply. In addition, the following proposals were emphasized: (1) the importance of taking medium and long term measures such as global warming countermeasures and formation of a low-carbon society and (2) the necessity for reexamining energy policies, taking into account the Basic Act on Energy Policy (a unified settlement of 3E).

The petroleum industry has been arguing in favor of the following opinions through the deliberations of the council meetings:

1. Oil should be regarded as a core energy, not as a buffer energy, since oil will remain the major energy (40% of primary energy supply) even in 2030.
2. The Alternative Energy Law should be abolished and new legislation should be established to allow sophisticated use of all energies through innovative technologies for securing stable supply as well as efficient and clean use of oil resources.
3. An equal footing of competitive conditions such as taxation and subsidies among energy sources should be provided to achieve the optimum mix of energy sources.

In consequence, as the basic policy for Japan to realize “a low-carbon society”, the points below were indicated in the report compiled in January 2009:

1. To reexamine the alternative energy policies for which the purpose is merely restraining oil usage
2. To conduct an objective assessment of each energy’s characteristics based on the basic principles of the Basic Act on Energy Policy and to enhance the corresponding development of an sophisticated energy supply structure
3. To give consideration to the impartiality of competitive conditions among energy sources

The petroleum industry considers these points to be extremely significant.

With the compilation of the report, the concept of “oil substitution” in the policy measures of the Alternative Energy Law, which aims only at reducing reliance on oil, was reexamined and this concept was eliminated in the revised law. Thereafter, a new law, the Law Concerning Sophisticated Methods of Energy Supply Structures, which incentivizes energy suppliers to take such measures as listed below, was enacted in July 2009:

1. To promote innovative energy technologies and non-conventional resource development
2. To expand the use of nonfossil energy resources (nuclear, hydraulic, geothermal, new energy sources, etc.)
3. To enhance the sophisticated and effective use of fossil resources (crude oil, natural gas, coal, etc.)

This new law is intended to urge energy suppliers (electric power, city gas and oil) to expand the use of nonfossil energy resources as well as to promote effective use of fossil resources. Specifically, the notification of the criteria for judgment concerning the promotion of the effective use of fossil energies was given in July 2010. Aiming to raise the installation ratio of Japan’s heavy oils cracking units (currently about 10%) to about 13% by FY2013, each oil refiner is obliged to attain the facility improvement in three stages depending on the current installation ratio. This leads to new or additional installation of heavy oils cracking units, or the reduction of crude distillation units to raise the installation ratio. In addition to these, each refiner is going to work on technology development such as improvements in facility operations.

Restructuring of Japan’s Energy Policies ~Energy Policies after the Great East Japan Earthquake~

In recent years, the global energy conditions such as the steep rise in crude oil prices have become increasingly severe. The international energy market is facing significant structural changes such as the rapid growth of energy demand in Asian countries and the rising tide of resource nationalism.

In addition, energy prices have fluctuated widely as the situation was made worse by various factors such as natural disasters including damage from an earthquake and a hurricane, reexamination of the safeness of energy in light of the Fukushima nuclear power plant accident, inflows of speculative money, terrorist activities and uncertainties in the Middle East like the issue of Iran’s nuclear development. Amid mounting international concern over energy security, many
countries are gearing up for the restructuring of their national energy strategies.

In the context of these circumstances, while the government pursues energy policies stipulated in the second revision of the Basic Energy Plan in June 2010, Japan faces unprecedented situations brought about by the Great East Japan Earthquake and Fukushima No. 1 nuclear power plant accident which occurred on March 11, 2011.

Under these circumstances, the government adopted “The Guideline on Policy Promotion ~For the Revitalization of Japan~” which shows Japan’s revitalization policy, at the cabinet meeting on May 17, 2011, to provide reconstruction support for the eastern Japan region, in addition to dealing with various pre-quake issues facing Japan, and to start its efforts for revitalizing Japan. This guideline specifies that correcting the distorted and vulnerable energy supply structures, implementing innovative strategies for energy and environment on a short-, medium- and long-term basis in order to comply with requests for overcoming limited power supply and strengthening safety measures, and enhancing safe, stable and efficient energy supply in line with environmental concerns shall be deliberated at the Council on the Realization of the New Growth Strategy.

In response, the following three points were confirmed again at the council’s meeting on June 7:

1. Japan is in a situation to reexamine with a clean slate the existing Basic Energy Plan that aimed for 50% dependency on nuclear power generation in primary energy supply by 2030.
2. It is always an important issue for all nations to select energy sources for achieving economic growth and the stability of their citizens’ lives.
3. Japan needs to speed up its new consensus building by reexamining its energy and environmental strategy from scratch.

It was also decided to establish the Energy and Environment Council, headed by the Minister for National Policy, to rethink the nation’s energy and environment strategies without exceptions across all government agencies and ministries.

The Energy and Environment Council issued the “Interim Compilation of Discussion Points for Formulation of Innovative Strategy for Energy and the Environment” in July and decided the broad direction by illustrating the scenarios of lowering the dependence on nuclear power and shifting to a distributed energy system. Based on this direction and the basic policy, deliberations on (1) the Green Growth Strategy, (2) validation of the power generation cost of each energy source including nuclear power, etc., (3) the new Basic Energy Plan (optimum energy mix), (4) countermeasures against global warming, and (5) issues on nuclear energy policy were conducted.

Taking into account the argument points and the deliberation results at those meetings, the Energy and Environment Council decided the “Basic Policy toward Presenting Options on Energy and Environment Strategies” in December. Following this policy, redesign of the energy and environment strategy was specified in the “Strategy for Rebirth of Japan” adopted at the cabinet meeting on December 24.

After that, especially such policies as the nuclear fuel cycle, energy mix, and countermeasures against global warming were energetically reviewed. In June 2012 the following scenarios were presented as the necessary options for the discussion by the public to select energy for the future:

1. Zero nuclear power scenario: Make the ratio of energy dependency on nuclear power zero at the earliest possible date or by 2030 at the latest
2. 15% nuclear power scenario: Steadily reduce the nuclear power ratio and make its dependency about 15% in 2030, as well as to lower fossil fuel dependency so as to smoothly meet the request for decreasing CO2 emissions
3. 20-25% nuclear power scenario: Modestly lower the nuclear power dependency and maintain its ratio at about 20 to 25% in 2030

As for these options, a national debate was carried out, though in a short period of time, by means of having public comments, hearings of opinions, deliberative polls, etc. Taking into account the national debate, the Innovative Strategy for Energy and Environment was compiled at the Energy and Environment Council in September 2012. In this strategy, such measures as follows were stipulated: (1) realize a non-nuclear-power-dependent society as soon as possible, (2) realize the green energy revolution, (3) ensure the stable supply of energy, (4) carry through the Electric
System Reform such as unbinding integrated power companies and full liberalization of power generation and retailing, and (5) steadily execute global warming countermeasures. Responding to this strategy, it was decided to compile the Framework for Green Development Policy, the Strategy on Electricity System Reform, and the plans for Global Warming Countermeasures, etc.

In response to the change in political administration after that, the deliberation of the new energy policy is awaited. Since a nation’s energy policy is an issue that directly impacts people’s lives as well as business activities, the petroleum industry, which assumes the largest share of the primary energy supply, expects that the new administration will quickly develop and execute a down-to-earth strategy for mapping out the direction of future energy policy.

### Reexamination of Japan’s Petroleum Policies

In reaction to the Great East Japan Earthquake, petroleum policies were partially reexamined.

In particular, for securing a stable supply of oil as the superior energy source due to its disaster response capabilities, such topics to be tackled in advance were studied at the Round-table Session of Experts on the Policies of Resource and Fuels. At the round-table session, it was reported that in the Great East Japan Earthquake, many requests from various quarters were made for oil as a distributed energy in the situation where the system energies’ supply (electricity and city gas) was suspended. It was determined that oil, which could meet such supply requests, played the role of the “last resort of energy” for protecting people’s lives. It was also decided, as a reinforced measure for a thoroughgoing oil supply chain in a time of disaster, to formulate a joint disaster preparedness system among oil and LPG companies by strengthening disaster response capabilities at oil terminals and service stations as well as to develop a system for data gathering and information service on oil and LPG reserves, etc. With Petroleum Association of Japan (PAJ)’s advocacy efforts, the following opinions were incorporated into the deliberation:

- Clarification of role sharing between public and private sectors, and enhancement of their collaboration
- Preparation for a system for information gathering
- Enhancement of disaster response capability at oil terminals
- Necessity for stable oil demand to maintain a sound supply chain in addition to the expansion of government oil product stockpiling

Responding to the commencement of the deliberation about the direction of reform for Japan’s optimum energy mix and energy policy at the Basic Issue Committee of the Advisory Committee on Energy and Natural Resources in October 2011, the petroleum industry insisted on and made the proposal for the importance of oil as a core energy five times. Under such circumstances, the Innovative Strategy for Energy and Environment was compiled in September 2012; however, it mainly focused on nuclear energy and renewable energy. In this report, oil was not sufficiently evaluated in line with its importance, but also the following measures were illustrated: (1) banning, in principle, the use of heavy fuel-fired boilers and (2) limiting the traffic of gasoline-powered cars, etc., in central urban districts. It is very regrettable that these measures were unrealistic, because these impair the oil supply chain and jeopardize emergency response capabilities.

On the other hand, it is highly commendable that the report titled “the Prioritized Policy Measures on Energy in the Future”, which was deliberated as the framework of the Basic Energy Plan at the meeting of the 30th Basic Issue Committee of the Advisory Committee on Energy and Natural Resources, indicated the importance of oil for effectiveness in disaster response and specified such measures as (1) realization of the electricity source mix including oil-fired power generation and (2) strengthening the international competitiveness and the management base of the oil refining industry.

Furthermore, deliberation is expected to begin at an early date about the concrete measures for securing a stable scale of oil demand, replacing old oil-fired power generation facilities with new ones, and making regulatory reform of the natural gas business, which can all lead toward a borderless energy environment.

The necessity of oil and its superiority as an energy supply due to its disaster response capabilities won’t
be changed in the future. Considering the efficient use of oil, PAJ continues to advocate the optimum energy mix for Japan which can most benefit affected people.

Final energy consumption for FY2011 showed a 2.9% decrease from the previous year, due to declining production, energy saving, etc. In comparison with the previous year by sector are: 4.9% down for the industrial sector, 1.4% down for the household and civil sector, and 1.3% down for the transportation sector.

Though the total final energy consumption for FY2010 showed an increase versus the previous year after six years of decline since FY2004, its consumption for FY2011 declined again.

On the other hand, the total domestic primary energy supply was 21,108 petajoules (PJ), or 544.6 million KL in crude oil equivalent, down by 4.3% versus the previous year; of which oil was 9,089 PJ, or 234.5 million KL in crude oil equivalent, an increase of 2.9% versus the previous year.

The supply ratios in the total primary energy supply are: nuclear power decreased from 11.3% to 4.2% and coal decreased from 22.5% to 22.1%, while oil
increased from 40.1% to 43.1% and natural gas increased from 19.2% to 23.2%. Due to the drastic decline in the energy supply from nuclear power, the energy supply from natural gas and oil increased. However, even the ratio of natural gas, the second largest primary energy source following oil, is just half that of oil. Stable oil supply, therefore, is absolutely essential for ensuring energy security in Japan even in the future.

At the time of the Great East Japan Earthquake when no electricity and city gas were available, oil played an active role as the energy source for reconstructing the disaster areas as well as for a stable electricity power supply. Especially, oil-fired power generation fulfills the role of a backup electric source in such emergencies as power outages of other electricity sources, extremely hot summer weather and severe winters. It is essential to make the position of oil-fired power generation, the last resort of a system power source for stable electricity supply, and it is also important to secure a stable scale of oil demand during ordinary times by achieving a well-balanced electricity supply composition. In addition, in such segments as heating and hot-water supply, usage of oil, as a distributed energy which has strong disaster response capabilities, should be maintained and promoted as a substitutable energy for electricity.

### Long-term Final Energy Consumption Outlook by Sector

<table>
<thead>
<tr>
<th>Energy Category</th>
<th>Final Energy Consumption</th>
<th>(FY)</th>
<th>1990</th>
<th>2005</th>
<th>2011</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Energy Domestic Supply</td>
<td>359</td>
<td>100%</td>
<td>413</td>
<td>100%</td>
<td>375</td>
<td>100%</td>
<td>421</td>
</tr>
<tr>
<td>Industry</td>
<td>181</td>
<td>50%</td>
<td>181</td>
<td>44%</td>
<td>161</td>
<td>43%</td>
<td>180</td>
</tr>
<tr>
<td>Household &amp; Commercial</td>
<td>95</td>
<td>27%</td>
<td>134</td>
<td>32%</td>
<td>127</td>
<td>34%</td>
<td>149</td>
</tr>
<tr>
<td>• Household</td>
<td>43</td>
<td>12%</td>
<td>56</td>
<td>14%</td>
<td>53</td>
<td>14%</td>
<td>61</td>
</tr>
<tr>
<td>• Commercial, etc.</td>
<td>52</td>
<td>16%</td>
<td>78</td>
<td>19%</td>
<td>74</td>
<td>20%</td>
<td>88</td>
</tr>
<tr>
<td>Transportation</td>
<td>83</td>
<td>23%</td>
<td>98</td>
<td>24%</td>
<td>87</td>
<td>23%</td>
<td>92</td>
</tr>
</tbody>
</table>

### Long-term Primary Energy Supply Outlook

<table>
<thead>
<tr>
<th>Energy Category</th>
<th>Primary Energy Domestic Supply</th>
<th>(FY)</th>
<th>1990</th>
<th>2005</th>
<th>2011*</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>265</td>
<td>52%</td>
<td>255</td>
<td>43%</td>
<td>219</td>
<td>40%</td>
<td>227</td>
</tr>
<tr>
<td>LP Gas</td>
<td>19</td>
<td>4%</td>
<td>18</td>
<td>3%</td>
<td>17</td>
<td>3%</td>
<td>18</td>
</tr>
<tr>
<td>Coal</td>
<td>85</td>
<td>17%</td>
<td>123</td>
<td>21%</td>
<td>120</td>
<td>22%</td>
<td>128</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>54</td>
<td>11%</td>
<td>88</td>
<td>15%</td>
<td>127</td>
<td>23%</td>
<td>114</td>
</tr>
<tr>
<td>Nuclear Power</td>
<td>49</td>
<td>10%</td>
<td>69</td>
<td>12%</td>
<td>23</td>
<td>4%</td>
<td>99</td>
</tr>
<tr>
<td>Hydropower</td>
<td>22</td>
<td>4%</td>
<td>17</td>
<td>3%</td>
<td>19</td>
<td>3%</td>
<td>19</td>
</tr>
<tr>
<td>Geothermal</td>
<td>0</td>
<td>0%</td>
<td>1</td>
<td>0%</td>
<td>1</td>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td>New Energy</td>
<td>13</td>
<td>3%</td>
<td>16</td>
<td>3%</td>
<td>21</td>
<td>4%</td>
<td>22</td>
</tr>
</tbody>
</table>

* actual figure

Source: METI: The Long-term Energy Supply and Demand Outlook, in August 2009
### Primary Energy Supply Trends

**Unit:** million kl crude oil equivalent, %

<table>
<thead>
<tr>
<th>(FY)</th>
<th>Nuclear Power</th>
<th>Coal</th>
<th>Natural Gas</th>
<th>New Energy</th>
<th>Geothermal Power &amp; New Energies</th>
<th>Hydroelectric Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>0.6</td>
<td>15.5</td>
<td>1.5</td>
<td>1.0</td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td>1975</td>
<td>2.5</td>
<td>16.4</td>
<td>5.3</td>
<td>5.2</td>
<td></td>
<td>1.1</td>
</tr>
<tr>
<td>1980</td>
<td>6.1</td>
<td>16.9</td>
<td>4.7</td>
<td>5.2</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>1990</td>
<td>10.2</td>
<td>16.7</td>
<td>9.3</td>
<td>4.1</td>
<td></td>
<td>2.6</td>
</tr>
<tr>
<td>2000</td>
<td>9.3</td>
<td>18.1</td>
<td>13.0</td>
<td>12.2</td>
<td></td>
<td>3.3</td>
</tr>
<tr>
<td>2010</td>
<td>17.3</td>
<td>21.6</td>
<td>10.8</td>
<td>10.8</td>
<td></td>
<td>3.1</td>
</tr>
<tr>
<td>2011</td>
<td>21.4</td>
<td>21.3</td>
<td>4.0</td>
<td>3.3</td>
<td></td>
<td>3.8</td>
</tr>
</tbody>
</table>

**Source:** METI

### Final Energy Consumption Trends

**Unit:** million kl crude oil equivalent

<table>
<thead>
<tr>
<th>(FY)</th>
<th>Industrial</th>
<th>Civil</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>188</td>
<td>52</td>
<td>47</td>
</tr>
<tr>
<td>1975</td>
<td>168</td>
<td>53</td>
<td>50</td>
</tr>
<tr>
<td>1980</td>
<td>165</td>
<td>61</td>
<td>59</td>
</tr>
<tr>
<td>1990</td>
<td>180</td>
<td>95</td>
<td>83</td>
</tr>
<tr>
<td>2000</td>
<td>186</td>
<td>125</td>
<td>101</td>
</tr>
<tr>
<td>2010</td>
<td>169</td>
<td>128</td>
<td>89</td>
</tr>
<tr>
<td>2011</td>
<td>161</td>
<td>127</td>
<td>87</td>
</tr>
</tbody>
</table>

**Source:** METI

### Trends of Electricity Generated Output by Source

**Unit:** 100 mil kWh, %

<table>
<thead>
<tr>
<th>(FY)</th>
<th>Nuclear Power &amp; New Energies</th>
<th>Hydraulic Power</th>
<th>Natural Gas</th>
<th>Oils</th>
<th>Coal</th>
<th>Nuclear Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** FEPC* (*Federation of Electric Power Companies*)

---

**Notes:**
- Primary Energy Supply Trends: The chart illustrates the percentage distribution of energy sources from 1973 to 2011, with a focus on nuclear power, coal, and natural gas.
- Final Energy Consumption Trends: This chart shows the distribution of energy consumption across different sectors (Industrial, Civil, Transportation) from 1973 to 2011, with a clear emphasis on the decrease in nuclear power and the increase in other sources.
- Trends of Electricity Generated Output by Source: The chart provides a detailed breakdown of electricity generated from various sources over the years, indicating a shift away from nuclear power and towards new and renewable energy sources.
Oil Stockpiling and New Emergency Response Measures

Background of Japan’s Oil Stockpiling System

In response to OECD advice in 1962, which obliged member countries to hold oil stockpiling at a 60-day equivalent to the nation’s oil demand, the Energy Committee under the Industrial Structure Council made a proposal in December 1963 for the necessity of oil stockpiling, stating that “holding a certain level of oil stockpiling meets the requirement for energy supply security as a transitional measure to rectify a supply and demand imbalance until converting to alternative supply sources at a time of temporary supply shortage.”

At the outbreak of the third Middle East War in 1967, Japan’s oil dependency reached 65% of the primary energy supply. With a rapid rise in risk awareness in Japan, the Petroleum Subcommittee of the Advisory Committee for Natural Resources and Energy compiled its interim report, which indicates the necessity for establishment of the petroleum special account as a subsidy measure from financial aspects in order to achieve 60-day oil stockpiling by the end of FY1974. Accordingly, the oil stockpiling system in Japan virtually started from FY1972. At that time, the government made the decision that holding of oil stockpiling by the private sector with governmental subsidies was appropriate, and the following measures were taken:

1. Long-term low-interest loans for purchasing crude oil for stockpiling
2. Japan Development Bank loans for constructing oil reserve facilities
3. Accelerated depreciation deductions for oil storage tanks

The first oil crisis occurred in 1973. As oil constituted about 77% of the primary energy supply at that time, people’s lives were severely impacted. For this reason, the interim report of the Petroleum Subcommittee of the Advisory Committee for Natural Resources and Energy, compiled in 1974, specified that “it is needless to say a level of 60-day oil stockpiling should be held; on top of this, the level should be built up to 90 days in a planned manner to develop a reinforced oil stockpiling system through joint efforts of the public and private sectors.”

With the promulgation of the Petroleum Reserve Law in 1975, such measures by the government were legislated as (1) setting the stockpiling target, (2) putting an obligation on refiners, marketers and importers of petroleum to hold oil stockpiling at least above the level of their basic obligation volumes, and (3) lowering the basic obligation volume, especially when it is considered to be necessary to secure a stable supply of oil in the event of an oil supply shortage in Japan.

In addition, various measures were taken such as providing more low-interest loans (expanding interest subsidies), raising the loan ratio of the Japan Development Bank’s loan for oil storage facilities, establishing the capital subscription scheme to the joint stockpiling companies from Japan Petroleum Development Corporation, currently JOGMEC (Japan Oil, Gas and Metals National Corporation) in order to lessen the burden of the enormous cost of funds associated with the buildup of stockpiles. After coping with the second oil crisis in 1979, the 90-day equivalent oil stockpiling system (the private sector’s 90-day equivalent volume obligation) was established in April 1981.

With recognition of the need for the government itself to take an initiative in maintaining the oil stockpile, government stockpiling by Japan National Oil Corporation (currently JOGMEC) was started in 1978. The target volumes of the government oil reserve were achieved: 30 million kiloliters (KL) in February 1989, and 50 million KL in February 1998. During this 20 years period, 10 national oil stockpiling bases were constructed across the country.

In accordance with the expansion of government stockpiling, the private sector stockpiling was reduced by 4 days each year from 1989 to 1993, and since then a 70-day equivalent oil stockpiling system (the private sector’s 70-day equivalent volume obligation) has been maintained.

Oil Stockpiling System after Deregulation

As a result of the abolition of the Provisional Measures Law on the Importation on Specific Refined Petroleum Products (Fuel Import Restriction Law) in 1996, the Petroleum Reserve Law was amended to stipulate the requirements for new entrants of oil
1. Notification requirements for business commencement of oil refiners, distributors and retailers; clarification of registration requirements for oil importers.

2. Clarification of the provisions concerning a release order of the government oil stockpiles by the minister of the Ministry of Economy, Trade and Industry (METI).

### Overview of Past Emergency Periods

<table>
<thead>
<tr>
<th>Event</th>
<th>1st Oil Crisis</th>
<th>2nd Oil Crisis</th>
<th>Gulf Crisis</th>
<th>Hurricane Katrina</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>Crude oil supply cut due to oil export suspension by Arab countries at the outbreak of the 4th Middle East War</td>
<td>Suspension of Iranian crude export and interruption of tanker traffic in the Gulf due to the Iranian Revolution</td>
<td>Invasion of Kuwait by Iraq resulted in economic sanctions, and escalated into the Gulf War</td>
<td>Damage to oil-related facilities in the Gulf of Mexico area in the USA due to the destructive hurricane Katrina</td>
</tr>
<tr>
<td><strong>Crude Oil Import Vol.</strong></td>
<td>228.6 Million kl</td>
<td>277.1 Million kl</td>
<td>238.5 Million kl</td>
<td>241.8 Million kl</td>
</tr>
<tr>
<td><strong>Ratio of Crude Import Amount to Japan Total Imports</strong></td>
<td>23%</td>
<td>43%</td>
<td>19%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Crude Oil Dependence on Middle East</strong></td>
<td>77.5%</td>
<td>75.9%</td>
<td>71.5%</td>
<td>89.5%</td>
</tr>
<tr>
<td><strong>Events of the Period and Government Responses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1st Oil Crisis</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Hoarding of toilet paper, etc.</em></td>
<td><em>Partial release of private oil stockpiles (Apr ’79–Aug ’80)</em></td>
<td><em>Voluntary ban on purchasing crude oil at high prices</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Setting of wholesale &amp; retail prices by Administrative Guidance (Jun–Aug ’79)</em></td>
<td><em>Setting of wholesale prices by Administrative Guidance (Mar ’79–Apr ’82)</em></td>
<td><em>Setting of fuel imports and shift to a domestic production structure</em></td>
<td><em>Voluntary ban on gasoline imports</em></td>
</tr>
<tr>
<td></td>
<td><em>Implementation of energy saving measures such as target temperatures for air conditioning</em></td>
<td><em>Setting of wholesale prices by Administrative Guidance &amp; Moving to &quot;Monthly Settlement Method&quot; (Sep ’86–Apr ’91)</em></td>
<td><em>Setting of wholesale oil prices by Administrative Guidance</em></td>
<td><em>Partial release of private oil stockpiles (4 days)</em></td>
</tr>
<tr>
<td></td>
<td><em>Enforcement of Petroleum Stockpiling Law (Apr ’76)</em></td>
<td><em>Enforcement of Alternative Energy Promotion Law (May ’90)</em></td>
<td><em>Partial release of private oil stockpiles (2 days)</em></td>
<td><em>Urgent gasoline export to USA</em></td>
</tr>
</tbody>
</table>

*1 Government Statistics + 2 Oil Information Center
Subcommittee recommended the following measures from a viewpoint of the necessity for forming a responsive oil stockpiling system:

1. Increasing the stockpile volume (by buildup of the government stockpile)
2. Introducing government oil product reserves with high mobility to complement crude oil reserves

Regarding the government product reserves, kerosene stockpiling at a level equivalent to one day’s consumption during the peak season has been implemented since 2009.

In FY2007, the Subcommittee on Next Generation Fuels and Petroleum Policies made a review based on active promotion of international cooperation for oil stockpiling with countries in and surrounding Asia, where oil consumption is rapidly increasing. It was also discussed Japan’s cooperation toward stabilization of the international oil market in an emergency, taking into account the possible direct release of its stockpile to overseas countries.

In line with such movements, an intergovernmental agreement on preferential sales and purchase from the crude oil stockpile was concluded between Japan and New Zealand in 2009. Then a Japanese oil company is able to make a bid for “the Rights to Purchase Oil Stockpile in an Emergency” conducted by the government of New Zealand, and some firms successfully won those international bids. Additionally the Japanese government promoted a joint stockpiling project with an oil producing country. The project scheme is that oil producing countries can reserve their crude oils in Japan and use them commercially under normal times; however, in an emergency, Japanese oil companies receive preferential crude oil supply from their reserves under this agreement.

Such crude oil reserves in Japan were started by Abu Dhabi National Oil Company in 2009 and Saudi Arabian Oil Company in 2010. This scheme is expected

### Current Status of Oil Stockpiling in Japan (as of Dec 2012)

<table>
<thead>
<tr>
<th></th>
<th>Private Stockpiling</th>
<th>Government Stockpiling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockpile Days</td>
<td>81 days</td>
<td>103 days</td>
</tr>
<tr>
<td>Stockpiling Volume</td>
<td>37.7 million kl</td>
<td>47.8 million kl</td>
</tr>
<tr>
<td>Obligation Days</td>
<td>70 days of domestic demand</td>
<td>50 million kl (attained in Feb 1998)</td>
</tr>
<tr>
<td>Holding Method</td>
<td>Through production and distribution processes</td>
<td>In sealed designated storage tanks</td>
</tr>
<tr>
<td>Holding Location</td>
<td>Private sector tanks in refineries and oil terminals</td>
<td>① Tanks of national stockpiling bases ② Tanks borrowed from private sector</td>
</tr>
<tr>
<td>Composition</td>
<td>Crude oil: 50% Oil products: 50%</td>
<td>Crude oil: 99.5% Oil products: 0.5%</td>
</tr>
<tr>
<td>Administrative Body</td>
<td>Oil refiners and importers</td>
<td>① 10 national stockpiling bases (2/3 of government reserve) ② Private oil companies (1/3 of government reserve)</td>
</tr>
</tbody>
</table>

**Effect of Stockpile Release**

1. Prompt supply to distribution markets as stockpiles are held at refineries and oil terminals
2. Flexible release of stockpiles depending on crude procurement status and seasonal demand fluctuation
3. Weak psychological effect on the markets, compared with the government announcement on releasing its stockpiles
4. Strong psychological effect on the market when the government announces its decision to release its stockpiling to increase oil supply in the market
5. Reduced mobility of released stockpiling, compared with the private sector release, as reserves are stored at remote national stockpiling bases

**Cases of Stockpile Release**

1. 2nd Oil Crisis (Mar 1979—Aug 1980)
2. Gulf Crisis in response to CERM (Jan—Mar 1991)
3. Hurricane Katrina aftermath (Sep—Dec 2005)
4. The Great East Japan Earthquake (Mar—May 2011)
5. Libyan situation (Jun—Dec 2011)

**Financial Measures**

Subsidy for oil purchasing costs and tank construction costs

Government’s budget (Petroleum and Coal Tax)

**Cost Recovery**

Part of product cost (passing the cost on to consumers is expected)

Part of product cost (passing the cost on to consumers is expected)
to reinforce energy security and at the same time enhance the formation of strategic relationships with oil producing countries.

**Formulation of Stockpiling System Envisaged for Disasters**

At the time of the Great East Japan Earthquake in March 2011, the petroleum industry made its utmost efforts to stably supply oil products from refining to all segments of distribution, utilizing the characteristics of distributed energy, which can better cope with disasters. The petroleum industry is advocating formulation of an agile and flexible stockpiling system, considering the lessons learned from the recent great earthquake, and made the following proposal to fulfill a stable oil supply at a time of disaster:

1. The government’s reserve of petroleum products should be built up as a last resort of oil supply when the usual product and commercial distribution is interrupted.
2. Such government reserves should be kept at refineries, etc. as an operating inventory to secure mobility and quality maintenance (a unified public/private storage method).
3. A system to directly supply petroleum products to critical sites such as evacuation centers and hospitals should be launched by organizing in advance a cooperative structure between petroleum reserve management companies and transportation companies to secure prompt and assured deliveries at the time of release.

In 2012 the government amended the Oil Stockpiling Act to make it possible to release the government crude oil reserve at the time of a domestic oil supply shortage in a certain area due to a disaster, in addition to oil supply disruption from overseas. As for the government oil product stockpiling, the stockpiling of gasoline, diesel fuel and Fuel Oil A has been implemented.

---

**Oil Stockpiling Obligation Trends: Volume and Days (end of March each year)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978 (FY)</td>
<td>5,954 (90)</td>
<td>(7)</td>
</tr>
<tr>
<td>1979</td>
<td>6,593 (95)</td>
<td>(31)</td>
</tr>
<tr>
<td>1980</td>
<td>6,594 (126)</td>
<td>(55)</td>
</tr>
<tr>
<td>1985</td>
<td>8,277 (144)</td>
<td>(70)</td>
</tr>
<tr>
<td>1990</td>
<td>8,816 (157)</td>
<td>(76)</td>
</tr>
<tr>
<td>1995</td>
<td>8,806 (156)</td>
<td>(84)</td>
</tr>
<tr>
<td>2000</td>
<td>8,743 (166)</td>
<td>(95)</td>
</tr>
<tr>
<td>2005</td>
<td>8,902 (174)</td>
<td>(99)</td>
</tr>
<tr>
<td>2010</td>
<td>8,670 (184)</td>
<td>(102)</td>
</tr>
<tr>
<td>2011</td>
<td>8,301 (199)</td>
<td>(115)</td>
</tr>
<tr>
<td>2012</td>
<td>8,075 (193)</td>
<td>(114)</td>
</tr>
<tr>
<td>2013</td>
<td>8,343 (197)</td>
<td>(113)</td>
</tr>
<tr>
<td>2014</td>
<td>8,590 (185)</td>
<td>(102)</td>
</tr>
</tbody>
</table>

**Unit:** 10,000kl, (days)

**Government Stockpiles**

**Private Stockpiles**

**Applied Cases for Stockpiling Releases**

- **The Second Oil Crisis:** Mar.1973–Mar.1980
  - Based on Application
  - 82days~78days (4days)
- **Hurricane Katrina:** Sep.7,2005–Jan.4,2006
  - 87days~67days (3days)
- **The Great East Japan Earthquake:** Mar.14,2011–May.20
  - 78days~67days~45days (3days)
  - 73days~67days (3days)

**Source:** METI

---

volume: Product equivalent basis
days: Petroleum Reserve Law
in addition to the current kerosene stockpiling. Furthermore, the following provisions were incorporated into the amended act: (1) primary oil distributors (Motouri) are obliged to work together to prepare in advance the Oil Supply Coordination Plan in Disaster in 10 domestic regions as a disaster response measure for supplying oil products to disaster victims, (2) at the time of disaster, the METI minister will urge Motouri to take actions based on the subject plan, and each oil marketer which operates service stations (SS) with a certain volume of refueling facilities or more is obliged to inform METI so that it can make such SS into refueling points in a time of disaster. This resulted in reshaping the stockpiling system to better correspond to a large-scale domestic disaster.

### Outline of Japan’s Emergency Response Measures (as of Apr 2013)

<table>
<thead>
<tr>
<th>Oil Stockpiling Measures</th>
<th>Oil Supply Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amended Oil Stockpiling Act</td>
<td>Petroleum Supply &amp; Demand Adjustment Act</td>
</tr>
<tr>
<td>JOGMEC*</td>
<td>Emergency Declaration</td>
</tr>
<tr>
<td>Maintain reserves</td>
<td>Cooperate actions by the oil industry under government direction/ supervision</td>
</tr>
<tr>
<td>Registration of oil refiners, importers &amp; distributors for information gathering</td>
<td>Cooperate actions by industries under government direction/ supervision</td>
</tr>
</tbody>
</table>
| * Japan Oil, Gas & Metals National Corporation

At a normal time
- Secure stable supply by releasing oil reserves

At a time of threat
- Stop making up oil reserves
- Draw down oil reserves

In the event of an emergency
- Establish oil supply targets
- Indicate production/import plans
- Restrict oil consumption
- Restrict operations at SS
- Cooperative actions by the oil industry under government direction/ supervision
- Order oil holdings, sales/deliveries
- Mediate/guide oil supplies
- Indicate commodity production
- Indicate/commodity imports
- Indicate commodity holdings
- Order sales/deliveries
- Allocation/Ration Systems of Oil Products
- Allocation/Ration Systems of Major Commodities

Control Measures on Oil Consumption
- Act on Emergency Measures for Stabilization of National Life
- Determine standard prices
- Indicate commodity production
- Indicate commodity imports
- Indicate commodity holdings
- Order sales/deliveries
Japan’s Petroleum Resource Development

Petroleum resource development in Japan started in the early Meiji period (1870s) primarily in Niigata Prefecture. Currently, commercial production is carried out in Hokkaido, Akita and Niigata Prefectures. Also, exploration development activities continue to be conducted at sites including Yufutsu Oil/Gas Well, Minami Nagaoka Oil/Gas Well, Iwafuneoki Oil/Gas Well (offshore oil/gas field), etc. These wells are currently under production. Associated natural gas produced with oil is utilized as city gas or power generation fuel in most adjacent areas and contributes to the local economies of such communities. Though Japan is the third largest oil consuming country (2011), the ratio of domestically produced crude oil volume is only 0.4% of the domestic consumption volume, and that of domestically produced natural gas was only 2.8% in 2011. Almost all petroleum resources are dependent on imports.

Independent development of offshore oil and natural gas resources by Japanese firms contributes not only to ensuring long-term supply stability of energy resources, but also to establishing and strengthening mutual relationships between Japan and oil and gas producing countries. Fostering business links with those national oil companies and oil majors has great significance for energy security.

Today, Japanese firms are involved in over 140 oil and gas development projects around the world in areas such as the Middle East, South-east Asia, Africa, South and North America, Australia and the former republics of the Soviet Union, of which about 70 have performed well in commercial production of crude oil and natural gas (at the end of June 2012). The share of crude oil and natural gas from independent crude oil and gas development projects is about 23% of the total domestic demand volume.

Japan’s Independent Oil and Natural Gas Development in Future

To acquire promising areas for exploration, it is essential for the government to take diplomatic initiatives for opening up access as well as for building and enhancing cooperative relationships with oil and gas producing countries. As Japan’s oil development firms are latecomers to this business sector and inferior in both capital and technologies to oil exploration companies such as the oil majors in the USA and Europe, they have been subsidized by the government through Japan National Oil Corporation (JNOC) and, then, a newly established organization called Japan Oil, Gas and Metals National Corporation (JOGMEC) which succeeded JNOC’s functions such as risk money supply and R&D when it was abolished in April 2005.

In addition, such institutional assistance has been conducted for financing by Japan Bank for International Cooperation (JBIC), etc. and for international trade insurance by Incorporated Administrative Agency, Nippon Export and Investment Insurance (NEXI).

In this way, the government regards crude oil and natural gas as important energy sources and provides a favorable business environment for the private oil and gas companies to conduct their business operations. In turn, the development firms invest and distribute business resources to achieve their targets. It is expected that such a joint government and private-sector system will continue to function effectively and secure a stable energy supply to Japan.
Japan’s Petroleum Resource Development

Major Independent Oil Development Projects by Japanese Firms (as of the end of Nov 2012)

- Arabian Oil
- Teikoku Oil Algeria
- Teikoku Oil Suez SOB
- INPEX Libya
- Moeko Libya
- ITOCHU Oil Exploration (Azerbaijan)
- INPEX North Caspian Sea
- INPEX Southwest Caspian Sea
- INPEX BTC Pipeline
- ITOCHU Oil Exploration (BTC)
- Sakhalin Oil and Gas Development
- Sakhalin Energy Investment
- INPEX Ichthys
- INPEX BABAR SELARU
- JX Nippon Oil & Gas Exploration (Australia)
- Japan Australia LNG (MIMI)
- Japan Australia LNG (MINI Browse)
- INPEX Alpha
- INPEX Browse
- Cosmo Oil Ashmore
- INPEX Masela
- INPEX Sahul
- INPEX Timor Sea
- INPEX Oil & Gas Australia
- Mitsui E&P Australia
- JAPAN ENERGY E&P AUSTRALIA
- JAPAN ENERGY E&P UPDA
- Osaka Gas Australia
- Osaka Gas Crux
- Osaka Gas Gorgon
- Osaka Gas Ichthys Development
- Osaka Gas Sunrise (PSC 19-20)
- INPEX Gas British Columbia
- JGC Exploration Canada
- Canada Oil Sands
- Japan Canada Oil
- INPEX Canada
- MCX Gulf of Mexico
- JD Rockies Resources
- Osaka Gas Resources America
- Summit Discovery Resources
- Mid Continent Oil & Gas
- JX NOEX USA
- Teikoku Oil de Burgos
- JAPEX (U.S.)
- Teikoku Oil (North America)
- Mitsui E&P USA
- Mitsui E&P Texas
- MOEX Gulf of Mexico
- MOEX Oil & Gas Texas
- INPEX Gulf of Mexico
- JGC Exploration Eagle Ford
- JGC Energy Development (USA)
- JAPAN CARABOBO
- INPEX North Peru
- Teikoku Oil (Venezuela)
- Teikoku Oil (Suriname)
- INPEX Corporation
- INPEX Tengah
- Indonesia Natural Gas Resources Muturi
- KG Wiriagar Petroleum
- KG Berau Petroleum
- MI Berau
- Japan Papua New Guinea Petroleum
- Southern Highlands Petroleum
- Murray Petroleum
- INPEX Offshore North Makassar
- JAPEX Buton
- INPEX SERAM SEA
- Nippon Oil Exploration (Niugini)
- Moeco West Papua 1
- Moeco West Papua 3
- JX Nippon Oil & Gas Exploration (Onshore Sarawak)
- Energy Mega Pratama
- JX Nippon Oil & Gas Exploration (Deepwater Sabah)
- KG Bano Petroleum

Remarks: ○ projects in production

Source: Japan Petroleum Development Association
Amid the ongoing globalization and easing of regulations in the Japanese economic society, the Japanese petroleum industry reached almost complete liberalization at the end of 2001 when the Petroleum Industry Law was abolished.

In consideration of the importance of oil, regulations of the petroleum industry had been enforced by giving the highest priority to the concept of securing a stable supply under the Petroleum Industry Law, which was enacted in October 1962 as a fundamental law. The Petroleum Reserve Law, the Gasoline Retail Business Law, and the Provisional Measures Law on the Importation on Specific Refined Petroleum Products (Fuel Import Restriction Law) were enacted since then to complement the Petroleum Industry Law. Consequently, a broad range of regulations as well as administrative guidance on petroleum imports, refining, manufacturing, and marketing were in effect.

However, as the gap between domestic and foreign prices during the deregulation process became a political issue, the shape of petroleum industry regulations was reviewed. As a result, a series of deregulation measures concerning the administrative guidance and its procedures under the Petroleum Industry Law and the Gasoline Retail Business Law were implemented during the period between 1987 and 1992. After April 1996, when the Fuel Import Restriction Law was abolished, the objective of Japanese petroleum policy became the realization of an efficient oil supply using market mechanisms, in addition to securing a stable oil supply.

In June 1998 the Petroleum Council compiled a report outlining the future direction of the petroleum policy with a main focus on the following points, aiming at implementation in 2001:

1. The abolition of supply and demand adjustment regulations such as the need for approval for business commencement and facility investments
2. The abolition of regulations on pricing based on setting standard prices

The council then deliberated the optimum form of oil stockpiling and emergency responses, and proposed in its report in August 1999 to establish specific response measures and an increase in the volume of the government oil stockpiling. The report also pointed out that “it is extremely important from the viewpoint of security measures to have a healthy petroleum industry which runs a stable business even in a severe management climate.”

Taking into account the above report and others, the Petroleum Industry Law was abolished at the end of December 2001. At the same time, the Petroleum Reserve Law was amended and reformulated as the new Oil Stockpiling Act, enforced in January 2002, to strengthen the infrastructure for emergency responses. As a result, major petroleum industry regulations are limited to oil stockpiling requirements by the Oil Stockpiling Act, and to fuel quality by the Act on Quality Control of Gasoline and Other Fuels.

In the midst of such ongoing regulatory reforms, the excess capacity of oil refining facilities became an issue under a decline in domestic oil product demand mainly attributable to the enhancement of the oil use reduction policy, the falling population, a low birthrate and aging population, a rapid increase in crude oil prices, and growing awareness of energy conservation during the economic recession after the Lehman Shock. While the petroleum industry is making voluntary efforts to reduce its refining capacity, it was decided that oil refiners need to hold at least a certain level of the capacity of heavy oil cracking units by the Law Concerning Sophisticated Methods of Energy Supply Structures. Consequently, each oil company is requested to cut its refining capacity through this regulatory measure by the end of March 2014. In some oil companies, the partial reduction in refining capacities as well as refinery closures have already been decided.
With deregulation and the abolition of the Fuel Import Restriction Law as a turning point, the petroleum industry has been forced to face a difficult business environment under sluggish market conditions and worsening corporate profits due to severe price competition in distribution markets. For this reason, each oil company has been making efforts to lower its operating costs in every aspect of business, such as the rationalization of refining and distribution functions, restructuring by large-scale workforce reductions in marketing and administrative functions, and the reengineering of corporate organizations.

In the ongoing process of liberalization in each phase of manufacturing, importing and marketing, after such regulatory reforms as the abolition of the Fuel Import Restriction Law and the Petroleum Industry Law, it has become much more important for the petroleum industry to conduct business activities under market mechanisms. The introduction of a market mechanism helps to promote the streamlining of manufacturing and supply systems through appropriate distribution of resources in a market. To that end, extensive disclosure of appropriate market information is essential for the effective functioning of market mechanisms. Before deregulation, however, the available information on oil supply and demand was limited to the statistics collected and publicized by the government. As these statistics were mainly for analyzing the nation’s macroeconomic trends, it was insufficient for use as an up-to-date tool to allow market mechanisms to function effectively.

Under such circumstances, Petroleum Association of Japan (PAJ) developed the PAJ Oil Statistics Weekly, which gives the weekly supply statistics on crude oil and petroleum products, an accurate, prompt and precise database, to provide data on oil supply situations on a weekly basis in January 2003. Since then, data on petroleum product supply by area (East Japan and West Japan), petroleum product export, and refining capacity utilization ratios were added. PAJ continues to extend its information coverage and expects the establishment of a market mechanism to function effectively.

### Petroleum Industry Regulatory Reform History in Japan

<table>
<thead>
<tr>
<th>Year</th>
<th>During Normal Periods</th>
<th>During Emergencies</th>
</tr>
</thead>
</table>
| 1960 | Jul ‘60 Enactment of Petroleum Industry Law | Dec. ‘73 Two Emergency Laws:  
|      |                      | • Emergency Law for Stabilization of National Life  
|      |                      | • Petroleum Supply and Demand Optimization Law |
| 1965 | Apr ‘76 Enactment of Petroleum Reserve Law | May ‘75 Enactment of Gasoline Retail Business Law |
| 1975 | May ‘77 Enactment of Gasoline Retail Business Law | Jan ‘82 Enactment of Petroleum Reserve Law  
|      |                      | Feb ‘87 Amendment of Petroleum Reserve Law  
|      |                      | Jul ‘87 Automatic Approval for Installation of Product Upgrading Facilities  
|      |                      | Mar ‘89 Abolition of Guidance on Gasoline Production Quota |
| 1980 | Jan ‘86 Enactment of Provisional Measures Law on Importation of Specific Refined Petroleum Products (Fuel Import Restriction Law)  
|      |                      | Jul ‘89 Revocation of SS Construction (Scrap-and-Build Rule) and on Transfer of SS Brand between Primary Distributors |
|      |                      | Oct ‘89 Abolition of Guidance on Kerosene Inventory Build-up for Winter |
| 1985 | Mar ‘90 Abolition of Guidance on SS Construction (Scrap-and-Build Rule) and on Transfer of SS Brand between Primary Distributors  
|      |                      | Sep ‘91 Flexible Approval for Installations of Crude Processing Facilities  
|      |                      | Mar ‘92 Abolition of Guidance on Crude Processing (Throughput) |
|      |                      | Mar ‘93 Abolition of Tariff-quotas system (TQ) for Heavy Fuels |
| 1990 | Mar ‘96 Repeal of Fuel Import Restriction Law (Import liberalization of fuel products)  
|      |                      | Apr ‘96 Enactment of Act on Quality Control of Gasoline and Other Fuels by revising Gasoline Retail Business Law |
|      |                      | Aug ‘96 Amendment of Petroleum Reserve Law  
|      |                      | Jul ‘97 Automatic Approval of Petroleum Product Exports (Export Liberalization of Fuel Products)  
|      |                      | Dec ‘97 Abolition of SS Certificate System for Fuel Supply-source by its Branded Primary Distributor |
|      |                      | Apr ‘98 Lifting of the Ban on Manned Self-service SS |
| 1995 | Dec ‘01 Repeal of Petroleum Industry Law  
|      |                      | Jan ‘02 Enactment of New Oil Stockpiling Act  
|      |                      | Feb ‘03 Partial Revision of Act on Quality Control of Gasoline and Other Fuels (Registration and Quality Assurance Obligation of Processors) |
|      |                      | Nov ‘10 Notification of Criteria for Judgment Concerning Promotion of Effective Use of Fossil Energies (Raising Installation Ratio of Heavy Oils Cracking Units to about 13% by FY2013)  
|      |                      | Nov ‘12 Amendment of Oil Stockpiling Act |
| 2000 |                      | Aug ‘09 Enforcement of Law Concerning Sophisticated Methods of Energy Supply Structures  
| 2010 |                      | Nov ‘12 Amendment of Oil Stockpiling Act |
of a transparent oil market by providing up-to-date oil supply information which can be used to allow the full functioning of market mechanisms.

**Establishment of Fair and Equal Competitive Conditions among Energy Sources**

More intensified competition than ever among energy sources is projected with the progress of deregulation. In such a situation, compared with other energy sources, oil is unfavorably treated to a significant degree in terms of taxation, its stockpiling obligations, etc.

From April 2003 coal was added as a taxable product under the petroleum and coal tax scheme, and the tax rates of LNG and imported LPG were raised, taking into account the reinforcement of measures to reduce CO₂ emissions originating from fossil fuels and the fairness of tax burdens among energy sources. Though the tax gaps between oil and other energy sources were narrowed, still higher tax rates versus other energies were imposed on oil (more than double) even after April 2007 when the final tax rates were applied as shown below:

- Oil : 2,040 yen/Kiloliter (KL)
- Coal : 700 yen/ton
- LNG : 757 yen/KL on an oil calorie equivalent basis
- LPG : 822 yen/KL on an oil calorie equivalent basis

Furthermore, a rise in the tax rate of petroleum and coal tax, in accordance with the amount of CO₂ emissions, was decided in phases from October 2012 as a tax for global warming countermeasures. The new tax rates for FY2016 will be 2,800 yen/KL for oil, 1,860 yen/KL for LNG and LPG, and 1,370 yen/KL for coal. Though the petroleum industry had been insisting on conducting a close investigation beforehand of the global warming countermeasures in the existing budget, which exceeds 1 trillion yen, a tax hike merely for obtaining tax revenue was decided. As petroleum and coal tax is levied on crude oil, the oil companies are responsible for all tax collections and payments under open competition based on market mechanisms. Thus, no cost recovery system including such tax collections is provided. Essentially, taxes on oil consumption are considered to be borne by its end-consumers. The tax-paying capacity of oil companies reaches a critical limit during a downturn in domestic demand. The petroleum industry therefore seeks a political consideration for ensuring the collection of the tax increases.

On top of that, new fuels like alcohol fuels (100% alcohol) and compressed natural gas for CNG vehicles have neither any diesel oil transaction tax nor gasoline tax imposed on them. Since those fuels are for use in automobiles, the impartiality of tax imposition is being seriously ignored.

The oil stockpiling scheme was enriched and became a very useful policy measure as a pillar for energy security after the oil crises. In reaction to the Great East Japan Earthquake, the Oil Stockpiling Act was amended so as to make it possible for the oil stockpiling scheme to efficiently cope with domestic disasters. As for the stockpiling obligation of imported energy resources other than oil, however, only LPG has a 50-day requirement, but there is no obligation for natural gas. As it is assumed that natural gas demand will increase from now on, prompt actions regarding natural gas stockpiling are necessary from the viewpoint of maintaining a stable energy supply.

On the other hand, the Law Concerning Sophisticated Methods of Energy Supply Structures was enacted in June 2009 to enhance the efforts towards the formation of a low-carbon society. The Law Concerning Promotion of the Development and Introduction of Alternative Energy (the Alternative Energy Law) was also revised, so that the past mindset of promoting alternative energy sources at the expense of an excessive tax burden only on oil has been changed.
Realizing competitive conditions on an equal footing among energy sources is important to form a fair market where market mechanisms are allowed to function effectively.

Movements toward Petroleum Industry Reorganization

In view of the global realignment of oil majors, reorganization of domestic financial institutions, and fierce competition in the domestic oil market after the abolition of the Fuel Import Restriction Law, a realignment of domestic oil refiners and primary oil distributors (Motouri) was put in motion after the merger of Nippon Oil and Mitsubishi Oil in April 1999. Unprecedentedly large-scale and rapid market reorganization has occurred since then. As a result, the petroleum industry entered an era centering on a four-group-Motouri framework; i.e., the Nippon Oil and Cosmo Oil Group, ExxonMobil Japan Group, Japan Energy and Showa Shell Sekiyu Group, and Idemitsu Kosan as of 2000.

However, excess refining capacity remains an industry-wide issue. Even after reorganization into four major nationwide groups, Japan’s ExxonMobil Group further integrated with four affiliated companies into ExxonMobil Yugen Kaisha. Idemitsu Kosan closed its Hyogo Refinery in April 2003 and its affiliate Okinawa Sekiyu Seisei’s refinery in November 2003 to resolve its group’s facility surplus. At the same time, the company extended its business alliance with Nippon Oil to the refining function in addition to the current distribution function.

Moreover, backed by soaring crude oil prices and strong demand for oil and petrochemical products in Asia, such movements as the formation of strong partnerships between oil companies in Japan and Middle Eastern oil producing countries through capital alliances, and the entry into Japan’s oil market by foreign capital companies from Brazil and China were seen around 2007.

In 2008, to cope with recent high crude oil prices and fierce competition in the overall energy market, Nippon Oil merged with Kyushu Oil in October 2008. Furthermore, in July 2010 JX Nippon Oil & Energy was established as a result of the management integration between Nippon Oil and Japan Energy, which had concluded a wide-ranging business tie-up agreement from upstream operations to refining and distribution opera-
Enhancement of Rationalization and Efficiency Improvement after Reorganization

With the progress of such reorganization, each oil company made efforts to streamline all of its business segments such as their own refineries, fuel storage terminals and service stations. Consequently, Japan’s total refining capacity decreased by 0.88 million barrels per day (BPD) or more than 16% during the past 13 years from 5.35 million BPD in March 2000 to 4.47 million BPD at the end of March 2013. Furthermore, oil refiners are required to reexamine their production facilities by the Law Concerning Sophisticated Methods of Energy Supply Structures. In response, about 0.55 million BPD of refining capacity is planned to be reduced by means of refinery closure, etc. by March 2014.

With the efforts towards management efficiency improvement and rationalization such as mergers and business consolidation, the total workforce of oil refiners and Motouri was reduced significantly during the past 17 years, and at the end of March 2012 it was below 20,000 employees, compared with about 36,000 employees at the end of March 1995.

In addition, aiming at becoming integrated energy firms, some oil companies are expanding into other energy businesses, such as electric power, LNG, and the distributed energy sector, where new energies like fuel cells and solar photovoltaic power generation are expected to grow. Beside the progress in streamlining management style, creation of holding companies among affiliated firms is seen in some cases.

Shaping the future evolution of the Japanese petroleum industry, oil companies have been making efforts to enter new or other energy fields like electricity, since oil demand will continue to decrease. They are also accelerating their movement toward becoming a total energy industry through realizing integrated operations, utilizing existing facilities in refineries, with various industries such as petrochemical companies through Refinery Integration for Group-operation (RING) projects, while working on further rationalization and efficiency improvement of their core oil business.
Distribution Rationalization and Efficiency Improvement due to Deregulation

Petroleum products are delivered to consumers via oil terminals and service stations (SS) by coastal tankers, tank trucks, railroad tankers and pipelines in Japan. A large portion of oil distribution is carried out by tank trucks and coastal tankers.

A number of developments have taken place to cope with the changes in the management climate since the abolition of the Provisional Measures Law on the Importation of Specific Refined Petroleum Products (Fuel Import Restriction Law) at the end of March 1996. In the logistics segment, the petroleum industry has pushed forward relocation and integration of distribution facilities, expansion of product exchanges with other oil companies, as well as joint use of refining and distribution facilities. As a wave of business alliances and integration beyond the corporate framework has been taking place, especially after 1999, further efficiency improvement and cost reduction measures in the industry have been taken.

Meanwhile, deregulation in coastal and land transportation has been executed from the viewpoint of the industry’s efficiency improvement in physical distribution. For example, in the area of land transportation, the introduction of tank trucks with a larger capacity was promoted, as trucks with a cargo capacity of 26-28 kiloliters (KL) were allowed by regulation amendments in November 1993, and “ultra-compact” tank trucks (more compact than conventional trucks but with the same 24KL cargo capacity) as well as those with a cargo capacity of 30KL were developed by further partial mitigation of the regulation and safety standards in October 2003. Besides, unloading of fuels at a service station (SS) by the tank truck (T/T) driver alone (SS staff presence is not required) was permitted from April 1999 to improve delivery efficiency on condition that safety countermeasures should be more strictly adhered to. The permission was expanded in October 2005 to include deliveries to tanks at kerosene distribution depots and to customer owned tanks.

It is also expected that expansion of the T/T driver unloading system will enhance safety, reduce distribution costs and boost convenience for SS operation and for customers.

Business Climate Changes Surrounding Service Stations

The Japanese petroleum industry entered a period of full-scale globalization and liberalization after the abolition of the Petroleum Industry Law in December 2001, and the domestic oil market became linked with international markets. Besides, an increase in new generation vehicles such as electric vehicles (EV) and plug-in hybrid vehicles (PHV) is expected in the future.

To cope with such changes, it has become the most pressing issue for oil refiners, primary oil distributors (Motouri) and retail dealers (SS) to make joint efforts to establish a sound distribution market and to create new additional services at SS by further upgrading quality, promoting value-added sales activities and improving operational efficiency.

Rapid Increase in Numbers of Self-service SS

In April 1998, a manned self-service SS, where a qualified SS attendant could watch car drivers’ refueling operations, was introduced. Over 8,500 self-service SS were in operation in March 2012. This accounted for about 23% of the total SS. In Japan, self-service SS were first developed by foreign capital Motouri, with long experience in the USA and Europe, and by small and medium-sized Motouri in the early stages of introduction. Other major domestic capital Motouri actively joined the development after 2002. Retail dealers have recently been highly motivated to develop self-service SS. However, with increased keen competition among self-service SS, some of these have closed.

Safety Measures at Self-service SS

The number of incidents caused by drivers at self-service stations is increasing, such as gasoline spills and refueling with the wrong fuel. Petroleum Association of Japan (PAJ), therefore, is disseminating information on how to fill gasoline properly at self-service SS through posters and the PAJ website.
As refueling is done by drivers at self-service SS, each oil company is actively taking safety countermeasures such as strengthening monitoring of refueling, ensuring good conductivity of refueling nozzles to prevent static electricity spark-induced fires and installing splash guard units to prevent spills in order to improve safety at self-service SS.

**Increase in New Generation Vehicles**
Along with an increase in new generation vehicles such as EV and PHV, the services provided at SS would be greatly changed from the conventional ones. Therefore, it would be a challenge for the industry to develop such infrastructure as solar photovoltaic power generation and a quick electric charger, and to provide new additional services at SS such as car-sharing in order to cope with changes in the business climate surrounding SS.

**Responses to Environmental Issues at SS**
The petroleum industry’s efforts in regard to environmental issues have focused mainly on refineries; however, there are many cases in which SS have earnestly dealt with environmental issues in recent years. Some examples are the notification of the emission quantities of harmful chemical substances such as benzene under the Pollutant Release and Transfer Register (PRTR) Law enforced from April 2002, and the world’s first nationwide supply of sulfur-free gasoline and diesel fuel (10ppm or less) from January 2005.

Considering the importance of the soil and groundwater pollution issue at SS, PAJ has created the “SS Soil Environment Safety Book” for early identification and prevention of soil pollution by oil spills at SS.

In addition, in response to the Fire and Disaster Management Agency’s issuance of a partial revision of the notification concerning the construction techniques of synthetic resin plumbing, etc. in August 2009, PAJ prepared its master specifications of the standard construction method for using synthetic resin plumbing and its fire-resistant connection boxes to be used underground in March 2010, as a part of the industry’s efforts towards this pollution prevention issue. PAJ promotes the dissemination of using such synthetic resin plumbing in view of its low risk of corrosion in underground piping.

A partial revision of the fire regulation on the control of hazardous materials was made in June 2010 to cope with accidental oil spills from underground tanks (UGT). With the revised regulation, operators are obliged to take measures for the prevention of oil leakage from single-hull UGT in accordance with the number of years the UGT has been buried, the design performance, etc. The moratorium on this regulation ends at the end of January 2013 (and at the end of January 2016 for those areas stricken by the Great East Japan Earthquake). The petroleum industry is making efforts to advance measures for prevention of soil pollution.

**Issue of SS in Depopulated Areas**
With fierce market competition due to declining petroleum fuel demand, the number of SS has been decreasing. Consequently, the diminishing number of SS in the depopulated areas has become an issue of concern. Due to closures of SS, the areas which face difficulty in obtaining supplies of fuels such as kerosene, an essential commodity in cold regions, and vehicle fuels for agricultural and forestry vehicles and machinery have been increasing. This has become a social problem in such regions. One reason behind this was an increase in the number of SS closures due to financial inability to make facility investments to meet the legal obligation for the prevention of oil

---

**Main Distribution Channels of Gasoline**

- **Domestic Production**
- **Product Imports**
- **Primary Distributors (Motouri)**
- **Trading Houses**
- **Zen-Noh***
- **Dealers**
- **Sub-dealers Retailers**
- **Consumers**

* National Federation of Agricultural Cooperative Associations
leakage from aged UGTs, the moratorium on which terminates in January 2013 as mentioned above. This situation would bring serious consequences by not only inconveniencing consumers during ordinary times, but also by seriously destabilizing fuel supply to local residents if an SS were forced to suspend its operation during an emergency.

It is important for the petroleum industry to address this issue with the central and local governments, as well as community residents, in order to fulfill the social responsibility for stably supplying petroleum products.

From the perspective of corporate social responsibility (CSR), PAJ aims at living in harmony with local communities by ensuring as stable as possible a supply of petroleum products even in the event of a large-scale disaster.

Petroleum products are considered to be flexible in supply at the time of disasters like earthquakes, because they can be delivered to SS and consumers through various means such as vessels and tank trucks. Tank trucks are especially flexible in choosing a route to a particular destination from nearby refineries or oil storage terminals.

In November 2008, PAJ and the Tokyo Metropolitan Government concluded an agreement on “Stable Supply of Oil Products in Case of a Large-scale Disaster”, which stipulates preferential fuel supply to important public facilities for deploying disaster relief operations in case of an earthquake with an intensity of lower 6 on the Japanese scale. The field exercise based on this agreement has been conducted once a year since 2010.

Actually at the time of the Great East Japan Earthquake in March 2011, the petroleum industry suffered significantly from the earthquake and the subsequent tsunami. Though many of the oil terminals and refineries were damaged, the petroleum industry made concerted efforts, utilizing the findings of previous exercises, to continue a stable supply of oil to the quake-hit areas. From the day of the quake, PAJ coordinated with the government to cope with the emergency supply requests for petroleum products from the disaster-affected areas. The primary oil distributors (Motouri) made joint use of their oil terminals which were not seriously damaged for their product shipment.

Using lessons learned at the time of this huge earthquake, in order for the petroleum industry to maintain its oil supply chain after a large-scale disaster, the industry has been working on various measures such as developing an information gathering system at the time of disaster, installing drum filling facilities for shipment to the affected areas, and organization of a cooperative system across the industries in an emergency.

Taking the experiences of responses to urgent requests at the time of the Great East Japan Earthquake into consideration, PAJ is developing an emergency response system for information sharing with local prefectural governments across the country to promptly and flexibly respond to urgent requests for

![Number of Service Stations (end of March each year)](image)

Source: METI, Oil Information Center
petroleum product supply from the disaster-hit areas in an emergency.

The amended Oil Stockpiling Act was enforced in November 2012 to strengthen the coping measures at a time of a large-scale disaster. With this amended act, oil refiners and Motouris need to prepare and submit the Oil Supply Coordination Plan in Disaster in 10 domestic regions to the government in order for oil companies to collaborate to deal with the supply of petroleum products in an emergency like a large-scale disaster. In addition, the government stockpiling release requirements were revised so that the government oil reserves can be released at a time of oil supply shortage in a specific region after a disaster occurs. The government petroleum product reserves have also expanded in both volume and product coverage in addition to the already existing kerosene reserve by utilizing oil storage tanks at oil companies’ shipping terminals to promptly meet the demand at disaster sites.

For Maintaining and Strengthening Oil Supply Chain

The petroleum industry continues to extend the broad range of its oil supply chain, covering all steps from acquiring petroleum resources and exploration development to importing, refining, distributing and marketing, throughout the nation, as a vascular network to deliver petroleum products to consumers.

However, under such circumstances as a declining trend in domestic petroleum product demand, and the continuous management rationalization based on market mechanisms, it is getting difficult for the industry to maintain a sufficient scale in its supply chain. The issue of declining numbers of SS in depopulated areas is an example of the fraying of the front line of sales in the supply chain.

Additionally, in 2007 when Kashiwazaki Kariwa Power Plant suspended its operations due to the Chuetsu-oki Earthquake, fuel deliveries to oil-burning power plants could not be smoothly conducted due to a lack of sufficient oil product tankers.

The Ministry of Economy, Trade and Industry (METI) issued its Petroleum Demand Outlook toward 2014 in March 2010. Assuming its demand trend in this outlook continues to 2020, the domestic petroleum product demand would decrease by 30% versus fiscal year (FY) 2010 and be almost 50% down from the peak year of 1999. Consequently, it would be more and more difficult to maintain the oil supply chain if this declining trend continues.

At the time of the Great East Japan Earthquake, right after the supply stoppages of electricity and city gas, (which are known as so-called “system energies”), oil as the “distributed energy”, which is easy to deliver and store, demonstrated its emergency response capabilities. Oil was widely used as fuel for heating at the evacuation centers, for emergency electrical generators at hospitals as well as nuclear power plants, and for emergency and evacuation vehicles. In this way oil played the role of protecting the lives of the victims.

If the reduction of the oil supply chain continues due to a decline in domestic demand, the petroleum industry has serious concerns that the industry will not be able to make such responses as it had done after the great earthquake if a large-scale disaster occurs in the future. Considering the importance of a stable energy supply to end-consumers at the time of a natural disaster, it is essential to maintain and strengthen the current level of the supply chain. To that end, ensuring a “stable scale of oil demand” is an urgent issue for the petroleum industry.

Taking into consideration the current level of oil demand by maintaining and promoting oil usage mainly in the heating, hot-water supply and the transportation sectors, PAJ assumes that securing approximately 180 million KL (down by 8% from 2010) of stable oil demand is necessary for sustaining the oil supply chain.
Toward a Fundamental Reexamination of Petroleum-related Taxes

Exorbitant Amounts and High Rates of Petroleum-related Taxes

Oil accounts for about 46% of the primary energy supply and is the central energy source to support people’s daily lives and industrial activities. Therefore, cost reduction is an important issue from the viewpoint of the national economy. Since exorbitant amounts and high rates of taxes are imposed on petroleum products in a multiple-layered and multistage way, such tax revenues have reached nearly 4.5 trillion yen per year (FY2013 budget).

Currently, customs duty and various taxes are imposed on crude oil and petroleum products. Specifically, customs duty is imposed on imported petroleum products, and petroleum and coal tax (national) is levied on imported crude oil and petroleum products at the import stage. When refined products are delivered in the domestic market, the following indirect taxes are imposed:
- Gasoline: Gasoline tax and local road tax (national)
- Diesel Fuel: Diesel fuel transaction tax (local/prefectural)
- Jet Fuel: Aircraft fuel tax (national)
- LPG: Petroleum gas tax (national)

In addition, about 1,085 billion yen of general consumption tax is also levied on those petroleum products (5% of product sales revenue). Consequently, total petroleum-related taxes amount to about 5,585 billion yen, equivalent to about 45 US dollars per barrel (at an exchange rate of 95 yen to the dollar). Such exorbitant amounts and high rates of tax raised energy supply costs significantly and had a severe impact on people’s daily lives and industrial activities.

Unreasonable and Unfair Petroleum-related Taxes

At the time of the introduction of the consumption taxation in April 1989, the streamlining, including abolition, of existing indirect taxes was carried out and adjusted with the existing taxes so as not to increase consumers’ overall tax burden. However, petroleum-related taxes were neither abolished nor reduced due to their connection with specific

- Multiple & Multi-stage Imposition of Petroleum-related Taxes (FY2013 Budget)

<table>
<thead>
<tr>
<th>Imported Crude Oil</th>
<th>Customs Duty</th>
<th>4.5 billion yen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imported Oil Products</td>
<td></td>
<td>650 billion yen</td>
</tr>
<tr>
<td>Petroleum and Coal Tax</td>
<td>2,290 yen/kl</td>
<td></td>
</tr>
</tbody>
</table>

- LP Gas:
  - Petroleum Gas Tax 9,800 yen/kl
  - 22 billion yen

- Gasoline:
  - Gasoline Tax 53,800 yen/kl
  - 2,842 billion yen

- Diesel Fuel:
  - Diesel Fuel Transaction Tax 32,100 yen/kl
  - 823 billion yen

- Jet Fuel:
  - Aviation Fuel Tax 18,000 yen/kl
  - 64 billion yen

- Naphtha
- Kerosene
- Heavy Fuel
- Others

Total Petroleum-related Tax: Approx. 4.5 trillion yen

Total Approx. 5.59 trillion yen (Crude Oil at 45 US$/Bbl and 95 yen/$)
revenue sources for road construction. The government took unreasonable and unfair measures by simply adding consumption tax to petroleum product sales prices including the respective petroleum-related taxes, namely, a tax on tax. When the 3% rate of consumption tax was subsequently raised to 5% in 1997, no corrective actions were taken.

The system of the Specific Revenue Source for Road Construction was abolished in April 2009 and those tax revenues have been incorporated into the general revenue account. With this abolition, any grounds for argument that adjustments could not be made for the consumption tax on the petroleum-related taxes were nullified; however, specific measures for such adjustments have not been taken.

The government is aiming at raising the consumption tax in stages (8% from April 2014 and 10% from October 2015). If it is raised to 10%, the portion of the consumption tax levied on gasoline and other petroleum products, a so-called tax-on-tax treatment, which is worth 175 billion yen, will double. PAJ continues to work on the realization of adequate tax adjustment measures, especially the termination of such a tax-on-tax treatment, by returning to the basic principle at the time of launching the consumption tax.

Reducing Tax Burdens and Ensuring Fairness in Taxation of Petroleum-related Taxation

The provisional tax rates on top of the official rates of gasoline tax and diesel fuel transaction tax had been raised under the beneficiaries-pay principle to secure revenues for road maintenance and improvement. By shifting such tax revenue into general revenue in April 2009, there was left no foundation for imposing provisional taxes. Though the provisional tax rate system itself was abolished, the current provisional tax level continues to be maintained, with the reason being the prevention of revenue shortages.

Considering the following two points, the portion of the provisional tax rate should be abolished immediately:

<table>
<thead>
<tr>
<th>Current Status of Petroleum-related Taxes and Consumption Tax (FY2013 Estimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumption Tax Amount from Oil Product Sales</strong></td>
</tr>
<tr>
<td><strong>1,085</strong> billion yen</td>
</tr>
<tr>
<td><strong>Consumption Tax on Oil Portion</strong></td>
</tr>
<tr>
<td><strong>910</strong> billion yen</td>
</tr>
<tr>
<td><strong>Tax-on-Tax Portion</strong></td>
</tr>
<tr>
<td><strong>175</strong> billion yen</td>
</tr>
<tr>
<td><strong>Sales Amount excluding Taxes</strong></td>
</tr>
<tr>
<td><strong>Approx. 18.2 trillion yen</strong></td>
</tr>
<tr>
<td><strong>Gasoline Tax</strong></td>
</tr>
<tr>
<td><strong>2,842</strong> billion yen</td>
</tr>
<tr>
<td><strong>Petroleum and Coal Tax</strong></td>
</tr>
<tr>
<td><strong>650</strong> billion yen</td>
</tr>
<tr>
<td><strong>Other Taxes</strong></td>
</tr>
<tr>
<td><strong>27</strong> billion yen</td>
</tr>
<tr>
<td><strong>Approx. 3.52 trillion yen</strong></td>
</tr>
<tr>
<td><strong>Petroleum-related Taxes</strong></td>
</tr>
<tr>
<td><strong>Approx. 4.5 trillion yen</strong></td>
</tr>
<tr>
<td><strong>Oil Product Sales</strong></td>
</tr>
<tr>
<td><strong>Approx. 21.72 trillion yen (Excluding Consumption Tax)</strong></td>
</tr>
</tbody>
</table>

Current Consumption Tax Rate 5%
(1) Only automobile users are forced to bear excessive tax burden.

(2) There is a gap in the tax burden between urban areas and rural areas where gasoline and diesel fuel consumption is large.

Furthermore, petroleum and coal tax is levied on off-gas which is generated in the crude oil refining process to produce petroleum products and cannot itself be sold as a petroleum product. This imposes a serious disadvantage on domestic petroleum products when competing with imported ones for the portion of this additional tax rate. Though the Liberal Democratic Party, which won a change of government from the Democratic Party of Japan in January 2013, compiled the fiscal year (FY) 2013 Tax Reform Package, the tax treatment concerning such non-salable gas remained as a pending item to be studied. It is necessary to set up a reimbursement scheme for petroleum and coal tax in regard to off-gas.

Regarding recent automobile fuels and energies, in addition to compressed natural gas (CNG) vehicles which have been in practical use for more than 10 years, the sale of electric vehicles (EV) has started on a full-scale basis. Furthermore, it is anticipated that fuel cell vehicles using hydrogen will come into practical use in the future. However, automobile fuel taxes like gasoline tax and diesel fuel transaction tax are not imposed on those fuels/energy for CNG vehicles and EV. This fact completely ignores any impartiality among fuels/energy for automobiles. From the viewpoint of sharing a fair burden of automobile-related social expenses, such as for road maintenance and improvement, as well as preventive measures against traffic accidents and environmental protection, a level playing field in taxation on fuels/energy should be secured between CNG and electric vehicles and those of gasoline and diesel fuel.
Opposing Any Further Tax Burden

Huge taxes of more than five trillion yen have been imposed on oil. There is a thought that since a global warming countermeasure tax and a phased tax hike are anticipated in the near future, any further tax burden will not gain consumer understanding and will have significant adverse impacts on the Japanese economy, which needs to be revived as an urgent issue. It is, therefore, totally unacceptable to bear any further tax burden.

In the FY2013 Tax Reform Package, it is indicated that ensuring a stable revenue source is the prerequisite for lowering the tax burden levied on automobiles themselves. One consideration is to ensure a stable revenue source by increasing the rates of fuel/energy-related taxes. The reexamination of imposing taxes on automobiles themselves and on fuels/energy is not an issue of changing the tax structure, which merely aims at expanding a specific market. It is an issue to be comprehensively evaluated by taking such factors into account as the appropriate social costs of automobiles, the sharing of revenue sources between the central and local governments, the future form of energy policy, the realization of a level playing field among energy sources, and the impact on economic conditions.

Imposing excessive taxes on fuels and energy without careful consideration not only lacks reasonability but also places an excessive burden on rural areas where people have to rely on automobiles because of insufficient public transportation and the widening of the tax burden gap between urban and rural areas. Consequently, it would cause unfair tax burdens.

It is also indicated in the above tax reform package that deliberation of securing the revenue source for such measures as enhancing forest sinks as a global warming countermeasure will be conducted. There is a debate over the use of the global warming countermeasure tax for forest sink measures. With the development and usage of nonfossil energy and the enhancement of sophisticated use of energy, the taxation for measures against global warming was launched, right from the start to use this tax for measures to control CO2 emissions from fossil energy. Tax revenue should not be spent for forest preservation under the name of global warming countermeasures.
Toward a Fundamental Reexamination of Petroleum-related Taxes

**Trends in Indirect Taxes Imposed on Petroleum Products since the 1973 Oil Crisis**

Unit: yen/kl

- **Gasoline Tax (General Term for Gasoline Excise Tax and Local Road Tax)**
- **Aviation Fuel Tax**
- **Diesel Fuel Transaction Tax**
- **Petroleum Gas Tax**
- **Petroleum Tax**
- **Petroleum and Coal Tax**
- **Extraordinary Petroleum Tax**

**Comparison of Tax Burden Rates on Retail Prices among Commodities (as of Jul 2013)**

Unit: %

- Tobacco: 64.5%
- Beer: 45.5%
- Sake: 29.1%
- Automobile: 10.9%
- Piano: 4.8%
- Gasoline: 39.9%
- Diesel Fuel: 28.5%

**Transitional Measures on Petroleum and Coal Tax (Global Warming Countermeasure Tax)**

Unit: Yen

<table>
<thead>
<tr>
<th></th>
<th>Crude Oil &amp; Pet. Products (per KL)</th>
<th>LNG &amp; LPG (per ton)</th>
<th>Coal (per ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Until Sep. 30, 2012</td>
<td>2,040</td>
<td>1,080</td>
<td>700</td>
</tr>
<tr>
<td>From Oct. 1, 2012</td>
<td>2,290</td>
<td>1,340</td>
<td>920</td>
</tr>
<tr>
<td>From Apr. 1, 2014</td>
<td>2,540</td>
<td>1,600</td>
<td>1,140</td>
</tr>
<tr>
<td>From Apr. 1, 2016</td>
<td>2,800</td>
<td>1,860</td>
<td>1,370</td>
</tr>
</tbody>
</table>

Notes: Additional tax rates are calculated based on CO₂ emission from each fossil fuel.
Reinforcement of Corporate Structure

Vital Need to Reinforce Corporate Structure

The petroleum industry continues to be requested to supply petroleum products which are fundamental to people's lives in a stable manner.

Though the petroleum industry faces difficult business conditions, it is essential for the industry to make facility investment, etc. to secure stable oil supply. To comply with such requests, it is necessary for the petroleum industry to ensure a fair earnings level and to improve and reinforce the petroleum industry's business structure.

Financial Results

The earnings structure of the petroleum industry, however, is in an extremely severe situation, even in comparison with other industries. Under a declining trend of domestic petroleum product demand on a medium- and long-term basis as a consequence of falling population, etc., the domestic market size looks set to decrease in the future. In addition, the financial closing tends to be largely affected by the volatility risk of crude oil prices, etc. In such a difficult business environment, efforts to ensure proper earnings have become an increasingly important issue for the industry.

The recent financial results of the petroleum industry show that the profitability of the petroleum product segment is being put into place to create a better environment for ensuring a certain level of earnings through oil companies' efforts to improve the supply and demand environment.

The performance of the oil and gas exploration development segment is expected to continue firm, backed by a forecast of continuing high crude oil prices, etc., though exchange rate impacts exist.

On the other hand, the profitability of the petrochemical segment is affected by declining profit margins due to sluggish product market conditions caused by the downturn in the global economy and intensified competition with foreign petrochemical industries.

As for the earnings of the petroleum product segment, the apparent profits or losses are booked as a consequence due to the "inventory valuation impact" by the fluctuation of crude oil prices.

The "inventory valuation impact" means when crude oil prices fluctuate, a product's sales cost at financial closing is affected depending on the type of inventory valuation method which is used. During a period of rising crude oil prices, the inventory valuation gain is generated by the depressed sales cost at financial closing, because the opening inventory cost is lower than the inventory acquisition cost during the term. On the other hand, in a time of falling crude oil prices, the inventory valuation loss is generated due to the higher opening inventory cost than the inventory acquisition cost during the term. Such an "inventory valuation impact" creates a large fluctuation in earnings from the petroleum product segment.

The financial results of the petroleum industry for fiscal year (FY) 2011 ended in the black for the whole financial year. Though the profit margin of petroleum products worsened compared to that for FY2010, this positive figure was attributable to such factors as a rise in crude oil prices and the inventory valuation gain due to a change in the inventory valuation method by some oil companies. As for FY2012, despite many oil companies posting losses for the first half due to worsened profit margins, the crude oil price decline, etc., they are forecast to end in the black for the whole financial year because of the recovery in profit margins and a rise in crude oil prices in the second half of the year.

In response to the structural changes surrounding the petroleum industry, each oil company has been taking various countermeasures such as exporting petroleum products, reinforcing their petrochemical and oil exploration businesses, and investing in new businesses to strengthen their management base. Furthermore, various business efforts have been made, such as the reformulation of the wholesale pricing scheme to properly reflect crude oil price fluctuations and the improvement in the supply and demand situation by means of reducing excessive facilities.
It is essential from now on for each oil company to properly assess the changes in the business environment and take further rigorous measures. While making utmost efforts to construct a thoroughly streamlined and efficient business framework, each oil company is requested to build a stronger corporate structure by securing a certain earnings level in order to be able to make reinvestment.
Thorough Safety Measures

The petroleum industry has developed a safety management system using the latest technology and provides a strict prevention system to deal with unexpected disasters in such operational stages as refining, storage, transportation and sales. There are two aspects of these safety measures, the hardware and software.

On the hardware side, all possible safety measures are taken into consideration in facility construction, from a safety review on construction materials in the design stage to the management of construction work. Facility layouts are planned so that safe distances are kept between the petroleum processing and storage sites and the nearby residential areas, and firebreaks are also installed between all facilities. Each plant facility and storage tank is also designed to withstand massive earthquakes.

On the software side, facility maintenance is the core part of safety management. This includes periodic shutdown inspections, on-stream inspections, daily inspections and special inspections. An emergency shutdown system is in place and oil and gas leak detectors have been installed. Patrol teams make continuous rounds so they can act immediately when abnormal phenomena are detected, or can extinguish any fire at an early stage. Also, “In-company Disaster-prevention Organizations” and “Joint Disaster-prevention Organizations” have been formed. These are composed to include personnel from large-scale industrial plants nearby with trained workers on a full-time basis to ensure prompt action in case of unexpected fires or oil outflows. In such organizations, chemical fire engines, elevated water spraying vehicles, foam liquid carriers, oil skimmers, oil recovery vessels, and fire-floats are in place and ready to operate.

In terms of safety measures for plant workers, several training programs are conducted in each working unit to elevate workers’ hazard awareness. Experiences of past incidents at refineries are studied collectively to develop incident prevention measures, which are incorporated in the safety training programs. From FY2002, information on facility-related incidents has been shared among industry members so as to develop proactive measures preventing similar incidents. Preventive actions taken by each oil company are compiled and shared as common information to prevent incidents in the petroleum industry as a whole. In August 2012, “The Study Group on Securing Refinery Safety” was organized to strengthen the prevention of incidents.

Disaster Prevention against Longer-Cycle Seismic Vibration

In September 2003, a large-scale tank fire broke out at the time of the Tokachi Offshore Earthquake. This was caused by longer-cycle seismic vibration that had not been experienced in the past. To cope with earthquakes of such a nature, the Petroleum Complex Disaster Prevention Law and related regulations were updated to include anti-earthquake safety measures for floating roof tanks and firefighting tactics in case a full-scale fire involving such a tank occurs. The petroleum industry is proceeding with a plan to reinforce the “wide-area joint disaster prevention organizations” by installing mass foam discharging systems, in cooperation with the national stockpiling facilities, the petrochemical industry and the electric power industry. By November 2008, the “wide-area joint disaster prevention organizations” were established in 12 nationwide blocks, and the installation of mass foam discharging systems was completed in May 2009. Furthermore, the framework of mutual assistance among these 12 blocks was established in March 2010.

Maintenance of Mobile Mutual Support Systems

Petroleum Association of Japan (PAJ) set up a policy named “PAJ Mutual Support Policy for Petroleum Refinery/Facility Disasters”, assuming a case in which wide-area and extensive assistance is needed beyond the Designated Disaster-prevention District specified by the Law on the Prevention of Disasters in Petroleum Industrial Complexes and
Other Petroleum Facilities. An appropriate, prompt and mobile support system has been developed for keeping damage to a minimum level with this policy. Refineries and oil storage terminals are thus protected by double and triple safety measures.

**Efforts to Develop New Technological Innovations**

Introducing the latest innovative technology is essential for improving equipment reliability and disaster prevention capability. As old-fashioned technical standards not only impede safety improvements but also require a heavy cost burden, it is an alarming problem in view of international competitiveness. PAJ, therefore, plays a leading role in advocating incorporation of performance standards into the Fire Defense Law and other safety-related regulations, and also is working on the introduction of new technologies for plant facility maintenance and disaster prevention as voluntarily taken safety measures.

1. **Introduction of Large-capacity Extinguishing Foam Cannon System**

   A large-capacity extinguishing foam cannon system was installed at the wide-area joint disaster prevention organizations to cope with a full-scale fire involving a large storage tank. A foam cannon used in this system has a capacity equal to ten conventional foam fire trucks. To operate the system effectively and efficiently, PAJ conducts regular education and training.

2. **Establishment of Facility Maintenance Standards**

   As the existing law stipulates strict criteria for facility maintenance and repair, even fully usable equipment sometimes has to be replaced or repaired by law. PAJ has been addressing the need for the establishment of private sector voluntary standards, aiming at legally stipulating equipment performance standards so as to promote voluntary safety maintenance.

   As part of this activity, PAJ jointly issued the “Handbook on Evaluation of Appropriate Useful Life” with the Japan Petrochemical Industry Association, and developed a software program to evaluate whether damage detected within a given piece of equipment’s normal lifespan would affect its future continued operation. Also jointly with the Japan Petroleum Institute, PAJ compiled inspection and maintenance technologies into the “Maintenance Standard for Piping, Static Equipment, Rotating Machinery, Electrical Installations, Instruments, and Outside Storage Tanks” to improve the reliability of facility maintenance.

3. **Introducing New Inspection Technology**

   Improving inspection technology while facilities are in operation is extremely important to maintain facility operations safely. However, new inspection technologies cannot be employed based on facility staff’s own judgment since the inspection methods are specified by the existing Fire Defense Law and High Pressure Gas Safety Law. PAJ requests that the Fire and Disaster Management Agency legislate the performance standards to avoid such an adverse effect. At the same time, PAJ is conducting open demonstrations of new inspection technologies, which are already accepted in foreign countries, so as to obtain domestic acceptance of the technology.
Petroleum Association of Japan (PAJ) established six domestic and five overseas bases by the end of March 1996 for stockpiling and lending oil spill response (OSR) equipment in the event of a major oil spill incident upon request by the parties concerned. The domestic Wakkanai sub-base was added in July 2010 in line with the start-up of crude loading from Sakhalin II Project site.

In preparation for a spill incident, domestic bases are located at oil refineries/storage terminals on 24-hour operations in close proximity to the waters where there is heavy traffic in marine transportation of oil.

Overseas bases are in the United Arab Emirates (UAE), Saudi Arabia, Indonesia, Malaysia and Singapore along the major oil routes from Middle Eastern oil producing countries to Japan.

As of April 2013, PAJ had lent out OSR equipment 27 times (17 times for domestic spills) since the establishment of the first stockpile base in November 1991.

A substantial quantity of large-scale oil booms, skimmers, temporary storage tanks, etc. were lent out at the request of ship owners and/or other parties concerned in such major lending cases as a tanker stranding incident off Yeochon in the Republic of Korea in July 1995, a spill incident from a Russian-flagged tanker in Japanese territorial waters off Shimane Prefecture in January 1997, a tanker collision incident in the Singapore Strait in October 1997, the submergence of a large-scale barge in the Arabian Gulf in January 1998, a tanker stranding incident in the Singapore Strait in October 2000, and a tanker collision incident in May 2010. Especially in the incident of the Russian tanker Nakhodka, PAJ fully contributed to the response activity by continuously dispatching OSR equipment instructors in cooperation with the storage/maintenance companies of the domestic bases.

Under this OSR equipment stockpiling program, because all the equipment, including foreign products, consists of new large-scale and high performance devices, it is necessary for concerned parties to undergo training to familiarize them with the handling of such equipment for quick and smooth response activities. PAJ not only participates actively in disaster response drills conducted by local Coast Guard headquarters or disaster response cooperatives in the areas where the domestic stockpile bases are located, but also conducts periodic training courses in the bases for OSR staff of PAJ member companies and their subsidiaries nearby to familiarize staff with the handling of OSR equipment. PAJ also gives training to the stockpile base staff to train experts to be on-scene commanders by dispatching them to overseas institutions specializing in oil spill responses. Joint OSR drills with the staff of the overseas bases are also held abroad.

PAJ has conducted research and development activities on OSR for many years.
1. Improvement and Maintenance of the Diffusion/Drifting Model for Spilt Oil
   It started in 1992 to develop a “Diffusion/Drifting Simulation Model for Spilt Oil (a trajectory model)” so that the model could be utilized for quick and effective containment and cleanup work of an oil spill incident. The model has been upgraded in accuracy and convenience of use since then by expanding the coverage of sea areas, giving changes with the passage of time, showing geodesic change, etc. Simulation models are available at the PAJ OSR website (http://www.pcs.gr.jp) and are easily downloadable for use on personal computers
2. Oil Slick Detection Technology Using Satellite Imagery
   In 2011 PAJ developed a system to automatically
detect oil slicks in a spill incident at sea. This system, by utilizing space satellite observation data, detects the situation of the diffusion/drifting trajectory in any weather conditions. This gives essential information for early establishment of an effective and efficient response to oil spill incidents. The PAJ OSR website carries this system for ready use.

In this system, automatic detection results of past oil spill incidents which were subjects of study, as well as technical data, research reports and other information on past spill incidents are available. Furthermore, oil slicks can be automatically detected by the system’s automatic identification program using the imagery of synthetic aperture radar (SAR) which is carried by satellite.

Hosting of International Oil Spill Conferences

PAJ invites oil spill specialists from Japan and abroad to its international oil spill conferences held every year (15 symposia and 2 workshops were held between 1995 and 2012). The purposes are to exchange information among participants about responses to major oil spill incidents, recent movements of international compensation systems, and technology development regarding oil spills.

Since the disaster in the Gulf of Mexico, several accidents occurred inland and overseas, such as in the Bohai Sea and New Zealand offshore. However, the number of major incidents is gradually decreasing owing to the efforts of the parties concerned and international cooperation. In February 2013, an international workshop was held on the subject of “Deepwater Horizon Update and Hereafter” to discuss the consequences of the incident in the Gulf of Mexico in 2010. Workshop speakers were from the major organizations associated with the incident.
Environmental Measures in the Oil Refining Sector

Various Environmental Measures

The Japanese petroleum industry is striving for cleanliness in refineries with special attention to air and water quality, noise levels, the volume of industrial waste and areas of greenery. The industry is also dedicated to improving the environmental performance of product processing. The completion of the world’s first lead-free gasoline program and the implementation of a phased sulfur reduction program for diesel fuel have been highlights of the industry’s accomplishments.

The petroleum industry has also implemented environmental control systems to carry out appropriate environmental management in refineries and fuel storage facilities. One major example is the ISO Environmental Management System, which came into effect in September 1996, and was enacted as the Japanese Industrial Standard in October 1996. Each oil company was accredited internationally by the adoption of ISO 14001, and maintains a control system for improving environmental conservation.

Air Pollution Control Measures

Sulfur Oxide Reduction Measures

To reduce Sulfur Oxides (SOx) emissions from refineries, low-sulfur by-product gas, which is released from various processing units and low-sulfur fuel oils, is used as an on-site fuel for furnaces and boilers in refineries. Furthermore, the flue gas desulfurization process substantially reduces the SOx contained in the combustion gas. The process which reduces products’ sulfur content (such as the heavy oil desulfurization units and hydrotreating units for kerosene, gas oil and lubricating oil) generates by-product gas with a high concentration of hydrogen sulfide. The by-product gas is treated in a sulfur recovery unit to collect sulfur. The remaining sulfur compounds are then processed in a tail-gas processing unit.

Nitrogen Oxide Reduction Measures

To lower the amount of Nitrogen Oxides (NOx) emitted from furnaces and boilers at refineries, the petroleum industry has improved the combustion method through low NOx burners and two-step combustion; flue gas denitrification units further reduce NOx in the combustion gas.

Soot and Dust Reduction Measures

As a refinery makes the best possible use of its by-product gas released from various processing units as on-site fuels, the amount of soot and dust emissions becomes very small. Cyclones and electric dust precipitators are installed in series in fluidized catalytic cracker (FCC) units and large boilers to minimize soot and dust emissions.

Volatile Organic Compounds Reduction Measures

Volatile Organic Compounds (VOC) are known to change into suspended particulate matter (SPM) or photochemical oxidants when released into the atmosphere. Fuel storage tanks and their loading facilities are the main sources of VOC emissions from refineries. Crude oil and gasoline are stored in tanks with a sealed-type floating or inner-floating roof to contain VOC emissions. In addition, hydrocarbon vapor recovery units are installed at fuel loading facilities for railroad tankers and tank trucks.

Petroleum Association of Japan (PAJ) has been
making efforts to control VOC emissions under its Voluntary Action Plan, which set a target of a 30% reduction in 2010 versus the base year of 2000, and is confirming the results periodically. The reduction target was achieved in FY2010 with a 31% reduction versus the FY2000 level. The effort was continued and the FY2011 result was a 32% reduction.

**Measures against Hazardous Air Pollutants**

Chemical substances which were in relatively high concentration in the air and that would be hazardous to human health were investigated for the purpose of legally controlling their mission. Consequently, the Air Pollution Control Law was amended, effective April 1997, to include benzene in the list of hazardous air pollutants, even though it is only emitted in small quantities.

Regarding the benzene emission issue, PAJ announced its “Control Program for Hazardous Air Pollution Substances” in October 1996. In line with this program, various measures were taken to reduce benzene emissions, including the decision to reduce the benzene content in gasoline to less than 1%. Similarly, measures on the exhaust side were taken to reduce volatile organic compounds (VOC).

In July 1999, the Law concerning Reporting of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (PRTR* Law) was enacted. In compliance with the law, the petroleum industry continues to monitor the release and transport of quantities of specified chemical substances.

*PRTR: Pollutant Release and Transfer Register

**Measures for Water Quality Conservation, Industrial Waste Handling, etc.**

**Conservation of Water Quality**

Though a large quantity of heat-exchanging water is used at refineries, the water does not come into contact with oils in order to prevent water contamination. Industrial water is recycled after it is processed with oil separators to reduce the net quantity of effluents from the refineries. In the case where seawater is used for cooling, it is strictly monitored so there is no chance of polluting the environment.

Wastewater from refining processes is treated first by an oil separator to recover oil contents, then goes through an advanced treatment method using chemical coagulants, activated sludge and activated charcoal. Then it is collected in a guard basin, a pond located near the final discharge point, where remaining contaminants can settle out to ensure the water’s cleanliness before its release from refinery sites.

**Noise Reduction**

Oil moving equipment at production, shipment and power utility sites produces a certain amount of noise. Each refining company makes every effort to minimize such noise; locating storage tanks effectively so as to serve as a sound barrier, utilizing low noise burners, and installing sound absorbers and soundproof walls around noise sources are some of the countermeasures being employed.

**Industrial Waste**

Various types of industrial waste are produced at refineries, namely waste oils, sludge, spent acid and alkali, and dust captured by electrostatic collectors. To minimize industrial waste disposal volumes, each oil company reprocesses waste oils, uses sludge and dust as raw materials for cement production, and produces caustic soda from spent alkali to minimize industrial waste volumes. The reduction in industrial waste was 2,000 tons in FY2011, a 98% reduction versus the FY1990 level.

**Measures to Increase Areas of Greenery**

Oil companies maintain refinery sites and their vicinity with as much greenery as possible. About 10% of a refinery’s lot area is allocated for greenery where lawns and trees are planted. The ratio of areas of greenery to the total site area is significantly higher than that of other industry sectors.
Environmental Measures in the Oil Refining Sector

Environmental Regulations and Petroleum Industry Facility Investment

Unit: billion yen

- Heavy Oil Desulfurization ±550
- Unleaded Gasoline ±300
- Low-Sulfur Diesel Fuel ±200
- Further Reduction in Sulfur Content of Gasoline and Diesel Fuel ±300 (Estimate)
- Lower Benzene ±140

Envirionmental Measures:

- Court Decision on Yokkaichi Pollution Lawsuit (1967-1972)
- Automobile Emission Control (1970)
- Establishment of the Agency of Environment (1971)
- Ultra Low-sulfur (50 ppm) Diesel Fuel (End-2004)
- Ultra Low-sulfur (50 ppm) Gasoline (End-2004)
- Long-term Emission Gas Control (2005 for Gasoline and Diesel Fuel)
- Sulfur-free (10 ppm) Diesel Fuel (2007)
- Sulfur-free (10 ppm) Gasoline (2008)
- Diesel Vehicle Emission Control - Short-term (1993)
- - Long-term (1997-99)
- Setup of Benzene Environmental Standard (1996-2000)
- Establishment of Ministry of the Environment (2001)

Heavy Oil Desulfurization Capacity Trends (end of Mar each year)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1,200 (37)</td>
<td>1,441 (44)</td>
<td>1,509 (43)</td>
<td>1,449 (39)</td>
</tr>
<tr>
<td>289 (7)</td>
<td>1,387 (41)</td>
<td>1,447 (40)</td>
<td>1,449 (39)</td>
</tr>
<tr>
<td>862 (29)</td>
<td>1,267 (40)</td>
<td>1,447 (40)</td>
<td>1,449 (39)</td>
</tr>
<tr>
<td>194 (5)</td>
<td>1,358 (40)</td>
<td>1,448 (40)</td>
<td>1,449 (39)</td>
</tr>
<tr>
<td>668 (24)</td>
<td>1,509 (43)</td>
<td>1,451 (40)</td>
<td>1,450 (39)</td>
</tr>
</tbody>
</table>

Source: PAJ

Direct Desulfurization Unit

Indirect Desulfurization Unit

1,000 b/d: number of facility units

Source: PAJ
Efforts toward Fuel Quality Improvements

Improvement in Gasoline and Diesel Fuel Quality

The rapid increase in the number of motor vehicles in Japan, which started in the early 1970s, created serious air pollution problems, including lead emissions, especially in urban areas. To cope with this national concern, the Japanese petroleum industry initiated a program for the first time in the world to eliminate tetra-alkyl-lead blending with gasoline. The phased lead elimination program was completed in February 1975 for regular grade and in December 1986 for premium grade.

In the 1990s and after, the petroleum industry focused on sulfur reduction programs for both gasoline and diesel fuel in line with the development of more sophisticated exhaust gas aftertreatment systems. The petroleum industry launched sulfur-free (10 ppm or less) gasoline and diesel fuel from January 2005 on a voluntary basis.

Complying with a new standard for the emission of hazardous organic compounds, the petroleum industry reduced the content of benzene in gasoline to 1% or less from January 2000.

Airborne hydrocarbons are considered to be one of the main causes of photochemical smog in summer. To reduce hydrocarbon emissions from gasoline in the atmosphere, the petroleum industry voluntarily lowered the maximum vapor pressure standard for summer season gasoline from 2001, and reduced it to 65 kPa in 2005.

Low Sulfur Kerosene

Kerosene for heating use in Japan has the world’s highest standard for reduced sulfur content, a maximum of 80 ppm, to assure cleaner and safer indoor combustion.

Fuel Quality Control Law

With the start of import liberalization of petroleum products effective April 1996, the Act on the Quality Control of Gasoline and Other Fuels (Fuel Quality Control Act) was enacted, replacing the Gasoline Retail Business Law, to maintain the world’s highest level of gasoline, kerosene and diesel fuel quality. The new law specified the existing quality standards as compulsory ones from both environmental and safety viewpoints. The law also introduced the display of a Standard Quality (SQ) certificate at service stations for fuels satisfying the standard quality requirements.

At first, the compulsory standards were specified on 8 items for gasoline quality, and on 3 items for both diesel fuel and kerosene quality. The Fuel Quality Control act has been amended since then to reflect the national concern regarding further quality improvement.

### The Fuel Quality Control Act – Compulsory Standard (as of Apr 2013)

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>Non-detectable</td>
</tr>
<tr>
<td>Sulfur content</td>
<td>0.001 mass% max.</td>
</tr>
<tr>
<td>MTBE</td>
<td>7 vol% max.</td>
</tr>
<tr>
<td>Benzene</td>
<td>1 vol% max.</td>
</tr>
<tr>
<td>Kerosene</td>
<td>4 vol% max.</td>
</tr>
<tr>
<td>Methanol</td>
<td>Non-detectable</td>
</tr>
<tr>
<td>Washed gum</td>
<td>5 mg/100 ml max.</td>
</tr>
<tr>
<td>Color</td>
<td>Orange</td>
</tr>
<tr>
<td>Oxygen content**</td>
<td>1.3 mass% max.</td>
</tr>
<tr>
<td>Ethanol**</td>
<td>3.0 vol% max.</td>
</tr>
<tr>
<td>Diesel Fuel</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Specification</td>
</tr>
<tr>
<td>Cetane index</td>
<td>45 min.</td>
</tr>
<tr>
<td>Sulfur content</td>
<td>0.001 mass% max.</td>
</tr>
<tr>
<td>Distillation, T90%</td>
<td>360˚C max.</td>
</tr>
<tr>
<td>Triglyceride</td>
<td>0.01 mass% max.</td>
</tr>
<tr>
<td>FAME*2</td>
<td>0.1 mass% max.</td>
</tr>
<tr>
<td>Kerosene</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Specification</td>
</tr>
<tr>
<td>Sulfur content</td>
<td>0.008 mass% max.</td>
</tr>
<tr>
<td>Flash point</td>
<td>40˚C min.</td>
</tr>
<tr>
<td>Color, Saybolt</td>
<td>+25 min.</td>
</tr>
</tbody>
</table>

*1 For an automobile that received registration by the Road Vehicle Act or its vehicle number is specified by law as a vehicle compatible with E10, gasoline specifications for both oxygen and ethanol are relaxed to 3.7 mass% and 10 vol% max, respectively.

*2 This specification is applicable to diesel fuels without international blending of FAME (Fatty Acid Methyl Ester) Compulsory standards allow FAME upper blending limit of 5.0 mass%. In such a case, additional standards include
  - Methanol: 0.01 mass% max. + Acid value: 0.13 mgKOH/g max.
  - Formic acid + Acetic acid + Propionic acid: 0.003 mass% max. + Acid stability: 0.12 mgKOH/g max.
Through the progress of deregulation, alcohol-blended automotive fuel was introduced onto the market by product importers. The quality and performance of the alcohol-blended fuel were not covered by the scope of the Fuel Quality Control Act. Consequently, several fires involving vehicles using the alcohol-blended fuel were reported. To ensure consumers’ safety, the Ministry of Economy, Trade and Industry (METI) banned the sale of such alcohol-blended fuel effective August 2003 and amended the Fuel Quality Control Act to include the upper limit of alcohol-to-gasoline blending as a maximum of 3% of volume for ethanol and 1.3% in weight for oxygenate.

In view of verification work on biofuels recently conducted in various places, effective March 2007, mandatory standards for FAME (Fatty Acid Methyl Ester), Tri-glyceride and four other materials were added to diesel fuel quality requirements in order to allow blending of bio-diesel components in diesel fuel. The additional requirements include an upper limit for blending in diesel fuel. In February 2009, a registration system and quality assurance system was established for newcomers in the business for blending ethanol and equivalent products in gasoline.

Accordingly, the Fuel Quality Control Law should be revised as necessary from now on to properly assure fuel quality in line with METI’s plan.

Deterioration in air quality caused by diesel emissions, namely nitrogen oxides (NOx), soot and dust particulate matter (PM), had become a national concern in the 1980s. In 1989, short- and long-term emission standards were established to reduce NOx and PM emissions from diesel engine buses and trucks. To achieve this diesel engine emission standard, engine manufacturers were required to install advanced exhaust gas aftertreatment systems (EGR: Exhaust Gas Recirculation and Oxidation Catalyst).

The petroleum industry cooperated with the engine manufacturers to achieve the emission standard smoothly by reducing the fuel sulfur content of diesel fuel from 5,000 ppm to 2,000 ppm in 1992 and further to 500 ppm in October 1997. Over this period, oil refiners invested 200 billion yen to install new facilities for high-performance gasoil desulfurization.

In response to ongoing national concerns with PM emissions, the existing long-range diesel emission standard was revised to move forward the implementation year from 2007 to 2005. The target emission level was achievable only with the installation of aftertreatment devices, such as a diesel particulate filter (DPF), together with the reduction of diesel sulfur content. In this way, the requirement for diesel sulfur was lowered to 50 ppm or less by the end of 2004.

In the meantime, the Tokyo Metropolitan Government (TMG) started its own campaign named “Operation No Diesel Vehicle” from August 1999, banning high emission diesel vehicles from entering the metropolitan area. TMG mandated the installation of DPF on existing diesel vehicles effective October 2003, ahead of the national target in 2005, and urged vehicle manufacturers to implement early introduction of new DPF-equipped diesel vehicles.

In view of the urgent need for reduction of diesel emissions accelerated by the scheduled TMG regulation, the petroleum industry announced its partial supply of low sulfur (50 ppm max.) diesel fuel from

**Sign of Sulfur-free Gasoline**

![Sulfur-free Gasoline Sign](image)
October 2003 to meet the TGM regulation. Since then, several local governments, i.e., Osaka and Aichi, as well as large commercial diesel fuel users such as the bus and truck industries, requested an earlier introduction of low sulfur diesel fuel.

TMG also urged the introduction of a nationwide supply of low sulfur diesel fuel prior to the implementation of the local Tokyo regulation so that all DPF-equipped diesel vehicles could enter and drive through the metropolitan area. The petroleum industry moved forward the facility investment schedule for earlier production of low sulfur diesel fuel, and started supplying 50 ppm diesel fuel voluntarily from April 2003, 21 months earlier than the enforcement deadline of government regulations.

Needs for further reduction of fuel sulfur content to sulfur-free (10 ppm or less) were already reported on several occasions. In January 2002, TMG drew up its Basic Environment Plan in which sulfur content for both gasoline and diesel fuel was requested to be 10 ppm or less by 2008. In June 2003, the Petroleum Council Subcommittee referred to the appropriate timing for introduction of sulfur-free gasoline as 2008 and sulfur-free diesel fuel as 2007.

Availability of sulfur-free fuel is a prerequisite for developing technologies for exhaust emission after-treatment to meet more stringent emission standards for both gasoline and diesel fuel engines, and at the same time for improving the fuel economy of these engines. The introduction of sulfur-free fuels would contribute significantly to a clean environment by reducing vehicle emissions and to mitigating global warming by reducing CO₂ production.

The petroleum industry has invested 300 billion yen of capital resources in developing cleaner fuel production technologies, and on construction and modification of desulfurization facilities to ensure the production of sulfur-free fuels. As a result, the industry announced in September 2003 that the world’s first supply of sulfur-free gasoline and diesel fuels would start from January 2005 in all areas of Japan.
The Global Warming Issue and Oil

Global Trends Regarding the Climate Change Issue

Aiming at stabilizing the concentration of atmospheric greenhouse gas (GHG) and maintaining the current climate into the foreseeable future, international measures for global warming issue are discussed periodically in line with the United Nations Framework Convention on Climate Change (UNFCCC) and the “Kyoto Protocol” which rests on the framework.

The Kyoto Protocol, adopted in 1997, set legally binding GHG emission reduction targets on industrialized countries, namely Japan, the US and European nations, as a first commitment period. However, the US decided to withdraw from the Kyoto Protocol in 2001 and no emission reduction is obliged for developing countries including large emitting countries like China and India. As a result, the coverage of reduction obligations by the participating countries declined to about a quarter of the total global emission levels.

Japan continues its efforts to reduce GHG emission, but has stated that Japan has no intention to participate in the second commitment period because the existing Kyoto Protocol framework does not serve to construct a fair and feasible international framework in which all major emitting countries participate. European countries are leading the promotion of the second commitment period with a 2020 target year which covers a quarter of the global emission level.

Domestic Trends Regarding the Climate Change Issue

Trends of Greenhouse Gas Emission

A flash report on FY2011 GHG emissions shows a 3.6% increase versus the basis for the first commitment period of FY1990 level due to the increased ratio of thermal electric power generation after the Great East Japan Earthquake. However, incorporating the forest sink measures and Kyoto mechanism credits for the government and the private sectors, the amount of emissions for the four-year average from FY2008 to FY2011 decreased by 9.2%. This exceeds the Kyoto Protocol reduction target for the first commitment period of 6% versus the FY1990 level.

FY2011 CO₂ emissions by energy origin sector (flash report) showed that the industrial sector achieved a reduction of more than 10% versus the FY1990 level. However, the business sector as well as the household sector increased more than 50% in the same period.

Industry’s Movement

Japanese industry circles led by Keidanren (the Japanese Business Federation) developed targets on unit consumption or CO₂ emission, depending on the nature of their business, to meet the obligation set for the first commitment period of the Kyoto Protocol. As a social commitment, these targets were incorporated in “Keidanren’s Voluntary Action Plan”. The industry’s voluntary plan is achieving
steady results, and is credited with playing a central role in domestic measures which the government advocates.

Based on these experiences, Keidanren and major industry circles announced their “Low-Carbon Society Action Plan” to succeed Keidanren’s ongoing action plan. With a major focus on energy conservation at oil refineries, the petroleum industry prepared “Petroleum Industry’s Action Plan for a Low-Carbon Society”

**Petroleum Industry’s Efforts**

Being a frontrunner in taking environmental measures as “an advanced environmental industry”, the Japanese petroleum industry has been making positive efforts to address global warming through methods such as launching sulfur-free automotive fuels in 2005. With a focus on the steady implementation of the Nippon Keidanren’s Voluntary Action Plan, each member company of Petroleum Association of Japan (PAJ) has been implementing further energy conservation in its own business operations and making an active contribution to reducing GHG emissions in its transportation and operations units where petroleum products are consumed.
**Petroleum Industry’s Voluntary Action Plan for Global Environmental Conservation**

PAJ formulated the “Voluntary Action Plan for Global Environmental Conservation by the Petroleum Industry” in February 1997 to respond to Nippon Keidanren’s initiative, and set a target to be achieved by FY2012 for the improvement of unit energy consumption at oil refineries. Especially the unit energy consumption at oil refineries in FY2011 was improved by 16% from FY1990 through the use of sophisticated heat recovery units and efficiency improvement and optimization of refining facilities. In October 2007, the petroleum industry’s target was revised upward to a 13% improvement from FY1990, incorporating progress in energy conservation and considering the projected decrease in oil demand in the future.

**Refineries’ Energy Conservation Measures**

Energy conservation at refineries consists of a wide range of measures which include (1) expanding the common use of heat among facilities and adding waste heat recovery units, (2) sophisticated operation control through innovative technology for process control and optimal operation, (3) adopting high-efficiency facilities and catalysts, and (4) operating facility maintenance efficiently. These measures are being evaluated at the “National Excellent Energy Conservation Examples Convention (until FY2008)” and “Energy Saving Grand Prix (organization category)” carried out by the Energy Conservation Center of Japan, and many oil refineries are awarded for their excellence.

The petroleum industry is actively utilizing the energy conservation project conducted by a governmental organization, and introducing advanced energy conservation technology to refineries.

In addition, many refineries are participating in “Kombinat (Refining and Petrochemical Complex) Renaissance Program” which is aimed at advanced integral management of nearby factories in a Kombinat group, and working on the overall reduction of energy consumption as a joint project, not only by reducing direct energy consumption but also by promoting procurement of raw materials, utilization of by-products and efficient process management.

### Energy Saving Projects at Refineries

<table>
<thead>
<tr>
<th>Energy Saving Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through insulation of towers, tanks and piping</td>
</tr>
<tr>
<td>Improving furnace efficiency</td>
</tr>
<tr>
<td>Installation and cleaning of various heat-exchangers</td>
</tr>
<tr>
<td>Flare gas recovery</td>
</tr>
<tr>
<td>Reducing furnace air flow rate</td>
</tr>
<tr>
<td>Common use of heat among processing units</td>
</tr>
<tr>
<td>Installation of process turbines (recovery of pressure energy)</td>
</tr>
<tr>
<td>Optimizing pump capacity (cut impellers)</td>
</tr>
<tr>
<td>Promoting computer control</td>
</tr>
<tr>
<td>Previewing control limit of operation</td>
</tr>
<tr>
<td>Improving efficiency of power-train equipment such as motors and compressors</td>
</tr>
<tr>
<td>Introduction of high efficiency equipment</td>
</tr>
<tr>
<td>Through management of steam traps to reduce steam consumption</td>
</tr>
<tr>
<td>Reducing boiler air flow rate</td>
</tr>
<tr>
<td>Introduction of co-generation system</td>
</tr>
</tbody>
</table>

### Energy Saving Technologies in the Government Support Projects on Energy Use Utilization

<table>
<thead>
<tr>
<th>Energy Saving Technologies Introduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Introduce variable-speed gas compressor</td>
</tr>
<tr>
<td>2 Recover waste-heat from steam-traps by capturing effluent steam</td>
</tr>
<tr>
<td>3 Reduce furnace fuel consumption by replacing regular trays with high efficiency trays</td>
</tr>
<tr>
<td>4 Install desuperheater to recover steam</td>
</tr>
<tr>
<td>5 Install waste-heat boiler</td>
</tr>
<tr>
<td>6 Install propylene fractionation process unit of high energy-efficiency type incorporating industrial heat-pump system</td>
</tr>
</tbody>
</table>

As a result of these efforts, Japanese refineries have a world-leading level of energy efficiency.
The Global Warming Issue and Oil

Sulfur-free Automotive Fuels as a CO₂ Countermeasure

Using sulfur-free gasoline and diesel fuel (sulfur content of less than 10ppm) contributes to the reduction of nitrogen oxides (NOx) and particulate matter (PM), and also contributes to CO₂ reduction due to fuel efficiency improvement. This is expected to be a useful global warming countermeasure. The petroleum industry launched the nationwide supply of sulfur-free fuels in January 2005 well in advance of government regulation.

Promotion of Technology Development and International Cooperation

Technological breakthroughs are essential for global warming countermeasures. Each PAJ member company advances the development of emerging technologies like environmentally-friendly fuel cells and hydrogen refueling service stations. The oil companies also promote international technical cooperation for GHG reduction on a global basis and participate in overseas projects. In particular, regarding the United Nation’s Clean Development Mechanism (CDM), six projects by four oil companies (PAJ members) were recognized by the Japanese government.

Shifting to Diesel Vehicles (Diesel Shift)

Diesel engine vehicles are considered a more effective countermeasure to global warming than gasoline vehicles as they have better fuel efficiency and consequently generate less CO₂. In Europe, about 50% of newly registered passenger vehicles have diesel powered engines which have been technically improved since the late 1990s for better driving performance and less exhaust emissions. On the other hand, 0.1% of passenger vehicles sold in Japan are diesel powered. The lack of popularity of diesel vehicles is due to Japan’s more stringent NOx emission regulations compared with European standards, together with the negative image connected to the noise and vibration of diesel trucks. Although recent technological developments enabled us to sweep away all of these concerns, customers’ acceptance still remains at a low level.

Under these circumstances, the Ministry of Economy, Trade and Industry (METI) organized a study group to forecast the viability of clean diesel fuel for passenger vehicles. The group concluded in the report, issued in April 2005, that the promotion of diesel passenger vehicles (shifting to diesel vehicles) is
an effective means of reducing CO₂ generation in the transportation and industrial sectors. Some of the advantages are as follows:

1. A 10% increase in the number of diesel vehicles would reduce CO₂ generation by 2 million tons a year in the transportation sector.
2. A 10% shift in production volume from gasoline to diesel fuel (4 million KL a year) would lead to a 1.7 million ton CO₂ reduction in the oil refining sector.

Moreover, the Kyoto Protocol Target Achievement Plan approved in April 2005 stated that “when a clean diesel passenger vehicle that has exhaust emission quality not inferior to that of a gasoline vehicle is developed, the promotion of such a diesel vehicle shall be examined accordingly”.

Further to this, METI’s Basic Energy Plan, revised in February 2007, clearly stated that “Diesel Shift” should be one of the energy conservation and CO₂ reduction measures in the transportation sector. Meanwhile, METI released a report called the “Next-

<table>
<thead>
<tr>
<th>Manufacturing Stage of Petroleum Products (Refinery)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Maintain and improve the world's highest level of energy efficiency by the introduction of state-of-the-art technology and cooperation with nearby factories.</td>
</tr>
<tr>
<td>☐ Aim to achieve energy saving volume of 530 thousand KL (crude oil equivalent) in FY2020 with energy saving measures after FY2010.</td>
</tr>
<tr>
<td>☐ Introduce biomass fuel for which stable and economical procurement is possible as the effect on greenhouse gas reduction using LCA, competition with food, supply stability, and ecosystem consideration are being verified.</td>
</tr>
<tr>
<td>☐ Promote the use of ETBE blended biomass fuel while ensuring sustainability and stable supply in cooperation with the government, aiming at a steady introduction to meet the target amount of 500 thousand KL (crude oil equivalent) in FY2017 set by the Law Concerning Sophisticated Methods of Energy Supply Structures.</td>
</tr>
<tr>
<td>☐ Introducing Biomass Fuel</td>
</tr>
<tr>
<td>☐ Introducing High-Efficiency Water Heater (“Eco-Feel”)</td>
</tr>
<tr>
<td>☐ Oil-Based Fuel Cell</td>
</tr>
<tr>
<td>☐ Promoting lubricating oil superior in fuel performance (for gasoline powered automobiles)</td>
</tr>
<tr>
<td>☐ Use the knowledge and the experience of the petroleum industry that achieves the world’s highest level of energy efficiency for personal and technical exchanges with developing countries</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific Approach to FY2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Clean Diesel Powered Vehicle</td>
</tr>
<tr>
<td>☐ Promoting High-Efficiency Water Heater (“Eco-Feel”)</td>
</tr>
<tr>
<td>☐ Oil-Based Fuel Cell</td>
</tr>
<tr>
<td>☐ Promoting lubricating oil superior in fuel performance (for gasoline powered automobiles)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Development of Innovative Technologies (2030 - 2050)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ “Petroleomics Technology” combined with detailed structural analysis of heavy oils and reaction simulation model</td>
</tr>
<tr>
<td>☐ Carbon dioxide capture and storage (CCS)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>International Cooperation</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Use the knowledge and the experience of the petroleum industry that achieves the world’s highest level of energy efficiency for personal and technical exchanges with developing countries</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption Stage of Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Introducing Biomass Fuel</td>
</tr>
<tr>
<td>☐ Introducing High-Efficiency Water Heater (“Eco-Feel”)</td>
</tr>
<tr>
<td>☐ Oil-Based Fuel Cell</td>
</tr>
<tr>
<td>☐ Promoting lubricating oil superior in fuel performance (for gasoline powered automobiles)</td>
</tr>
</tbody>
</table>

The petroleum industry actively contributes to global environmental conservation, the formation of a recycling society and sustainable economic development of society. With these as basic principles, the industry aims to pursue the formation of a low-carbon society and simultaneous achievement of the “3E” policy (energy security, environmental concern and efficient supply).
The Global Warming Issue and Oil

The “Next-Generation Vehicle and Fuel Initiative” in May. The report compiled measures to implement the initiative, such as a need for early introduction of clean diesel vehicles which meet the latest emission standards in view of global warming and energy security issues as well as international competitiveness.

The petroleum industry has invested about 300 billion yen of capital resources and started the world’s first supply of sulfur-free diesel fuel in all areas of Japan in January 2005 with an expectation of expanding demand for clean diesel vehicles with improved fuel efficiency. In recent years, clean diesel vehicles are being reevaluated in terms of both air pollution abatement and global warming viewpoints by many parties concerned, and its policy positioning has been significantly changed from that in the past.

To achieve the realization of the “Next-Generation Vehicle and Fuel Initiative”, national and local governments together with automobile and petroleum industries set up the “Clean Diesel Study Group” in January 2008 to discuss promotion plans to expand the utilization of clean diesel vehicles. Such issues as dissemination of clean diesel vehicles, image enhancement, cost reduction, and the outlook for diesel technology development were deliberated at the meetings, and two reports, entitled “Clean Diesel Promotion Strategy” and “Clean Diesel Promotion Policy (Detailed Strategy Version)”, were compiled in June 2008. The reports reconfirm the significance of launching clean diesel vehicles which contribute to CO₂ emission reduction in the transportation sector. In addition, image enhancement strategies and tax incentives were taken. As a promotional measure for diesel vehicles, image improvement events like exhibitions and test-ride events were conducted at the G8 Hokkaido Toyako Summit in July 2008. This is because Hokkaido has the regional distinction of having a high diesel vehicle ownership ratio and of having many active environmental industries.

Clean diesel vehicles, together with hybrid and electric ones are regarded as key players in the environmentally friendly vehicle market in the short and medium term. Therefore, market creation and widespread utilization of clean diesel vehicles are emerging issues. The petroleum industry looks forward to significantly expanding the clean diesel vehicle market based on the above strategy, and will continue collaborating with the central and local governments as well as the automobile industry.
Utilization of Biomass Fuel

Biomass fuels can be produced from renewable materials such as agricultural crops and trees, and they are considered to be “carbon neutral” in terms of carbon emissions. Thus, many environmentally conscious countries are showing great interest in biomass fuels. In the Kyoto Protocol Target Achievement Plan of April 2005, the government specified the use of 500,000KL (crude oil equivalent) of biomass fuels for transportation use.

In January 2006, based on the request of the Agency of Natural Resources and Energy, the petroleum industry announced a target plan to blend bio-ETBE (ethyl-tertiary-butyl-ether) produced from 360,000KL of bio-ethanol (210,000KL of crude oil equivalent) in FY2010 aiming to cooperate in the achievement of the government plan.

With a basic policy of “Priority for Consumers”, “Safety, Security and Fairness”, and “Domestic Production and Consumption” as an accountable fuel supplier, the petroleum industry is steadily striving to meet the whole quantity of the targeted amount set forth by the Law Concerning Sophisticated Methods of Energy Supply Structures. In January 2007, the member companies of Petroleum Association of Japan (PAJ) established a limited liability partnership company (LLP) to jointly procure bio-ETBE and related products. In FY2007, the sale of bio-ETBE blended gasoline was launched at 50 service stations in the Kanto area and it was expanded in FY2008 to 100 sites including such areas as Osaka and Miyagi. The test marketing of bio-gasoline (the government subsidized project) was completed at the end of FY2008. The member companies of PAJ introduced 200,000KL of bio-ETBE blended gasoline in FY2009 to the market prior to the nationwide sales plan of 840,000KL (210,000KL of crude equivalent target volume) in FY2010.

For proper dissemination of bio-ETBE gasoline, PAJ issued display guidelines, such as posting of the bio-ETBE blending ratio. This provides the handling of the name and the logo of “Bio-Gasoline” when bio-ETBE blended gasoline is sold in the service stations of PAJ member companies in an effort to establish a marketing environment where consumers are assured of product quality. As of February 2013, bio-gasoline was being sold at about 3130 service stations, and it is likely to meet 210,000KL of crude equivalent target volume.

Furthermore, the Basic Energy Plan revised in June 2010 includes introducing biomass fuel as over 3% of national gasoline consumption in FY2020*. In line with this plan, the Law Concerning Sophisticated Methods of Energy Supply Structures, enforced in November 2010, specified blending about 820,000KL of bio-ethanol (500,000KL of crude equivalent volume) directly into gasoline or in the form of bio-ETBE in FY2017.

Although bio-ethanol is drawing attention as a biomass fuel, there are several concerns as follows:

① Its domestic production is practically not viable due to Japan’s limited cropland and high production costs.
② Since Brazil is the only country which has a surplus export capacity of bio-ethanol, there is a risk of not being able to secure a stable supply resulting from uncertain weather conditions and food market prices (Stable Supply).
③ The raw material is a high-priced agricultural crop.
④ Its calorific value is 30% less than that of gasoline (Fuel Economy).

Moreover, if bio-ethanol is blended directly with gasoline, ① a small quantity of water contamination would result in the phase separation of gasoline and ethanol to increase the possibility of fuel quality change (a lowered octane number), ② the safety of consumers might be threatened by corrosion and deterioration of distribution/marketing facilities, and ③ as the direct blending method increases gasoline vapor pressure (an indicator for gasoline volatility), it would increase the emission of poisonous materials such as the hydrocarbons that are considered to cause photochemical smog. Although the advantage of bio-ethanol regarding CO₂ reduction measures tends to be emphasized, it should not be forgotten to discuss pollution abate-
On the other hand, the bio-ETBE method which is promoted by PAJ would never cause such problems. As bio-ETBE is generally blended with gasoline at the refinery (in the production process), the evasion of tax and the circulation of inferior quality gasoline would be prevented. Therefore, the oil industry considers the refinery blending of bio-ETBE be the most appropriate method to cope with those concerns, and recommends this bio-ETBE should be used for automotive fuel.

### Sustainability Standards for Biomass Fuel

At first, great expectations were held regarding the use of biomass fuel as an effective means for the reduction of greenhouse gas (GHG) emissions. Recently, some issues have arisen in relation to competition with food production and also impact on the ecological system. In view of these concerns, Nomura Research Institute, on behalf of the petroleum industry, made a survey to assess the problem and the approach to these issues in other countries. “The Report Concerning Biomass Fuels” was published in December 2007.

Biomass fuel sources as a competitor with those for food has been in the spotlight since early 2008 as the worldwide use of biomass fuel was one of the causes of rapid food price increases. While the use of biomass fuel is expanding around the world, various studies and discussions are ongoing in European countries, the U.S., as well as in the U.N., to establish standards for the development and sustainable use of biomass fuel, focusing on such concerns as competition with food and environmental problems of deforestation. To cope with these moves, the Ministry of Economy, Trade and Industry organized the “Biofuel Sustainability Study Group” in October 2008, with the participation of the Cabinet Office, the Ministry of Agriculture, Forestry and Fisheries and the Ministry of Environment. The group studied the requirements to formulate the Japanese version of biomass fuel sustainability standards. The group, considering the importance of sustainability and stable supply in order to expand the introduction of biomass fuel, investigated European and U.S. trends, and identified various problems to be solved, including effects on GHG reduction, land use for cultivation of biomass, competition with food, and stability of supply. (Report toward Establishing the Japanese Version of Biofuel Sustainability Standards, April 2009)

“The Study Group on Sustainability Standards for the Introduction of Biofuel” was then organized in July 2009 to develop Japan’s own standards and operating procedures. The interim report issued in March 2010 is summarized as follows: (1) As one of the sustainability standards for biomass fuel, the

---

**Self-sufficiency of Bio-ethanol in Major countries**

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Share of Ethanol Consumption including non-Fuel Use (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>2008</td>
<td>99%</td>
</tr>
<tr>
<td>US</td>
<td>2017</td>
<td>91%</td>
</tr>
<tr>
<td>EU</td>
<td>2008</td>
<td>60%</td>
</tr>
<tr>
<td>EU</td>
<td>2017</td>
<td>81%</td>
</tr>
<tr>
<td>Brazil</td>
<td>2008</td>
<td>100%</td>
</tr>
<tr>
<td>Brazil</td>
<td>2017</td>
<td>100%</td>
</tr>
<tr>
<td>Japan</td>
<td>2007</td>
<td>97%</td>
</tr>
</tbody>
</table>

Source: Biofuel Sustainability Study Group (April 2009)

---

**LCA of the Effect of Bio-ethanol on GHG Emissions Reduction**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use change</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>7%</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Crop production</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
</tr>
<tr>
<td>Feedstock transport</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Conversion</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Liquid fuel transport</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Construction</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Debris wood</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Blackstrap molasses</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Source: Interim Report of the Study Group on Sustainability Standards for the Introduction of Biofuel (March 2011)
life cycle assessment (LCA) of the GHG reduction effect should be more than 50 % of the GHG emission by gasoline. ② A high rate of self-sufficiency is necessary for a stable supply of biomass fuel as the current supply is limited to imported products from Brazil and to a small part of domestic products. ③ All related ministries should have a mutual view on biomass fuel’s competitive nature with food and examine the root cause analysis and the action plan. The sustainability standard of biomass fuel, which is to be introduced based on the Law Concerning Sophisticated Methods of Energy Supply Structures, will follow the directionality that had been shown by the interim report.

Since Japan is a country of limited natural resources, it is fundamental to satisfy the principle of 3E energy policy (securing stable energy supply, environmental consideration and efficient supply) in a well-balanced manner and the use of biomass fuels as automotive fuel is not an exceptional case. In order to expand the promotion of biomass fuels in future, it is essential to consider “stable supply”, and, in the long term to develop innovative technologies for manufacturing low cost biomass fuel by utilizing plants and trees that do not conflict with food production or supply. In order to abide by the sustainability standards set forth by the above interim report, the petroleum industry plans to effectively utilize bio-ethanol as renewable energy within a range where food supply and the environment are not negatively affected. This sound approach will be continued in the future for achieving the objectives of 3E policy.

### Biofuel Marketing Schedule

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>April 2007 - March 2009 Test Marketing</td>
<td>[Bio-ETBE 0.2 million KL]</td>
<td>0.21 million KL of Crude Oil Equivalent [Bio-ETBE 0.84 million KL]</td>
<td>0.5 million KL of Crude Oil Equivalent [Bio-ETBE 1.94 million KL]</td>
<td></td>
</tr>
</tbody>
</table>

- **Maintenance of Domestic Infrastructure**
  1. Import Terminal Maintenance Summer 2008: Contract
  2. Ocean Tanker Procurement Summer 2008: Contract
  3. Coastal Tanker Procurement Winter 2008: Contract

- **Bio-ETBE Supply**
  - July 2008: Memorandum Conclusion in Brazil, Purchase Contract with US company
  - September 2009: Start to Trade Domestic Ethanol

*Supported by Governmental fund (Verification Work on Distribution System) for 2 years from FY2007
Efficient Use of Petroleum Products

Demand for heavy fuels is projected to show a steady decline in the future, so the petroleum industry is making efforts to develop innovative technologies to create effective uses for residual oils like Heavy Fuel Oil C.

Integrated Gasification Combined Cycle (IGCC) is the most prominent technology among them all for using residuals in a cleaner and more efficient manner, and is gathering worldwide attention. IGCC is a system that uses gasification technology on low-value residual oils like asphalt to generate electricity efficiently from a compound turbine powered by synthetic gas and steam. With this technology, impurities such as sulfur in fuel oils can be removed through the gasification process. In addition, sulfur oxides and nitrogen oxides can be reduced to a minimum, and high thermal efficiency (46%) can be achieved. Also, a strong CO₂ emission-reduction effect (15% lower than that of a conventional oil thermal power plant) can be achieved by gas-turbine and steam-turbine combined cycles. Commercial operation of an electric power wholesale supply using IGCC fueled by residual oils (asphalt) began in June 2003.

The high-severity fluid catalytic cracking (HS-FCC) process is another example of technical advancement. Jointly with the Saudi Arabia government, the petroleum industry carried out the development of the HS-FCC process. HS-FCC plants were constructed in Saudi Arabia in 2003 and in Japan in 2011, and they were tested for verification of the HS-FCC process technology. This process cracks heavy oils and produces a high yield of gasoline and also propylene, which is a high-value raw material for petrochemical products. As the demand for propylene continues to expand mainly in the Asian market, an increasing supply is required from crude oil processing. In this regard, the commercialization of the HS-FCC process is highly anticipated.

<table>
<thead>
<tr>
<th>Characteristics of IGCC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IGCC</strong></td>
</tr>
<tr>
<td>Generating Efficiency</td>
</tr>
<tr>
<td>CO₂ Emission</td>
</tr>
<tr>
<td>Emission Gas Level*²</td>
</tr>
</tbody>
</table>

*¹ BTG=Boiler-Turbine-Generator
*² Comparison based on NOx and SOx emissions

**IGCC: Integrated Gasification Combined Cycle**

- **Air Separation Unit**
  - Air
  - Nitrogen
  - Oxygen
  - Asphalt
  - Steam

- **Gasification Unit**
  - Hydrogen
  - Carbon Monoxide
  - Synthetic Gas

- **Compound Generation Unit**
  - Gas Turbine
  - Steam Turbine
  - Generator

- **Electricity**
- **Gas Turbine Exhaust**
- **Waste Heat Boiler**
Effective Petroleum Product Use during Consumption

As part of its policy of enhancing energy saving and improvement in fuel handling, PAJ has worked on the development and wider range of consumer use of its Kerosene Utilization Systems since FY1993. The system aims to promote oil co-generation systems, oil central heating systems, and district heating and cooling systems.

Environmentally Friendly High Efficiency Boiler

Jointly with the Japan Petroleum Energy Center (JPEC), PAJ developed and commercialized a high-efficiency (95%), low-nitrogen oxide (NOx) boiler fueled by Fuel Oil A, which attained NOx emission of less than 70 ppm, far below the Ministry of Environment’s “NOx Emission Guideline for Small-scale Burning Appliances”.

Lower NOx Emission Attained

![Graph comparing NOx concentration of conventional and high-efficiency boilers](image)

1. Waste Heat Recovery: An additional heat exchanger is installed to recover exhaust heat usually emitted into the air. The efficiency of “Eco-Feel” is improved to 95%, resulting in less kerosene consumption.

2. CO₂ Emission Reduction: Compared with a conventional water heater (83% efficiency), “Eco-Feel” required 12% less kerosene for burning and decreased CO₂ emissions by 12%.

High-Efficiency Water Heater, “Eco-Feel”

An innovative kerosene-based water heater was introduced in December 2006. In comparison with conventional water heaters, this unit uses less fuel and reduces CO₂ emissions, considered one of the causes of global warming. PAJ, jointly with the Japan Industry Association of Gas and Kerosene Appliances (JGKA), registered a trade name for this heater, “Eco-Feel”, and started sales promotion of the product.

Listed below are the advantages of “Eco-Feel”

- Waste Heat Recovery: An additional heat exchanger is installed to recover exhaust heat usually emitted into the air. The efficiency of “Eco-Feel” is improved to 95%, resulting in less kerosene consumption.

Central Hot-Water Heating System, “Hotto-Sumairu” (Hot Smile)

As household heating and cooling performance is improving through the introduction of super-insulated houses, concerns about the safety and hygiene aspects of air conditioning are growing. To meet such concerns, the petroleum industry is disseminating the advantages of a kerosene-based central hot-water heating system. A registered trade name, “Hotto-Sumairu”, was chosen in agreement between PAJ and LGKA for joint promotion of the system. As the hot water made by a kerosene-fired boiler is used for heating, the room is free of exhaust gas and would be kept in a pollution-free condition. “Hotto-Sumairu” promotion is directed not only at detached housing but also at housing complexes.
**Kerosene is Friendly to Environment and Household Economy**

There are various sources of energy familiar to us besides kerosene such as gas and electricity. Among these, the amount of carbon dioxide exhaust attributable to kerosene is actually less than that from electricity. This is because the transmission loss and heat loss occurs by as much as 63% before electricity reaches each home from the power plant. Kerosene, which is considered to emit a large amount of carbon dioxide, is actually an environmentally friendly energy source.

In addition, the price of kerosene per 1kW is about 30% of the cost of electricity in daytime, and about 60% that of city gas. Kerosene is more economical and friendly to household expenses than either electricity or city gas.

**Kerosene; a Decentralized Source of Energy that Excels in Disaster Responsive Capability**

Kerosene can be stored in decentralized tanks and be utilized as an energy source in case of disaster when “system energy” sources such as electric power and town gas supplies are cut off.

A survey of 1,000 adult men and women in Iwate, Miyagi and Fukushima areas which were struck by the Great East Japan Earthquake showed that about 52% of them used kerosene immediately after the quake.

In the evacuation facilities, the kerosene heaters were ubiquitously utilized as shelter residents’ heating equipment. Furthermore, many lives of people injured in the disaster were saved in hospitals with onsite oil-driven electric power generation facilities.

To cope with an increasing awareness about disasters after the Great East Japan Earthquake, PAJ formulated “Action Program for Disseminating Oil-based Systems”, and actively promotes the installation of oil-based systems (heaters, boilers, electric power generators) in public facilities, such as elementary and middle schools, which can be utilized in case of disaster.

**R&D on Oil-Based Heating/Cooling Systems**

In line with the “Oil-based System Promotion Policy for the 21st Century” which started in February 2001, PAJ is disseminating the advantages of oil-based heating/cooling systems to both industrial and household sectors. To support this, PITRI evaluated the performance and the comfort of “Hotto-Sumairu” (an oil based central heating and hot-water supply system) and the positive results are being effectively used for this system’s promotion.
Expectations for Fuel Cells
With their high energy efficiency and low environmental burden, fuel cells are expected to become a new form of energy supply for household and automotive use. To promote the future popularization of fuel cells, the government is taking initiatives in technology development and field demonstration. The petroleum industry is also advancing its efforts to develop and spread the use of petroleum-based fuel cells as a new energy system.

Stationary Fuel Cell System
A stationary fuel cell system generates electricity, using hydrogen produced from petroleum fuels like kerosene and LPG, and oxygen in the air. The heat given off from power generation can be used for hot-water supply in kitchens and bathrooms as well as for the heat source of a floor heating system.

Its major features are: (1) good energy efficiency, (2) eco-friendliness and (3) low utility costs.

The advantages of using petroleum fuels are:
(1) Hydrogen for generating electricity can be produced from common fuels such as kerosene and LPG; these fuels’ supply infrastructures have already been established nationwide and storage and transportation are easy.
(2) Kerosene and LPG supply infrastructures are highly disaster resistant, as shown at the time of the Great Hanshin Earthquake and the Niigata-Chuetsu Earthquake. Petroleum-based fuel cells would be an effective energy supply system in the event of natural disasters.

Petroleum Industry’s Efforts
The petroleum industry has accumulated advanced technologies and know-how regarding hydrogen production from petroleum fuels for many years. With that know-how and the fuel supply infrastructures, field demonstrations of a system of fuel cells using petroleum fuels have been carried out in households throughout the country. As a result, in 2009, sales activity for fuel cells for household use was started under the trade name of “Ene-Farm”. LPG was utilized as a first stage of petroleum fuel supply.

For Popularization of Fuel Cells
Since the Great East Japan Earthquake, social interest is increasing in preparation and power saving measures to avoid blackouts. In this regard, the petroleum industry is making positive efforts in the following areas for promotion of fuel cells:
• Marketing of household type solid oxide fuel cells (SOFC) was launched in October 2011. This fuel cell achieved a generation efficiency rating of 45% in comparison with the conventional polymer electrolyte fuel cells (PEFC). Further development will actively be carried out on a disaster resistant fuel cell system utilizing the characteristics of petroleum fuels.
• Reflecting the results of technology development, verification tests will be conducted for a fuel cell system run by petroleum fuels in facilities for household and business use.

Hydrogen Supply to Fuel Cell Vehicles
The petroleum industry is increasing its efforts in developing hydrogen production technologies and in the field demonstration of hydrogen filling stations for fuel cell vehicles. Oil companies in Japan participated in the national demonstration projects (JHFC*1/NEDO*2 Projects and HySUT*3 activity) to operate various type of hydrogen filling stations. In January 2011, 13 companies including oil, automobile and gas companies jointly made a statement to develop a hydrogen supply infrastructure and to introduce fuel cell vehicles in 2015.

Oil companies, as hydrogen suppliers, plan to establish the infrastructure beforehand and, with auto and gas companies, to promote fuel cell vehicles. For the realization of this plan, companies are requesting the government to set up a promotion strategy through public-private cooperation such as dissemination support and expanding public acceptance.

Furthermore, technology development to produce hydrogen from kerosene at a filling station site is ongoing. This includes a hydrogen manufacturing process using membrane separation technology started in FY2008.

*1 METI’s Japan Hydrogen & Fuel Cell Demonstration Program
*2 New Energy and Industrial Technology Development Organization
*3 Research Association of Hydrogen Supply/Utilization Technology
Aiming at developing the highly efficient utilization of petroleum and supplying high quality products, Petroleum Association of Japan (PAJ) established the Petroleum Industry Technology and Research Institute, Inc. (PITRI) in December 1990 in order to deal with various technical issues to be tackled by the petroleum industry as a whole. PITRI has been conducting research and development (R&D) on automotive, industrial and household fuels, as well as safety management systems for oil refining and storage facilities.

In FY1991, PITRI started research activities at its laboratory in Chiba City in collaboration with the Advanced Technology and Research Institute (ATRI) under the Petroleum Energy Center (JPEC) to carry out various R&D projects.

R&D on Combustion Technologies for Automotive Fuel

In order to answer the national concern about environmental issues, it is essential for the petroleum industry to establish quality requirements for automotive fuel that are attributable to improvements in automotive vehicles’ fuel economy and exhaust gas quality.

With governmental support, the petroleum industry and the automotive industry jointly completed a research program called the Japan Clean Air Program, (JCAP) run in two steps (JCAP-I and JCAP-II). The outcome of JCAP activities includes the verification of cleaner automotive exhaust gas and better fuel economy by reducing the sulfur content of gasoline and diesel fuel. Based on this, the petroleum industry started sulfur-free gasoline and diesel fuel supply.

In FY2007, a new research project, Japan Auto-Oil Program (JATOP), was carried out for developing optimum automotive and fuel technology to fulfill three requirements, namely “CO₂ Reduction”, “Fuel Diversification” and “Exhaust Gas Reduction,” in view of the issues of preservation of air quality, global warming and energy security. The results are summarized as follows.

(1) Evaluation of biomass fuel

The findings are utilized as the domestic petroleum industry's database for introducing bio-ETBE blend gasoline.

(2) Research on future diesel fuel

The study includes the evaluation of diesel vehicle performance with various diesel fuel blending stocks such as non-conventional types of oil antici-
The Great East Japan Earthquake: Experience and Lessons Learned

In the aftermath of the Great East Japan Earthquake, while the supply of electricity and city gas was stopped, oil, which excels in handling, storage and transportability, played a significant role as the most independent and distributed source of energy supply. Oil was effectively used as fuel for hospitals’ emergency power generation, heating at evacuation centers and emergency vehicles.

Shipping bases such as refineries and oil terminals also suffered severe damage from the earthquake. Among nine refineries located in the Kanto and Tohoku regions, six refineries halted production, accounting for 1.4 million barrels per day or around 30% of Japan’s total refining capacity. Oil terminals on the northern Pacific coast were unable to carry out product shipment although there were adequate inventories. Because of the paralyzed social infrastructure such as harbor facilities and roads, together with logistic obstacles, supply of petroleum products could not be secured for some time in parts of the region.

In view of these circumstances, maintenance and reinforcement of the supply chain to achieve a stable supply to end consumers even in a time of disaster became a big issue for the petroleum industry.

Reinforcement of Emergency Response Capability

The petroleum industry is promoting the reinforcement of emergency response capability from the aspect of both facilities and systems incorporating the lessons learned from the earthquake and tsunami.

Firstly, seismic reinforcement work, waterproofing of electric facilities and deployment of emergency power supply units were instituted at shipping bases. Drum shipment had been being reduced because of its small lot size and inefficiency of handling; however, there were many urgent requests for drums at the time of disaster for emergency support supplies. Maintenance and reinforcement of drum filling facilities are in progress to fulfill emergency requests.

At service stations, disaster response measures were initiated to install a back-up power source, to put hand-driven pumps in place, to store emergency use materials and to prepare the stations as temporary evacuation sites.

On the system side, because sharing information between oil companies and their shipping bases took a long time, the work to strengthen communication links is proceeding. Petroleum Association of Japan (PAJ) is working to establish a system to centralize information from each oil company at a time of disaster.

Collaboration with Central and Local Governments

With the support of the prefectural government as well as the Ministry of Land, Infrastructure, Transport and Tourism, two oil terminals in Shiogama, which are large-scale facilities where the quake damage was relatively slight, resumed shipping their remaining products on March 17 (6 days after the disaster), and started receiving products from coastal tankers on March 21. In this connection, five rival oil companies set up a cooperative framework to jointly utilize the facilities of two oil companies in Shiogama. Furthermore, PAJ established an operation center to cope with urgent support requests from the Prime Minister’s Office and the Ministry of Economy, Trade and Industry, and responded effectually to about 1400 requests.

Base on such experience and lessons, the government amended the Oil Stockpiling Act so as to strengthen the structure of the oil supply system at a time of disaster. In this revision, oil companies are obliged to develop in advance the “Oil Supply Cooperation Plan in the Event of a Disaster” for 10 regions across Japan. The revised act also allowed commissioning the management of the stockpiling to private companies in order to start the national stockpiling of petroleum products such as gasoline and kerosene. Oil companies are actively cooperating with this plan.

At the time of the earthquake, when fuel was transported as an urgent support supply to key facilities such as hospitals, some troubles were reported; specifically, they were duplicated delivery, oil type error, incompatibility of delivery line coupling, etc. To avoid such incidents, PAJ is proposing to conclude a memorandum on information sharing, assuming that each prefecture will separately request emergency support supplies from the government, so as to secure product delivery to emergency centers. Based on the concluded memorandum, PAJ plans to compile the information on emergency centers into a database. Saitama, Yamagata, Gunma, Saga and Miyagi prefectures have already concluded this memorandum and several other prefectures are discussing it. PAJ already made an agreement in 2008 with the Tokyo Metropolitan Government for the supply of fuels in the case of an inland earthquake in the metropolitan area.

Securing Stable Oil Demand

The petroleum industry is striving to increase consumers’ recognition of oil as a safe and reliable source of energy by making recommendations through various approaches. This means that the industry realizes the importance of securing stable oil demand in peacetime comes first, before reinforcing the supply chain for securing a stable oil supply.

Firstly, the use of oil is proposed for hot water supply and the heating sector since it is highly efficient. For example, the industry developed a stand-alone oil-based water heating system in cooperation with the manufacturer, and is promoting its introduction to the market. Furthermore, as public buildings including schools and city halls are likely to be used as evacuation sites it is practical to operate oil-based heating equipment. PAJ is promoting the effectiveness of operating oil-based systems in peacetime for local governments.

As for the electricity generation sector, it is necessary to keep oil-fired power stations in continuous operation so as to fully utilize the emergency response capability of oil.

In future energy policy, consumers’ interests should be strongly kept in mind since tax and subsidy systems may distort consumers’ energy selection. In view of this, improved fairness is needed since there are competing conditions among several energy options.

The environment surrounding the petroleum industry continues to be in a difficult situation. In order to achieve sufficient oil supply to end consumers at a time of disaster, the industry continues to tackle this issue with its utmost effort.

Stable Oil Supply to End Consumers even at a Time of Disaster

The environment surrounding the petroleum industry continues to be in a difficult situation. In order to achieve sufficient oil supply to end consumers at a time of disaster, the industry continues to tackle this issue with its utmost effort.
Keeping themselves warm with a kerosene heater, at 1:30am, March 12, 2011

Response to the Great East Japan Earthquake

- Strengthen production system of refineries in operation (Raising operating rate, increasing production capacity, etc.)
- Urgent import of gasoline and restricting product export (Increasing domestic supply)
- Shipping petroleum products to disaster area from western Japan and Hokkaido (Coastal tanker, tank car and tank truck)
- Cooperation among oil companies in the disaster area (Joint use of oil storage facilities)
- Shifting of tank trucks from western Japan to the disaster area (Special engagement of approximately 300 trucks)
- Public relation activities in the disaster area for relieving consumers’ anxiety such as informing them of service stations in operation

March 12 (aftermath of the quake)

- Refining Capacity in Japan: 3.12 million b/d

March 21

- Refining Capacity in Japan: 4.0 million b/d

Oil terminals on the Pacific coast are partially open, and most of those in the Tokyo area are open.

Stable Oil Supply to End Consumers even at a Time of Disaster
Location of Refineries and Crude Distillation Capacity in Japan (as of Mar 2013)

TOTAL: 26 Refineries (4,474,700 b/d)
## Overview of the Japanese Petroleum Industry [Oil Refiners and Primary Oil Distributors (Motouri)]

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Oil Companies</td>
<td>16 companies (as of Aug 2013)</td>
</tr>
<tr>
<td>Total Capital</td>
<td>563.0 billion yen (as of Mar 2012)</td>
</tr>
<tr>
<td>Annual Sales Revenue</td>
<td>25.871 trillion yen (FY2012)</td>
</tr>
<tr>
<td>Total Number of Employees</td>
<td>Approx. 19,200 (as of the end of FY2012)</td>
</tr>
<tr>
<td>Crude &amp; Product Import Volume</td>
<td>249.9 million kl (FY2012)</td>
</tr>
<tr>
<td>Crude &amp; Product Import Amount</td>
<td>195.4 billion dollar (FY2012)</td>
</tr>
<tr>
<td>Oil Dependence on Imports</td>
<td>99.6% (FY2012)</td>
</tr>
</tbody>
</table>

## Main Product Specifications in Japan

### Motor Gasoline (JIS K2202)
- Lead: Unleaded
- Density (max.): 0.783g/cm³ (15°C)
- RVP: 44–78kPa
- RON (min.): Premium 96; Regular 89
- Sulfur content (max.): 0.0010wt%
- Benzene (max.): 1vol%
- MTBE (max.): 7vol%
- Ethanol (max.): 3vol% *1
- O₂ content (max.): 1.3wt% *1

### Kerosene (JIS K2203)
- Sulfur content (max.): 0.0080wt% (for fuel cell: 0.0010wt%)
- Smoke point (min.): 23mm (in winter season: 21mm)

### Gas Oil (JIS K2204)
- Pour point (max.): Special No.3: -30°C; No.3: -20°C; No.2: -7.5°C;
  No.1: -2.5°C; Special No.1: +5°C;
  Special No.1, No.1: 50
- Cetane index (min.): No.2, No.3, Special No.3: 45
- Sulfur content (max.): 0.0010wt%
- Density (max.): 0.86 (15°C)

Note: 5 grades depending on ambient temperature of seasons and/or districts.

### Fuel Oil A *2 (JIS K2205)
- Kinematic viscosity (max.): 20mm²/S (50°C)
- Pour point (max.): 5°C
- Sulfur content (max.): No.1: 0.5wt%; No.2: 2.0wt%

### Fuel Oil B *2 (JIS K2205)
- Kinematic viscosity (max.): 50mm²/S (50°C)
- Pour point (max.): 10°C
- Sulfur content (max.): 3.0wt%

### Fuel Oil C *2 (JIS K2205)
- Kinematic viscosity (max.): No.1 250mm²/S (50°C)
  No.2 400mm²/S (50°C)
  No.3 400mm²/S~1000mm²/S (50°C)
- Sulfur content (max.): No.1 3.5wt%
  No.2, No.3 no specification

*1 For an automobile that received registration by the Road Vehicle Act or its vehicle number is specified by law as a vehicle compatible with E10, gasoline specifications for both oxygen and ethanol are relaxed to 3.7 mass% and 10 vol% max., respectively.

*2 Fuel oil is classified into 3 types by viscosity. Even though Fuel Oil A has the name "fuel oil", it's a kind of distillate product. This is used for marine diesel engines, small boilers, etc. Fuel Oil B had been produced in large quantities in the past, but this fuel is rarely produced nowadays. Average sulfur level of Fuel Oil C produced in Japan is about 1.5wt% recently (including all its grades).

Please refer to PAJ’s Oil Statistics Website for Details
http://www.paj.gr.jp/english/statist.html