CONTENTS

1. Preface ............................................................ 2
2. Profile of Petroleum Association of Japan ............ 3
3. Domestic Oil Supply and Demand Trend ............... 7
4. Energy Policy in Japan ...................................... 13
5. Securing Stable Supply .................................... 20
6. Regulatory Reform and Petroleum Industry ......... 27
7. Petroleum Product Distribution
   and Marketing .................................................. 32
8. Toward a Fundamental Reexamination of
   Petroleum-related Taxes ................................... 35
9. Reinforcement of Corporate Structure ................. 39
10. Thorough Safety Measures ............................... 41
11. Preparation for Major Oil Spill Incidents .......... 43
12. Environmental Measures in the Oil Refining Sector .................................................. 45
13. Quality Improvement in Automotive Fuels .......... 48
14. The Global Warming Issue and Oil .................. 51
15. Utilization of Biomass Fuel ............................. 57
16. Efficient Use of Oil ......................................... 60
17. Efforts toward Developing New Energies .......... 63
Appendix: ........................................................... 65

■ Location of Refineries and Crude Distillation
  Capacity in Japan
■ Overview of the Japanese Petroleum Industry
■ Main Product Specifications in Japan
■ PAJ's Oil Statistics Website for Details
Prices of West Texas Intermediate (WTI) in 2010 had started with the level of some 80 US dollars per barrel (US$/Bbl), and once had declined to the level of 60 US$/Bbl in mid May. In comparison to 2008 and 2009, crude oil prices in 2010 showed a relatively stable trend, as those generally stayed within a range between 70 and 80 US dollar levels. However, crude oil prices climbed in late October, without returning to the 70 US dollar level, and WTI hit a level beyond 90 US$/Bbl in mid December, reflecting the supply and demand factors such as the impact of cold weather in winter, mainly in Europe, and oil demand increases among oil producing countries, as well as financial factors such as inflow of surplus funds into the crude oil futures markets due to the easing of the money supply in all advanced countries.

On April 20 an explosion and oil spill occurred at a deepwater oil rig, “Deepwater Horizon” (1,500 meters below sea level) operated by BP (British Petroleum) in the Gulf of Mexico in the United States. This was the largest-ever offshore oil spill disaster, as about 4.93 million barrels of crude oil were estimated to have flowed into the gulf. It is a concern from now that new exploration and development of deepwater oilfields will lose steam in the medium and long term due to tighter regulations for deepwater oil development and rising costs in such oil development.

Regarding the situation surrounding the domestic oil industry, the Basic Energy Plan, which needs to be revised every three years, was reviewed in May and amended in August 2010. In this review, oil is positioned as a core energy source even in 2020 and 2030 and the review also specified the necessity for securing a stable oil supply such as by maintaining its supply chain. On the other hand, from the viewpoint of efficient use of fossil fuels, the Law Concerning Sophisticated Methods of Energy Supply Structures stipulates that a certain level of heavy oils cracking capacity be held until 2013 in relation to refineries’ crude distillation unit capacity. This takes into account the heavier crude oils procurement structure expected in the future as well as the lighter domestic fuels demand structure. It also required oil companies to expand the supply of bio-ethanol to 500,000 kiloliters in crude oil equivalent by 2017, from the viewpoint of promoting non-fossil fuels.

Regarding the global warming issue, the petroleum industry, as an advanced environmental industry, has actively made efforts such as drawing up the industry’s Commitment to a Low Carbon Society, further enhancing energy saving at refineries, expanding biomass fuel supply, and promoting the dissemination of diesel engine vehicles.

Internationally, COP 16 was held in Cancun, Mexico in December 2010 to discuss the framework of the post-Kyoto Protocol after 2013. At the conference, participants avoided simply extending the Kyoto Protocol and they agreed on the direction of deliberation based on the Copenhagen Accord. Setting up the framework for the next term was carried over to COP17 at the end of 2011. Under such circumstances, an increase in the Petroleum and Coal Tax was decided on as a tax for global warming countermeasures by the Cabinet in Japan. (A bill for the tax reform package is suspended as of August 2011 due to political turmoil.)

Thus, against the backdrop of the global economic situation and global environmental issues, as well as domestic policy development, 2010 was another turbulent year for the petroleum industry.

The Great Higashi Nihon Earthquake of March 11, 2011 caused extensive damage to petroleum facilities. Especially, three oil refineries in Sendai, Kashima and Chiba suffered serious damage, and all fuel storage facilities along the Pacific Ocean coast in the Tohoku Region suspended their operations. In addition, many service stations in the disaster-stricken areas were unable to do business and more than 150 tank tracks were lost. For these reasons, there were temporary supply shortages in the affected areas and the Tokyo metropolitan area.

With the increasing awareness of the convenience and importance of oil due to the great earthquake, the petroleum industry expects that the position of oil in the energy policy shall be strengthened.

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.
The 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) 2011 Business Activities

Along with such changes in the business environment as the decline in domestic petroleum product demand and fluctuations in crude oil prices, the petroleum industry in Japan has been working positively as an advanced environmental industry to take global warming countermeasures, while making efforts to improve its revenue base. At the same time, even though domestic oil demand shows a downward trend, oil will continue to constitute the largest share of the primary energy supply. As the last resort for energy for sustaining the nation’s economy, the industry is continuously requested to play an important role in carrying out the social responsibility of meeting the 3E principles of Japan’s energy policy, namely, energy security, environmental consideration, and efficient supply while using market mechanisms.

In FY2011, PAJ positively advocates clarifying petroleum policies under the future energy policies. Taking action against a tax for global warming countermeasures, preparing opinions for the concrete arguments concerning the Basic Act on Global Warming Countermeasures and the Commitment to a Low Carbon Society, and continuously improving the business environment and competitiveness are the key issues. Also, each oil company is urged to make efforts to maintain a sound supply chain through solving such key issues as noted above.

Taking such circumstances into account, PAJ offers its opinions about the future direction of petroleum policies, etc. and contributes to the development of the petroleum industry as its basic policy through the following business activity plans:
1. Maintaining a huge oil supply chain, covering every segment from crude oil imports and refining to distribution and marketing
2. Promoting effective and sophisticated use of oil
3. Dealing with global and domestic environmental issues as well as safety issues
4. Gaining public and consumer understanding of and trust in the petroleum industry, as well as improving the industry’s image

II. Projects and Main Activities in FY2011

1. Addressing issues concerning the petroleum policy in the future
   (1) Proposals for energy policies focusing on how the petroleum industry should be in the future
   (2) Action toward the global warming issue
   (3) Action toward the introduction of bio-ETBE (ethyl-tertiary-butyl-ether)

2. Urging comprehensive reexamination of petroleum-related taxes and ensuring equity in taxation among energy sources

3. Strengthening both the domestic and international competitiveness of the petroleum refining industry in Japan
   (1) Response to international issues related to the petroleum industry and efforts to reinforce further competitiveness
   (2) Analysis of corporate performance and the
Profile of Petroleum Association of Japan

financial condition of the petroleum industry in Japan

4. Promoting various uses of petroleum products
   (1) Development of countermeasures for issues related to automotive fuels
   (2) Enhancement of promotional activities to encourage broad use of PAJ’s High Energy Efficiency Oil Utilization Systems that demonstrate superior performance from an environmental viewpoint
   (3) Research and development of automotive fuels, lubricating oils, etc.

5. Promoting disaster prevention and environmental protection activities
   (1) Reinforcement of disaster prevention measures, increased efforts to mitigate excessive safety and disaster prevention regulations, and enhancement of voluntary safety management systems
   (2) Maintenance and improvement of the PAJ Major Oil Spill Response Program
   (3) Formulation of a response system to such risks as major earthquakes, outbreaks of new-type influenza, etc.
   (4) Active participation in development of policies and programs on environmental issues such as toxic chemical substances

6. Addressing oil supply and distribution issues
   (1) Efforts towards formation of a fair and transparent petroleum product market
   (2) Improvement of services to provide information on oil-related databases and survey reports on domestic and foreign petroleum markets
   (3) Active participation in development of policies and programs for oil stockpiling and emergency responses
   (4) Enhancement of the rationalization of petroleum product distribution, as well as realization and implementation of environmental countermeasures

7. Promoting activities for a strong foundation for the petroleum industry
   (1) Effective PR activities for better public and consumer understanding of oil and the petroleum industry
   (2) Support for research operations by the Petroleum Industry Technology and Research Institute, Inc. (PITRI)
   (3) Support of activities of the Japanese National Committee of the World Petroleum Council
   (4) Action toward labor policy issues concerning the petroleum industry
   (5) Enhancement of communication among PAJ member companies and collaboration with concerned business organizations
PAJ Member Companies (14)

- Idemitsu Kosan Co., Ltd.
- 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
- ExxonMobil Y.K.
- Seibu Oil Co., Ltd.

Former Member & Friend of PAJ (1)

- Kygnus Sekiyu K.K.

**Executives**

President
Akihiko Tembo
Chairman, Representative Director, Idemitsu Kosan Co., Ltd.

Vice-President
Yaichi Kimura
President, Representative Director Chief Executive Officer, Cosmo Oil Co., Ltd.

Vice-President
Jun Arai
President, Representative Director, Showa Shell Sekiyu K.K.

Vice-President
Yasushi Kimura
President and Representative Director, JX Nippon Oil & Energy Corporation

Senior Managing Director
Hideo Matsui

Managing Director
Junichi Hatano

Managing Director
Nobuo Hata

**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
Profile of Petroleum Association of Japan

Management and Committees

- Commercial/Industrial Fuels
- Lubricating Oils
- Refining Technology
- Quality Control
- Hydrogen and Fuel Cell
- Automotive Fuels
- Commercial/Industrial Fuels
- Lubricating Oils
- Refining Technology
- Quality Control
- Hydrogen and Fuel Cell
- Finance
- Petroleum-related Taxation
- Inland Transportation
- Coastal Transportation
- Ocean Transportation
- Public Relations
- Stockpiling
- IAB (Industry Advisory Board)
- Crisis Management

Sub-committees

- Petroleum Distribution Laws
- Aviation
- Environmental
- Facilities Management
- Safety
- Global Environmental Issue
- Petroleum Energy System
- Technical Committee
- Taxation & Finance Committee
- Transportation Committee
- Public Relations Committee
- Oil Stockpiling Committee
- Crisis Management Committee

Associated Organizations

- ISO: International Standardization Organization
- TC: Technical Committee
- JIG: Joint Inspection Group Limited

Policy Planning Committee

- General Assembly
- Board of Directors
- Board of Standing Directors
- Auditor

Managing Directors Committee

- Oil Statistics Committee
- Japanese National Committee for ISO TC28*
- JIG Japan
- General Service Committee
- Countermeasure Committee
- Refining Technical Group
- Marketing Technical Group

Petroleum Distribution Law

- Global Environmental Issue
- Petroleum Energy System
- Distribution Committee
- Environment & Public Safety Committee
- Technical Committee
- Taxation & Finance Committee
- Transportation Committee
- Public Relations Committee
- Oil Stockpiling Committee
- Crisis Management Committee

Crisis Management Committee

Labor Policy

- Sub-committees
Structural Decline in Oil Demand

Total petroleum fuel demand for fiscal year (FY) 2009 was about 195 million kiloliters (KL), down by 3% from the previous year. The total fuel demand fell below the milestone 200 million KL level for the first time since it hit that level in FY1988.

Especially in the first half of FY2009, though there were some signs of recovery from the world economic stagnation triggered by the Lehman Shock, domestic production activities and consumer spending were still weak. Consequently, the total fuel demand showed a 7% decline versus the same term of the previous year.

Though total fuel demand had fallen below the 200 million KL level after the Second World War and the second oil crisis in the 1980s, gasoline, kerosene and diesel fuel demand increased fairly consistently. This upward trend terminated in 2000. Total fuel demand reached a peak of 246 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 (Fuel Oil B and Fuel Oil C), the peak volume was 111 million KL in FY1973.

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

① Lowering Oil Consumption Policy Gathering Momentum

After suffering the two oil crises, Japan has promoted the so-called “the policy of lowering oil consumption” 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 Fuel Oil B and Fuel Oil 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 oil consumption, since it is a fossil fuel, has been promoted. In response, oil consumption has been lowered by efficiency improvement of energy consumption such as shifting to energies that emit less CO₂ and improving vehicles’ fuel consumption.

Total fuel oil demand for the first half (Apr-Sep) of FY2010 was 91.7 million KL, 2% up from the previous year. On a product-by-product basis, naphtha and Fuel Oil A showed a decrease, while gasoline, diesel fuel, Fuel Oil B and Fuel Oil C showed increases of about 3%. Jet fuel and kerosene also increased by 6% and 11%, respectively from the previous year. The rise in demand for jet fuel, kerosene, Fuel Oil B and C is considered as a backdrop of the low demand levels in the previous year. The growth of gasoline and diesel fuel is attributable to a temporary demand increase due to the impact of a record-breaking hot summer in 2010.

It is projected that structural factors for a downward trend in Japan’s petroleum product demand will not be changed, excluding temporary impacts such as rapid changes in crude oil prices and trouble in power generation plant facilities. Under such circumstances, improving efficiency of the overall petroleum supply chain, while maintaining it at an adequate scale, is the urgent issue for the petroleum industry.
Domestic Oil Supply and Demand Trend

For FY2009, the domestic yield of crude oil was a mere 920 thousand KL, equivalent to 0.4%, or 1.5 days, of the 295.7 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 “white fuels” 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 “white fuels”. Any excess or deficiency beyond refining facility capacity has been supplemented by import or export of petroleum products.

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

Unit: 1,000 bbl/day

<table>
<thead>
<tr>
<th>Year</th>
<th>Crude Processing Capacity</th>
<th>Utilization Ratio(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>5,410</td>
<td>85.2</td>
</tr>
<tr>
<td>1975</td>
<td>5,940</td>
<td>70.7</td>
</tr>
<tr>
<td>1980</td>
<td>5,940</td>
<td>66.0</td>
</tr>
<tr>
<td>1985</td>
<td>4,973</td>
<td>62.3</td>
</tr>
<tr>
<td>1990</td>
<td>5,221</td>
<td>77.3</td>
</tr>
<tr>
<td>1995</td>
<td>5,274</td>
<td>79.4</td>
</tr>
<tr>
<td>2000</td>
<td>4,767</td>
<td>82.9</td>
</tr>
<tr>
<td>2005</td>
<td>4,796</td>
<td>82.7</td>
</tr>
<tr>
<td>2006</td>
<td>4,856</td>
<td>78.9</td>
</tr>
<tr>
<td>2007</td>
<td>4,895</td>
<td>74.5</td>
</tr>
<tr>
<td>2008</td>
<td>4,846</td>
<td>77.8</td>
</tr>
<tr>
<td>2009</td>
<td>4,615</td>
<td></td>
</tr>
<tr>
<td>2010(FY)</td>
<td>4,796</td>
<td></td>
</tr>
</tbody>
</table>

Source: PAJ

Petroleum Product Domestic Demand by Usage (FY2009)

<table>
<thead>
<tr>
<th>Usage</th>
<th>Product</th>
<th>Gasoline</th>
<th>Naphtha</th>
<th>Jet Fuel</th>
<th>Kerosene</th>
<th>Diesel Fuel</th>
<th>Heavy Fuel</th>
<th>Crude Oil</th>
<th>LP Gas</th>
<th>Lube Oil</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td></td>
<td>57,499</td>
<td>31,080</td>
<td>2,527</td>
<td>650</td>
<td>2,527</td>
<td>650</td>
<td>91,756</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aviation</td>
<td></td>
<td>4</td>
<td>5,319</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5,324</td>
</tr>
<tr>
<td>Transportation &amp; Marine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture &amp; Fisheries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4,055</td>
</tr>
<tr>
<td>Mining &amp; Manufacturing</td>
<td></td>
<td>65</td>
<td>4,349</td>
<td>45</td>
<td>12,041</td>
<td>6,647</td>
<td>894</td>
<td>24,042</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,489</td>
<td>1,489</td>
</tr>
<tr>
<td>Electric Power</td>
<td></td>
<td></td>
<td>248</td>
<td>7,211</td>
<td>3,644</td>
<td>567</td>
<td></td>
<td>11,670</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household &amp; Commercial</td>
<td></td>
<td></td>
<td></td>
<td>13,801</td>
<td>6,198</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13,005</td>
<td>33,005</td>
</tr>
<tr>
<td>Chemical Feedstock</td>
<td></td>
<td>47,310</td>
<td></td>
<td>5,319</td>
<td>20,045</td>
<td>32,257</td>
<td>32,433</td>
<td>4,286</td>
<td>30,178</td>
<td>1,681</td>
<td>231,079</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>57,569</td>
<td>47,310</td>
<td>5,319</td>
<td>20,045</td>
<td>32,257</td>
<td>32,433</td>
<td>4,286</td>
<td>30,178</td>
<td>1,681</td>
<td>231,079</td>
</tr>
</tbody>
</table>

Source: PAJ

Petroleum Supply and Demand (FY2010)

<table>
<thead>
<tr>
<th>Item</th>
<th>FY</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>%vs.Prev. Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Import</td>
<td></td>
<td>234,406</td>
<td>211,656</td>
<td>214,357</td>
<td>101.3</td>
</tr>
<tr>
<td>Processed</td>
<td></td>
<td>223,975</td>
<td>209,846</td>
<td>208,633</td>
<td>99.4</td>
</tr>
<tr>
<td>Opening Inventory</td>
<td></td>
<td>11,544</td>
<td>11,805</td>
<td>10,577</td>
<td>89.6</td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td>208,803</td>
<td>196,375</td>
<td>194,969</td>
<td>99.3</td>
</tr>
<tr>
<td>Import</td>
<td></td>
<td>29,315</td>
<td>29,799</td>
<td>33,067</td>
<td>111.0</td>
</tr>
<tr>
<td>Total Supply</td>
<td></td>
<td>238,119</td>
<td>226,174</td>
<td>228,036</td>
<td>100.8</td>
</tr>
<tr>
<td>Domestic</td>
<td></td>
<td>201,060</td>
<td>194,988</td>
<td>195,948</td>
<td>100.5</td>
</tr>
<tr>
<td>Export</td>
<td></td>
<td>34,153</td>
<td>29,932</td>
<td>30,282</td>
<td>101.2</td>
</tr>
<tr>
<td>Total Demand</td>
<td></td>
<td>235,213</td>
<td>224,920</td>
<td>226,230</td>
<td>100.6</td>
</tr>
<tr>
<td>Closing Inventory</td>
<td></td>
<td>11,805</td>
<td>10,577</td>
<td>10,339</td>
<td>97.7</td>
</tr>
</tbody>
</table>

Source: METI
Domestic Oil Supply and Demand Trend

Crude Oil Import

The crude import volume by region in FY2009 showed that Middle Eastern oil producing countries accounted for 89.5%. Oil dependency on the Middle East had once dropped to 68% in FY1987 after the oil 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 (29.5% of total import volume), the United Arab Emirates (21.3%), Qatar (12.1%) and Iran (10.9%), accounted for about three-quarters 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 those 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 fragile aspect of Japan’s petroleum supply structure.

Petroleum Product Import and Export

As previously indicated, petroleum product import plays a supplemental role in Japan because it has adopted the “Domestic Petroleum Refining System”. Regarding naphtha, however, about 54% of its domestic demand is served by imported products, because petrochemical companies in Japan independently import naphtha as a petrochemical feedstock.

Both Fuel Oil B and Fuel Oil C have considerable volumes shipped to ocean liners, which are fueled with imported products as well as domestically refined product exports. Jet fuel also makes up a large portion of fuel supplies to international aircraft, which is nearly double its domestic demand.

In recent years, the export volume of diesel fuel is increasing year by year, though the future trend is uncertain.
### Crude Oil Imports by Supplier

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil Majors</th>
<th>Independent Oil Companies</th>
<th>National Oil Companies of Oil-producing Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>70.0</td>
<td>14.3</td>
<td>8.3</td>
</tr>
<tr>
<td>1975</td>
<td>44.5</td>
<td>7.8</td>
<td>288,609</td>
</tr>
<tr>
<td>1980</td>
<td>26.1</td>
<td>10.5</td>
<td>262,785</td>
</tr>
<tr>
<td>1985</td>
<td>27.8</td>
<td>9.0</td>
<td>249,199</td>
</tr>
<tr>
<td>1990</td>
<td>23.9</td>
<td>10.4</td>
<td>238,480</td>
</tr>
<tr>
<td>1995</td>
<td>22.2</td>
<td>8.3</td>
<td>254,604</td>
</tr>
<tr>
<td>2000</td>
<td>18.8</td>
<td>4.4</td>
<td>249,010</td>
</tr>
<tr>
<td>2009</td>
<td>17.1</td>
<td>5.3</td>
<td>211,656</td>
</tr>
<tr>
<td>2010</td>
<td>17.8</td>
<td>4.7</td>
<td>214,117</td>
</tr>
</tbody>
</table>

Source: METI

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

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

Source: METI
Domestic Oil Supply and Demand Trend

### Major Petroleum Products by Importing & Exporting Country

#### Petroleum Product Import & Export Composition (FY2009)

**Import** 29,799

<table>
<thead>
<tr>
<th>Product</th>
<th>Import (thousand kl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>2,952</td>
</tr>
<tr>
<td>Naphtha</td>
<td>8,672</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>7,824</td>
</tr>
<tr>
<td>Kerosene</td>
<td>6,521</td>
</tr>
<tr>
<td>Diesel Fuel</td>
<td>37,611</td>
</tr>
<tr>
<td>Heavy Fuel</td>
<td>28,011</td>
</tr>
</tbody>
</table>

**Export** 29,932

<table>
<thead>
<tr>
<th>Product</th>
<th>Export (thousand kl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>1,552</td>
</tr>
<tr>
<td>Naphtha</td>
<td>2,083</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>0.0</td>
</tr>
<tr>
<td>Kerosene</td>
<td>1,221</td>
</tr>
<tr>
<td>Diesel Fuel</td>
<td>37,711</td>
</tr>
<tr>
<td>Heavy Fuel</td>
<td>28,011</td>
</tr>
</tbody>
</table>

**Source:** METI

#### Petroleum Product Import & Export Composition (FY2010)

**Import** 33,067

<table>
<thead>
<tr>
<th>Product</th>
<th>Import (thousand kl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>3,307</td>
</tr>
<tr>
<td>Naphtha</td>
<td>8,234</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>0.1</td>
</tr>
<tr>
<td>Kerosene</td>
<td>6,232</td>
</tr>
<tr>
<td>Diesel Fuel</td>
<td>36,510</td>
</tr>
<tr>
<td>Heavy Fuel</td>
<td>26,110</td>
</tr>
</tbody>
</table>

**Export** 30,282

<table>
<thead>
<tr>
<th>Product</th>
<th>Export (thousand kl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>1,098</td>
</tr>
<tr>
<td>Naphtha</td>
<td>0.0</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>29,510</td>
</tr>
<tr>
<td>Kerosene</td>
<td>0.6</td>
</tr>
<tr>
<td>Diesel Fuel</td>
<td>36,510</td>
</tr>
<tr>
<td>Heavy Fuel</td>
<td>26,110</td>
</tr>
</tbody>
</table>

**Source:** METI

---

*Unit: 1,000kl, %*

---

**Notes:**

1. The data reflects the petroleum product import and export composition for the fiscal year 2009 and 2010.
2. The figures indicate the volume of each product imported and exported, measured in thousands of kiloliters (kl).
3. The percentages represent the share of each product in the total import or export volume.
4. Source: METI (Ministry of Economy, Trade, and Industry)
Enactment of the Basic Act on Energy Policy

Japan’s energy policies have changed in response to the diverse requirements of the times. As more than 30 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 competitiveness 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 (the “3E”): “securing stable energy 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 be drawn up in line with these 3E principles.

Oil Remains an Important Energy even in the 21st Century

The petroleum industry has consistently advocated the following opinions for the simultaneous achievement of the energy policy’s three basic principles:

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 new energies such as nuclear power and 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 “Post-oil” and “Departure from 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. Oil substitution policy, as well as the definition of “new energies”, will be reexamined.

Restructuring of Japan’s Energy Policies

In recent years, the worldwide interest in energy security has grown as a result of the rapidly increasing severity of global energy conditions such as the steep rise in oil prices. 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 a hurricane, 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.

Under these circumstances, in May 2006, the Ministry of Economy, Trade and Industry (METI) set up five
quantitative targets as the New National Energy Strategies (the "New Strategies") mainly focusing on energy security. In response to this, the Basic Energy Plan was revised to emphasize strategic diplomatic efforts for securing energy resources, development and utilization of various energies, promotion of nuclear-oriented policy measures, and close cooperation with Asian countries (for energy conservation, oil stockpiling, etc.).

Points for the highly commendable policies are:

1. Necessity for in-depth strategic and comprehensive upstream policies and strengthening of the oil refining and distribution segments
2. Necessity for enhancing the diesel shift (shifting to diesel vehicles) as one of the effective energy conservation measures in the transportation sector
3. The petroleum industry’s commitment to launch bio-ETBE (ethyl-tertiary-butyl-ether) produced using bio-ethanol in FY2010 with respect to countermeasures for the introduction of biomass fuel

The revised Plan also indicates the importance of effective and efficient utilization of all kinds of energies including oil, enumerating the following basic principles for stable energy supply:

1. Effective and thorough utilization of energies
2. Evaluation of the 3E of all kinds of energies, selection of the optimum energy mix and reinforcement of measures for intensive use of those energies
3. Cooperation between the government and the private sector for strategic and comprehensive promotion of the measures leading to the acceleration of sophisticated use of oil

As a result of this revised Basic Energy Plan, the Long-term Energy Supply and Demand Outlook, issued in March 2008, indicates that oil will remain an important energy source in the future, even though oil’s share in Japan’s primary energy supply will decline to a little less than 40% in 2030.

During the deliberation of this revision, the petroleum industry indicated the importance of gaining a consensus that treats all energy sources equitably.

Taking into account the following points under a rapid rise in global energy demand, the second revision of the Basic Energy Plan was made in June 2010:

1. Constraints are increasing in both domestic and foreign energy environments such as through intensified competition for ensuring resource interests globally
2. Pressures to shift to a low-carbon path on the energy supply and demand structure to prevent global warming are getting stronger
3. The energy and environmental sectors are being required to become a leading force in economic growth

Aiming at reviewing the future energy policies on a medium- and long-term basis, the revised Basic Energy Plan, which contains the descriptions of not only the energy supply and demand structure, but also in-depth reforms of social systems and lifestyle, was drawn up with an eye to the next 20 years until 2030.

This outlook also includes the following points:

1. Request for maintaining the stable supply of oil, because oil excels in its convenience and economic efficiency, and it will remain as a core energy
2. Need for strengthening relationships as well as securing interests with resource-rich countries, enhancing competitiveness in the oil refining sector and maintaining a sound domestic supply chain
3. Aim for supplying biomass fuels at a volume equivalent to at least 3% of gasoline demand nationwide in 2020, on the basis that biomass fuels have a sufficient greenhouse gas (GHG) emission reduction effect on a Life Cycle Assessment (LCA) basis and the supply stability and economic efficiency are ensured
4. Aim for maximizing supply of biomass fuels in 2030 by developing production technologies for the next-generation biomass fuels such as cellulose

On the other hand, while debate on Post-Kyoto Protocol was being carried out, the government announced in June 2009 that the medium-term target of GHG emission reduction in 2020 is to be 15% versus 2005. In response to this, the Long-term Energy Supply and Demand Outlook, which had been plotted
out previously, was revised in August. Though dissemination of electric vehicles is mentioned in the revised outlook, oil still constitutes about 40% of the primary energy supply. After that, then Prime Minister Hatoyama, after a change in the Japanese government administration, proposed a 25% GHG emission reduction target versus 1990 on the premise of creation of a fair and viable international framework and mutual agreement on an ambitious target among all major nations.

Reexamination of Japan’s Petroleum Policies

In line with the deliberation of energy policies, petroleum policies were reexamined. In May 2006 METI compiled its report, highlighting the following points:

1. To promote independent development of crude oil resources and to facilitate natural gas development through enhancing venture money supply functions, etc.
2. To strengthen the refining function through rationalization for creating sophisticated refineries and promotion of business integration and cooperation among companies in petroleum complexes
3. To improve environmental and security aspects of the oil distribution function

In addition, the report points out that the new technologies for processing heavy crude oils/residuals and the clean and sophisticated utilization of petroleum resources are not necessarily encouraged by the Law Concerning Promotion of the Development and Introduction of Alternative Energy (Alternative Energy Law) enacted in 1980, when oil’s share of the primary energy supply was some 80%, as well as the Law on the Promotion of the Use of New Energy (New Energy Law) enacted in 1997. The report indicates the necessity for further utilization of petroleum resources.

During this period, the Petroleum Council of the Advisory Committee for Natural Resources and Energy reexamined what the nation’s petroleum policies and appropriate policy measures for biomass fuels should be, and issued a report in February 2008. The report expects the petroleum industry to play a key role in energy security through stable and efficient supply of petroleum products and stresses again the necessity of promoting the building of a strong business foundation in the petroleum industry to ensure energy security. Specifically, it points out that refiners are required to make efforts to promote diversified businesses such as enhancement of fuel export and diversification into the petrochemical business, tie-ups in refining operations and disposal of facilities, and further business tie-ups beyond the existing framework of companies.

From the viewpoint of sophisticated use of energy, it is desirable to upgrade cracking capacity for heavy oils that efficiently utilizes precious natural resources. The report therefore clearly states that it is necessary for both the government and the private sector jointly to promote policy measures for the development and promotion of innovative technologies.

The petroleum industry advocated the following three points at the hearing concerning the Basic Energy Plan at the Basic Plan Committee under the General Council of the Advisory Committee for Natural Resources and Energy:

1. Considering that stable energy supply is essential in Japan as a resource-poor nation and oil will remain the largest share in the primary energy supply even in 2030, the significance of oil and its stable supply must take priority over everything else.
2. It is necessary to provide policy measures for keeping stable oil supply such as through maintaining the domestic supply chain under the situation of a structural decline in domestic demand.
3. Launching of biomass fuels has a supply sustainability problem and involves the requirement for enormous costs associated with a large increase in their supply volume. Bearing such huge costs would become a serious issue for the petroleum industry and shake the foundations of its corporate management.
Toward the Advancement of Energy Supply Structure

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 METI started deliberations, from October 2008, on the reexamination of its alternative energy policy and the increased use of nonfossil energies. 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 energies.

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 a 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 completion 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 energies (nuclear, hydraulic, geothermal, new energies, 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.

Energy Supply and Demand Performance (FY2009 Flash Report)

Final energy consumption for FY2009 showed a 2.3% drop from the previous year, due to the impact of the continuous economic downturn from FY2008. In comparison with the previous year by sector are: 2.2% down for the industrial sector, 2.4% down for the household and civil sector, and 2.3% down for the transportation sector. As a result, the total final energy
consumption showed a year-on-year decrease for the fifth consecutive year since 2005.

On the other hand, the total domestic primary energy supply was 20,482 petajoules (PJ), or 528.4 million KL in crude oil equivalent, down by 5.0% versus the previous year; of which oil was 8,408 PJ, or 216.9 million KL in crude oil equivalent. The oil ratio decreased by 0.8% to 41.1% from the previous year's 41.9%.

Though supply quantity of each major primary energy, excluding nuclear power, decreased from the previous year, the ratio of coal to the total primary energy supply decreased from 22.8% to 21.4%, but natural gas increased from 18.6% to 19.4% and nuclear power also increased from 10.4% to 11.8%. However, even the ratio of coal, 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.

### Long-term Final Energy Consumption Outlook

<table>
<thead>
<tr>
<th>Energy Category</th>
<th>Business-as-usual Case</th>
<th>Additional Measures Case</th>
<th>Political Initiative Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Final Energy Consumption</strong></td>
<td>421 100%</td>
<td>401 100%</td>
<td>375 100%</td>
</tr>
<tr>
<td><strong>Industry</strong></td>
<td>180 43%</td>
<td>180 45%</td>
<td>177 47%</td>
</tr>
<tr>
<td><strong>Household &amp; Commercial</strong></td>
<td>149 35%</td>
<td>134 34%</td>
<td>121 32%</td>
</tr>
<tr>
<td>- Household</td>
<td>149 35%</td>
<td>134 34%</td>
<td>121 32%</td>
</tr>
<tr>
<td>- Commercial, etc.</td>
<td>149 35%</td>
<td>134 34%</td>
<td>121 32%</td>
</tr>
<tr>
<td><strong>Transportation</strong></td>
<td>92 22%</td>
<td>86 22%</td>
<td>78 21%</td>
</tr>
</tbody>
</table>

### Long-term Primary Energy Supply Outlook

<table>
<thead>
<tr>
<th>Energy Category</th>
<th>Business-as-usual Case</th>
<th>Additional Measures Case</th>
<th>Political Initiative Case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Energy Domestic Supply</strong></td>
<td>627 36%</td>
<td>596 36%</td>
<td>553 34%</td>
</tr>
<tr>
<td><strong>Oil</strong></td>
<td>227 36%</td>
<td>215 36%</td>
<td>190 34%</td>
</tr>
<tr>
<td><strong>LP Gas</strong></td>
<td>18 3%</td>
<td>18 3%</td>
<td>18 3%</td>
</tr>
<tr>
<td><strong>Coal</strong></td>
<td>128 20%</td>
<td>120 20%</td>
<td>107 19%</td>
</tr>
<tr>
<td><strong>Natural Gas</strong></td>
<td>114 18%</td>
<td>103 17%</td>
<td>89 16%</td>
</tr>
<tr>
<td><strong>Nuclear Power</strong></td>
<td>99 16%</td>
<td>99 17%</td>
<td>99 18%</td>
</tr>
<tr>
<td><strong>Hydropower</strong></td>
<td>19 3%</td>
<td>19 3%</td>
<td>19 3%</td>
</tr>
<tr>
<td><strong>Geothermal</strong></td>
<td>1 0%</td>
<td>1 0%</td>
<td>1 0%</td>
</tr>
<tr>
<td><strong>New Energy</strong></td>
<td>22 3%</td>
<td>22 4%</td>
<td>30 5%</td>
</tr>
</tbody>
</table>

* actual figure

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

<table>
<thead>
<tr>
<th>(FY)</th>
<th>Oil incl. LPG</th>
<th>Coal</th>
<th>Natural Gas</th>
<th>Nuclear Power</th>
<th>Hydro</th>
<th>Hydropower, Geothermal</th>
<th>New Energy</th>
<th>Unit: million kl crude oil equivalent, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>77.4</td>
<td>15.5</td>
<td>1.5</td>
<td>0.6</td>
<td>416</td>
<td></td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>73.4</td>
<td>16.4</td>
<td>5.3</td>
<td>0.8</td>
<td>396</td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>66.1</td>
<td>19.4</td>
<td>9.4</td>
<td>1.2</td>
<td>429</td>
<td></td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>56.3</td>
<td>19.4</td>
<td>9.4</td>
<td>1.2</td>
<td>438</td>
<td></td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>57.1</td>
<td>16.7</td>
<td>10.2</td>
<td>1.2</td>
<td>521</td>
<td></td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>54.8</td>
<td>16.5</td>
<td>10.9</td>
<td>3.5</td>
<td>585</td>
<td></td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>50.8</td>
<td>18.1</td>
<td>13.0</td>
<td>3.4</td>
<td>609</td>
<td></td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>49.0</td>
<td>20.3</td>
<td>13.8</td>
<td>2.9</td>
<td>614</td>
<td></td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>45.2</td>
<td>20.3</td>
<td>17.4</td>
<td>3.0</td>
<td>561</td>
<td></td>
<td>3.0</td>
<td></td>
</tr>
</tbody>
</table>

Source: METI

### Final Energy Consumption Trends

<table>
<thead>
<tr>
<th>(FY)</th>
<th>Industrial</th>
<th>Civil</th>
<th>Transportation</th>
<th>Unit: million kl crude oil equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>188</td>
<td>52</td>
<td>47</td>
<td>286</td>
</tr>
<tr>
<td>1975</td>
<td>168</td>
<td>53</td>
<td>50</td>
<td>271</td>
</tr>
<tr>
<td>1980</td>
<td>165</td>
<td>61</td>
<td>59</td>
<td>286</td>
</tr>
<tr>
<td>1985</td>
<td>157</td>
<td>71</td>
<td>64</td>
<td>292</td>
</tr>
<tr>
<td>1990</td>
<td>180</td>
<td>95</td>
<td>83</td>
<td>358</td>
</tr>
<tr>
<td>1995</td>
<td>185</td>
<td>112</td>
<td>98</td>
<td>395</td>
</tr>
<tr>
<td>2000</td>
<td>186</td>
<td>125</td>
<td>101</td>
<td>412</td>
</tr>
<tr>
<td>2005</td>
<td>182</td>
<td>134</td>
<td>97</td>
<td>413</td>
</tr>
<tr>
<td>2009</td>
<td>159</td>
<td>125</td>
<td>88</td>
<td>371</td>
</tr>
</tbody>
</table>

Source: METI
Securing Stable Supply

Japan's Oil Stockpiling System (History and Present Situation)

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 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”, in December 1963.

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 Council of the Advisory Committee for Natural Resources and Energy compiled its interim report in 1971, which indicated 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 the time, it was decided that holding of oil stockpiling by the private sector with governmental subsidies was more appropriate than holding it directly by the government, 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 after that. As oil constituted about 77% of the primary energy supply at that time, people’s lives were severely impacted. At the Ministerial Meeting on Energy Measures in December 1975, it was decided to raise the target days of oil stockpiling to 90 days, and plans were drawn up to increase stockpiling volume to a 90-day equivalent by the end of FY1979.

With the enforcement of the Petroleum Reserve Law, enacted in December 1975, 90-day oil stockpiling held by private oil companies was started in April 1976.

At the time of its start, various measures were taken such as expanding interest subsidies, the establishment of joint stockpiling companies including a rise in investment ratio, and the foundation of a subsidy scheme for oil storage locations in order to lessen the burden of the enormous cost of funds associated with the buildup of stockpiles.

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 (JNOC) was started in 1978. The target volumes of the government oil reserve were achieved: 30 million 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 stockpiling system 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 April 1996, importation of petroleum products was virtually liberalized. After that the petroleum industry legislation under normal times has been regulated by (1) the Act on Quality Control of Gasoline and Other Fuels (Fuel Quality Act), which was reformed from the previous Gasoline Retail Business Law and (2) the amended Petroleum Reserve Law, which stipulates the requirements for new entrants of oil importers.

In response to the abolition of the Petroleum Industry Law in January 2002, the new Oil Stockpiling Act was enforced. From the viewpoints of ensuring fulfillment of oil stockpiling obligations as well as strengthening the foundations for emergency responses, the following provisions were amended in the new act:
### Overview of Past Emergency Periods

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></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>Oil Share of Primary Energy Supply</strong></td>
<td>77.4% (FY1973)</td>
<td>71.5% (FY1979)</td>
<td>58.3% (FY1990)</td>
<td>50.0% (FY2003)</td>
</tr>
<tr>
<td><strong>Rate of Crude Oil Price Hike ($/Bbl)</strong></td>
<td>Arabian Light (Posted Price) 3.9 Times Oct 1973 → Jan 1974 Arabian Light (Spot Price) 3.3 Times Sep 1978 → Nov 1980</td>
<td>Dubai (Spot Price) 2.2 Times Jul 1990 → Sep 1990</td>
<td>Dubai (Spot Price) 1.1 Times Jul 2005 → Sep 2005</td>
<td>Arabian Light (Spot Price) 3.3 Times (as of Oct 1973) Arabian Light (Spot Price) 3.9 Times (as of Jan 1974)</td>
</tr>
<tr>
<td><strong>Crude CIF (Highest) (Yen/Liter)</strong></td>
<td>21.5 (Aug 1974)</td>
<td>55.2 (Aug 1981)</td>
<td>27.6 (Nov 1990)</td>
<td>42.7 (Oct 2005)</td>
</tr>
<tr>
<td><strong>Gasoline Retail Price (Yen/Liter)</strong></td>
<td>114 (May 1975)*1</td>
<td>177 (Dec 1982)*1</td>
<td>142 (Nov 1990)*2</td>
<td>131 (Oct 2005)*2</td>
</tr>
<tr>
<td><strong>Stockpiling Days - Private - Government</strong></td>
<td>67 (as of Oct 1973) 67 Days 0 Days</td>
<td>92 (as of Dec 1978) 85 Days 7 Days</td>
<td>142 (as of Dec 1990) 88 Days 54 Days</td>
<td>170 (as of Sep 2005) 80 Days 90 Days</td>
</tr>
<tr>
<td><strong>Crude Oil Import Vol.</strong></td>
<td>288.61 Million kl (FY1973)</td>
<td>277.14 Million kl (FY1979)</td>
<td>238.48 Million kl (FY1990)</td>
<td>241.81 Million kl (FY2004)</td>
</tr>
<tr>
<td><strong>Ratio of Crude Import Amount to Japan Total Imports</strong></td>
<td>23% (FY1973)</td>
<td>43% (FY1980)</td>
<td>19% (FY1990)</td>
<td>20% (FY2005)</td>
</tr>
<tr>
<td><strong>Crude Oil Dependence on Middle East</strong></td>
<td>77.5% (FY1973)</td>
<td>75.9% (FY1979)</td>
<td>71.5% (FY1990)</td>
<td>89.5% (FY2004)</td>
</tr>
</tbody>
</table>

#### Events of the Period and Government Responses

**1st Oil Crisis**
- Hoarding of toilet paper, etc.
- Setting of wholesale & retail prices by Administrative Guidance (Mar–Aug ‘75)
- Setting of Standard Prices by the Petroleum Industry Law (Dec ‘75–May ‘76)
- Restraint of large lot electric power use and voluntary ban on private vehicles
- Enforcement of two laws for emergency responses (Dec ’73)
- Enforcement of Petroleum Reserve Law (Apr ’76)

**2nd Oil Crisis**
- Partial release of private oil stockpiles (Apr ’78–Aug ’80)
- Setting of wholesale prices by Administrative Guidance (Mar ’78–Apr ’82)
- Implementation of energy saving measures such as target temperatures for air conditioning
- Introduction of lighter summer clothing
- Enforcement of Energy Saving Law (Jun ’79)
- Enforcement of Alternative Energy Promotion Law (May ’80)

**Gulf Crisis**
- Voluntary ban on purchasing crude oil at high prices
- Restraint of fuel imports and shift to a domestic production structure
- Setting of wholesale prices by Administrative Guidance & Moving to “Monthly Settlement Method” (Sep ’90–Apr ’91)
- Partial release of private oil stockpiles (4 days)
- Implementation of energy saving measures such as higher air conditioning temperatures during summer and environmentally-friendly driving campaign in government & private sectors

**Hurricane Katrina**
- Voluntary ban on gasoline imports
- Partial release of private oil stockpiles (3 days)
- Urgent gasoline export to USA

---

*1 Government Statistics  *2 Oil Information Center
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)

3. Advice to increase the crude oil processing volumes above planned volumes

The subcommittee on Petroleum Stockpiling and Emergency Preparedness under the Petroleum Council of the Advisory Committee for Natural Resources and Energy, started in March 2005, deliberated the redefinition of the roles of both government and private sectors’ stockpiling obligations, and the appropriate levels of each sector’s reserves. The subcommittee issued its report, which recommended mitigating the private sector stockpiling obligation from 70 days to a level of 60-65 days and increasing the government sector stockpiling with appropriate timing in order not to lower the nation’s energy security level. In response to these developments, the Petroleum Council’s Petroleum Policy Subcommittee was set up in December 2005. The subcommittee recommended the following measures in May 2006 from the necessity for forming a responsive oil stockpiling system:

1. Increasing of the stockpile volume (by buildup of

<table>
<thead>
<tr>
<th>Current Status of Oil Stockpiling in Japan (as of Dec 2010)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Private Stockpiling</strong></td>
</tr>
<tr>
<td>Stockpile Days</td>
</tr>
<tr>
<td>Stockpiling Volume</td>
</tr>
<tr>
<td>Obligation Days</td>
</tr>
<tr>
<td>Holding Method</td>
</tr>
</tbody>
</table>
| Holding Location | Private sector tanks in refineries and oil terminals | ☀ Tanks of national stockpiling bases
 aerospace tank from private sector |
| Composition | Crude oil: 50%
 Oil products: 50% | Crude oil: 99.7%
 Oil products: 0.3% |
| Administrative Body | Oil refiners and importers | ☀ 10 national stockpiling bases
 (2/3 of government reserve)
 ☀ Private oil companies
 (1/3 of government reserve) |
| Effect of Stockpile Release | ☀ Prompt supply to distribution markets as stockpiles are held at refineries and oil terminals
 ☀ Flexible release of stockpiles depending on crude procurement status and seasonal demand fluctuation
 ☀ Weak psychological effect on the markets, compared with the government announcement on releasing its stockpiles | ☀ strong psychological effect on the market when the government announces its decision to release its stockpiling to increase oil supply in the market
 ☀ Reduced mobility of released stockpiling, compared with the private sector release, as reserves are stored at remote national stockpiling bases |
| Cases of Stockpile Release | ☀ 2nd Oil Crisis (Mar 1979–Aug 1980)
 ☀ Gulf Crisis in response to CERM (Jan–Mar 1991)
 ☀ Hurricane Katrina aftermath (Sep–Dec 2005) | None
 (Only for stockpile release training exercises) |
| 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) |
the government stockpile)
2. Introducing oil product reserves by the government

Regarding the government product reserve, it was decided to implement kerosene stockpiling in July 2009. Kerosene reserve stockpiling at a level equivalent to one day’s consumption during the peak season (130 thousand kiloliters) is underway in the five regions (Hokkaido, East Japan, Kanto, Chubu & Kinki, and Shikoku & Kyushu) in Japan. However, neither reduction of the private sector stockpiling days nor buildup of the government stockpile volume was taken.

**Toward New Emergency Countermeasures**

In FY2007, the Subcommittee on Next Generation Fuels and Petroleum Policies under the Petroleum Council of the Advisory Committee for Natural Resources and Energy 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 based on 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, a Japanese oil company successfully won an international bid in 2009 for preferential sales and purchase of its crude oil stockpile, based on an intergovernmental agreement concluded with New Zealand. In June 2009, the Agency for Natural Resources and Energy (ANRE) in Japan made an agreement on the Joint Stockpiling Project with the Supreme Petroleum Council (SPC) of the United Arab Emirates. Based on this agreement, stockpiling of crude oil from Abu Dhabi National Oil Company (ADNOC) had started with receiving the first cargo (about 300 thousand kiloliters) at the Kiire Stockpiling Base in Kagoshima Prefecture in December 2009. In addition, under the basic agreement on a joint project between ANRE and Saudi Arabian Oil Company (Saudi Aramco) in June 2010, the first crude oil tanker (about 300 thousand kiloliters) is scheduled for arrival at the Okinawa Stockpiling Base in Okinawa Prefecture after February 2011. Such crude oil reserves are used commercially by these oil producing countries under normal times; however, in an emergency situation Japanese oil companies receive preferential crude oil supply from their reserves under these agreements. This scheme is expected to reinforce energy security and at the same time to enhance the formation of strategic relationships with oil producing countries.

On the other hand, in accordance with moving ahead with global warming countermeasures, promoting the introduction of renewable energies is underway. Since such energies as solar and wind power generally have a supply instability problem, oil, as the last resort of energies, which complements the
supply instability, will play an ever-greater role.

It is however assumed that Japan’s domestic oil demand will continue to show a structural downward trend. In order to keep playing roles as being the last resort of energies and for providing flexible responses in an emergency, it is an important policy issue to reduce the petroleum industry’s burden of huge costs associated with holding the private stockpiling.

Outline of Japan’s Response Measures for an Emergency Period (as of Apr 2011)

- At a normal time
  - Oil Stockpiling Measures
    - Private Sector Stockpiling
      - Maintain reserves
      - Registration of oil refiners, importers & distributors for information gathering
    - Revised Petroleum Stockpiling Act
    - JOGMEC*
  - Oil Supply Measures
    - Government Stockpiling
      - Maintain reserves
      - Secure stable supply by releasing oil reserves

- At a time of threat
  - Petroleum Supply & Demand Adjustment Act
    - Emergency Declaration
      - Stop making up oil reserves
      - Draw down oil reserves

- In the event of an emergency
  - Control Measures on Oil Consumption
    - Emergency Measures for Stabilization of National Life
      - Act on Emergency Measures for Stabilization of National Life
        - Cooperative actions by industries under government direction/supervision
        - Determine standard prices
        - Indicate commodity production
        - Indicate order commodity imports
        - Indicate commodity holdings
        - Order sales/deliveries
  - Supply Measures on Major Commodities
    - Allocation/Ration Systems of Major Commodities
      - Order sales/deliveries
      - Mediate/guide oil supplies
      - Order oil holdings, sales/deliveries
      - Cooperative actions by the oil industry under government direction/supervision
      - Indicate commodity holdings
      - Indicate commodity production
      - Determine standard prices
      - Indicate order commodity imports
      - Order sales/deliveries

* Japan Oil, Gas & Metals National Corporation
Japan's Petroleum Resource Development

Petroleum resource development in Japan started in the 1870s primarily in Niigata Prefecture. Currently, commercial production is carried out in Hokkaido, Akita and Niigata Prefectures. In addition, exploration activities have been conducted in the area around Japan’s continental shelf since the 1970s, and several oil and gas fields were found and developed such as the Iwaki Offshore Gas Well (production was terminated in mid 2007) and the Iwafune Offshore Oil/Gas Well (still in production today). 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. Although Japan is the third largest oil consuming country, domestic oil resources are limited. Domestic oil production is less than one percent of Japan’s consumption requirements and more than 99% of crude oil demand is 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 130 oil and gas development projects around the world in areas such as the Middle East, South-east Asia, Africa, South and North America, and the former republics of the Soviet Union, of which 70 have performed well in commercial production (at the end of June 2010). The import share of crude oil from independent crude oil and gas development projects is about 23% of the total import volume.

Japan’s Independent Oil and Natural Gas Development in Future

Oil and gas exploration development is a difficult business, requiring a huge amount of investment and advanced technologies. 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 when it was abolished in April 2005.

The government and the private sector are expected to effectively cooperate with each other in such a framework as this, in which the government provides the private sector with a favorable business environment for oil development and, in turn, oil development firms invest and distribute business resources to achieve their targets.
Progress in Deregulation

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 partially 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 post-oil 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.

Business Environment Changes after Deregulation

With deregulation and the abolition of the Fuel Import Restriction Law as a turning point, the petro-
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, PAJ developed the PAJ Oil Statistics Weekly, 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 transparent oil market by providing up-to-date oil supply information which can be used to allow the full functioning of market mechanisms.

<table>
<thead>
<tr>
<th>Year</th>
<th>During Normal Periods</th>
<th>During Emergencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965</td>
<td></td>
<td>• Emergency Law for Stabilization of National Life</td>
</tr>
<tr>
<td>1975</td>
<td>Apr ’76 Enactment of Petroleum Reserve Law</td>
<td>• Petroleum Supply and Demand Optimization Law</td>
</tr>
<tr>
<td></td>
<td>May ’77 Enactment of Gasoline Retail Business Law</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>Jan ’86 Enactment of Provisional Measures Law on Importation of Specific Refined</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Petroleum Products (Fuel Import Restriction Law)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jul ’87 Automatic Approval for Installation of Product Upgrading Facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mar ’89 Abolition of Guidance on Gasoline Production Quota</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Oct ’89 Abolition of Guidance on Kerosene Inventory Build-up for Winter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mar ’90 Abolition of Guidance on SS Construction (Scrap-and-Build Rule)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and on Transfer of SS Brand between Primary Distributors</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>Sep ’91 Flexible Approval for Installations of Crude Processing Facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mar ’92 Abolition of Guidance on Crude Processing (Throughput)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mar ’93 Abolition of Tariff-quota System (TQ) for Heavy Fuels</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>Mar ’96 Repeal of Fuel Import Restriction Law (Import liberalization of fuel products)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apr ’96 Enactment of Act on Quality Control of Gasoline and Other Fuels by revising</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gasoline Retail Business Law</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apr ’96 Revision of Petroleum Reserve Law</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jul ’97 Automatic Approval of Petroleum Product Exports (Export Liberalization of Fuel Products)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dec ’97 Abolition of SS Certificate System for Fuel Supply-source by its Branded Primary Distributor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Apr ’98 Lifting of the Ban on Manned Self-service SS</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>Dec ’01 Repeal of Petroleum Industry Law</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jan ’02 Enactment of New Petroleum Stockpiling Act</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feb ’09 Partial Revision of Act on Quality Control of Gasoline and Other Fuels (Registration and Quality Assurance Obligation of Processors)</td>
<td></td>
</tr>
</tbody>
</table>

Regulatory Reform and Petroleum Industry
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 energies, oil is unfavorably treated to a significant degree in terms of taxation and its stockpiling obligations.

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 energies 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
  (1,050 yen/KL on an oil calorie equivalent basis)
- LNG : 1,080 yen/ton
  (757 yen/KL on an oil calorie equivalent basis)
- Import LPG: 1,080 yen/ton
  (822 yen/KL on an oil calorie equivalent basis)

In addition, a rise on the tax rate of Petroleum and Coal Tax, in accordance with the amount of CO2 emissions originating from fossil fuels and the fairness of tax burdens among energy sources, is planned in phases from October 2011 as a tax for global warming countermeasures. The new tax rates for FY2015 will be 2,800 yen/KL for oil, 1,860 yen/KL for LNG and LPG, and 1,370 yen/KL for coal. Since 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, it is regrettable that 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. Contrary to the electricity and the city gas industries, the petroleum industry is in 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 taxpaying 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.

Oil stockpiling became a very useful policy measure as a pillar for energy security after the oil crises. 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.

### Petroleum Industry Rationalization in Production, Distribution and Sales Facilities (Example)

<table>
<thead>
<tr>
<th>Production Facilities (Refining Capacity)</th>
<th>Distribution Facilities (No. of Oil Storage Terminals)</th>
<th>Retail Outlets (No. of SS)</th>
<th>Work Force (No. of Employees)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
<td><img src="image4.png" alt="Graph" /></td>
</tr>
</tbody>
</table>

(Unit: 10,000b/d, Mar ’95, Mar ’00, Mar ’04, Mar ’09, Mar ’10, Mar ’11, ±535, ±499, ±452, ±600, ±190, 60,421, 40,357, 36,363, 20,912)
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 (Alternative Energy Law) was also revised, so that the past mindset of promoting alternative energies 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, Exxon Mobil Group, Japan Energy and Showa Shell Sekiyu Group, and Idemitsu Kosan as of 2000.

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, reorganizations beyond conventional business tie-ups have been accelerated as management integration, mainly led by Nippon Oil, in view of recent high crude oil prices and fierce competition in the total energy market. Further reorganizations are continuing such as the birth of JX Nippon Oil & Energy in July 2010.

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 0.83 million barrels per day (BPD) or more than 15% during the past 11 years from 5.35 million BPD in March 2000 to 4.52 million BPD at the end of March 2011. In addition, on September 30, 2010, JX Nippon Oil & Energy announced plans to reduce its group’s crude processing capacity by 400 thousand BPD versus December 2008 to 1.39 million BPD at the end of October 2010 as well as to move up by one year the schedule for an additional capacity reduction of 200 thousand BPD, which was originally planned to be completed by the end of March 2015, to the end of 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 10 years, and at the end of March 2009 it was about 21,000 employees, compared with about 36,000 employees at the end of March 1995.

Enhancement of Rationalization and Efficiency Improvement after Reorganization

Excess refining capacity remains an industry-wide issue. Even after reorganization into four major nationwide groups, Japan’s Exxon Mobil group further integrated with four affiliated companies into ExxonMobil Yugen Kaisha in June 2002. 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.

In June 2006, Nippon Oil and Japan Energy concluded a wide-ranging business tie-up agreement from upstream operations to refining and distribution operations, fuel cell business, and technology development. Furthermore, JX Nippon Oil & Energy was established due to their management integration in July 2010. Management efforts toward further rationalization and efficiency improvement apart from the existing four-group structure continue.

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 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.
Petroleum Product Distribution and Marketing

Distribution Rationalization and Efficiency Improvement due to Deregulation

Petroleum products are delivered to consumers 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. The industry has faced unprecedented structural changes, as 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 8,000 self-service SS are in operation. This accounted for about 19% of the total SS at the end of March 2010.

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.

In addition to an increase in non-brands and private brands, the number of self-service SS are also increasing and there is concern that this may trigger a severe price war in the future.

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. PAJ 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, the petroleum industry 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 (NGV) 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 create new additional services at SS such as the infrastructure development of solar photovoltaic power generation and car-sharing, to cope with changes in the business climate surrounding SS.

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.

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.

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 ground-water pollution issue at SS, PAJ has created the “SS Soil Environment Safety Book” for early identification and prevention of soil pollution 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. Though this regulation stipulates a moratorium until the end of January 2013, the petroleum industry is making efforts to assess the reality of the situation and to advance measures for prevention of soil pollution.
Living in Harmony with the Local Community

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 from nearby refineries or oil storage terminals.

Actually at the time of the Great Hanshin-Awaji Earthquake in January 1995, nearly 800 SS in the stricken area suffered no outbreaks of fire and supplied necessary fuels for recovery operations. In other recent large-scale earthquakes, the petroleum industry also made utmost efforts to supply petroleum products to SS and consumers smoothly by determining the extent of the damage at the product shipping facilities promptly.

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 first field exercise based on this agreement was conducted in October 2010, and the industry continues making efforts to improve the effectiveness.

Importance of Maintaining Supply Chain

According to the government’s energy outlook, oil will account for the maximum share, i.e., a little less than 40%, of the primary energy supply even in 2020 and 2030. Therefore, ensuring a stable oil supply continues to be an important issue for the national security of Japan.

In addition, oil has played a buffer role in energy supply as an alternative fuel in cases such as the temporary shutdown of nuclear power plants. Besides, renewable energies such as solar power and wind power raise concerns of supply instability. As a backup to these renewable energies, the buffer role of oil will be of increasing significance from now on.

The petroleum industry is not only a typical process industry but also a network industry. In order to secure stable supply, therefore, it is necessary for the industry at all times to maintain its total “supply chain” from oil resource development and importation to refining, distribution and marketing in a sound manner and with long-range planning.

Vast amounts of money are required to maintain huge facilities and equipment such as ocean tankers, crude oil storage tanks, oil refineries, fuel product storage tanks, tank trucks and SS. However, different from the electric power and the city gas industry, the petroleum industry is not guaranteed a systematic cost recovery.

Moreover, oil demand is projected to decrease by 30% toward 2020 due mainly to such structural factors as energy efficiency improvement, progress in fuel conversion and changes in lifestyle, together with such policy factors as enhancement of global warming countermeasures. Consequently, disposal and consolidation of excess facilities, as well as maintenance of the supply chain present big challenges for the petroleum industry. It would be desirable for the industry to be furnished with political support measures from the viewpoint of ensuring a stable energy supply.
Toward a Fundamental Reexamination of Petroleum-related Taxes

Exorbitant Amounts and High Rates of Petroleum-related Taxes

Because oil accounts for about 40% of the primary energy supply and is the central energy source to support people’s daily lives and industrial activities, 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 multi-stage way, such tax revenues have reached nearly 4.4 trillion yen per year (FY2011 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 & 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/Pre-fectural)
- Jet Fuel: Aircraft Fuel Tax (National)
- LPG: Petroleum Gas Tax (National)

In addition, about 920 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 5.32 trillion yen, equivalent to about 47 US dollars per barrel. 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, Gasoline Tax and other petroleum-related taxes were neither abolished nor reduced due to their connection with specific 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 such as from Gasoline Tax 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.

For this reason, PAJ continues to work on the realization of adequate tax adjustment measures, especially the termination of such a tax-on-tax treatment, which is worth 170 billion yen.

Global Warming Countermeasure Tax

The global warming issue is a key issue for all humanity to be tackled for a long period of time on a worldwide basis. The petroleum industry in Japan, as an advanced environmental industry, has been taking positive actions such as participating in Nippon Keidanren’s “Action Plans for a Low-carbon Society” and launching supply of biomass fuels.

The Government Tax Commission decided the introduction of a new tax concerning global warming
countermeasures, hereafter referred to “Global Warming Countermeasure Tax”, in its FY2011 Tax Reform Package compiled in December 2010. Specifically, a new scheme is to add corresponding tax rates to the existing Petroleum and Coal Tax in accordance with the amount of CO2 emissions by setting up a special treatment provision for imposing a tax for global warming countermeasures. It was decided that Petroleum and Coal Tax, currently 2,040 yen/KL, will be raised in phases to a final level of 2,800 yen/KL in April 2015.

A bill for the tax reform package including Global Warming Countermeasure Tax has not yet been enacted as of July 2011 due to political turmoil.

PAJ had been persistent in its opposition to choosing the easy way to introduce new taxation on global warming countermeasures from the following aspects:

• First of all, a thorough investigation of the existing budget for global warming countermeasures should be made.
• On that basis, careful discussion should be carried out.
• Despite all of the efforts made toward efficient use of the existing budget and careful consideration, if the implementation of such taxation is essentially inevitable, the tax scheme can only be implemented on a minimum scale on the premise of imposing tax on each fossil fuel based on carbon content.
• It is necessary to gain public understanding and consent through broad-ranging discussion on overall policy measures such as the specific plans for achieving a greenhouse gas (GHG) reduction target.

However, such discussion was not held. It is very regrettable that Global Warming Countermeasure Tax will be implemented.

For obtaining understanding and consent of the taxpayers, i.e., energy consumers, Global Warming Countermeasure Tax should be a specific purpose tax for global warming countermeasures, from the aspect of ensuring consistency among tax purposes, tax burden and its usage. It is also important to clarify at all times the tax usage through verifying the validity of and necessity for how it is used, and its effects, in order to avoid rigidity of the funding system.

While fulfilling its responsibility for stable oil supply, the petroleum industry has been paying 5 trillion yen or more of petroleum-related taxes each year. This taxing capacity, however, reaches its limit during a downturn in domestic petroleum product demand.

Essentially, a tax should be borne by an end-consumer. Global Warming Countermeasure Tax should also be levied at the stage of product consumption. However, because Petroleum and Coal Tax is levied on crude oil, consumers cannot recognize their tax burden directly, and all tax collection and payments are solely the responsibility of oil companies. The petroleum industry, under complete open competition, is not provided with a scheme for recovering taxes and costs. It is concerned about a greater burden on oil companies due to Global Warming Countermeasure Tax, because there is a possibility of not being able to pass this tax on to consumers.

**Shifting of Road Construction Specific Revenue to General Revenue**

Based on the Cabinet decision regarding the “Basic Policy on a Specific Revenue Source for Road Construction” in May 2008 and in line with the subsequent ruling parties’ agreement in December about incorporating the specific revenue for road construction into general revenue, this specific revenue source was abolished in April 2009 and incorporated into the general revenue account.

Taking such circumstances into consideration, PAJ believes that fundamental reexamination of the method, object, and usage of tax imposition on Gasoline Tax and Diesel Fuel Tax is necessary, since these are no longer the Specific Revenue Source for Road Construction. Currently all costs for construction and maintenance of roads are paid from the general revenue account. It is believed that road construction is financed by general revenue because everybody can use roads and this benefits public interest. However, it would be appear that the costs for road maintenance and repair should be covered at road users’ expense based on their utilization levels. Therefore, it is desirable to conduct a comprehensive study on how to determine the cost burden by road users who cause road deterioration, as is the case in Europe where tax imposition is based on the weight and mileage of a vehicle (Mileage Charged Taxation).
In addition, the provisional tax rates of Gasoline Tax and Diesel Fuel 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, there is no foundation for imposing provisional taxes. At the time of the general election in August 2009, the new ruling Democratic Party of Japan (DPJ) issued a manifesto including the abolition of the provisional tax rates. However, after that, DPJ states that the current provisional tax level will be maintained, though the provisional tax scheme is terminated because of revenue shortages.

Considering the following two points, convincing explanations to taxpayers, i.e., automobile users, are requested:

1. Drivers of gasoline and diesel fuel vehicles have to bear more taxes for general revenue.
2. There is a gap in the tax burden between urban areas and rural areas where gasoline and diesel fuel consumption is large.

An opinion was raised during political deliberations for converting the provisional tax portion into Global Warming Countermeasure Tax. Such an opinion is unacceptable to the petroleum industry by any means, because there is no justification for automobile users to be overly burdened by global warming countermeasures and it significantly ignores impartiality with other energy sources.

Currently, a large amount of petroleum-related taxes are levied at each stage. Considering the issues of a tax on tax, incorporation of Gasoline Tax and Diesel Fuel Tax into general revenue, and Global Warming Countermeasure Tax, a fundamental reexamination of petroleum-related taxes is necessary.
Vital Need to Reinforce Corporate Structure

The petroleum industry continues to be requested to supply environmentally-friendly petroleum products which mitigate global warming as well as meet environmental regulations in a stable and inexpensive manner.

The petroleum industry faces difficult business conditions due to soaring resource prices and a projected tight oil supply in the medium and long terms. Under such circumstances, it is essential for the industry to make efforts to enhance oil resource development for energy security and to make investment in facilities as well as in R&D to respond to environmental requirements.

To comply with such requests, it is necessary for the petroleum industry to ensure a fair earnings level and to make further improvements while reinforcing the petroleum industry’s business structure.

Financial Results

The recent earnings structure of the petroleum industry, however, is in an extremely severe situation. Under a declining trend of domestic petroleum product demand on a medium- and long-term basis, the main factor behind the low performance is thought attributable to the difficulty in passing the higher cost, beyond a certain level, on to the consumer through higher product sales prices during the time of rising crude oil prices. In addition, the record-breaking sharp rise and the great fall in crude oil prices in 2008, and the subsequent world recession arising from the global financial crisis led to a rapid decrease in petroleum product demand as well as to a destabilization of market conditions. However, it is projected that the declining trend in domestic oil demand will not change in the medium and long terms even in a period of falling oil prices. Efforts to ensure earnings have become an increasingly important issue for the industry.

The recent financial results of the petroleum industry show that the profitability of the petrochemical segment, which had at times been extremely good in the past, has worsened rapidly, reflecting soaring material prices and subsequent falling market prices, etc.

The performance of the oil and gas exploration development segment is expected to continue firm, backed by a high crude oil prices, etc. in the medium and long terms, despite a factor of profit decline due to the exchange rate impact (a strong yen).

Earnings of the petroleum product segment had been largely affected by the inventory valuation method which was used. During a period of rising crude oil prices, an oil company with the gross average inventory valuation method generated a huge “inventory valuation impact”, reflecting relatively lower costs of product inventories. As a result, a high level of apparent profits was booked. On the other hand, in a time of falling crude oil prices, such oil companies booked significant losses in a short period of time due to the opposite effect of the “inventory valuation impact”.

The “inventory valuation impact” means that a product’s sales cost is calculated as the sum of the opening inventory cost and the inventory acquisition cost during the term, minus the closing inventory cost. Consequently, product costs fluctuate depending on what inventory valuation method is applied. In case of the gross average inventory valuation method, which the majority of oil companies apply, the level of the opening inventory volume affects the up-and-down movement of the book value product costs (for financial closing).

Such an “inventory valuation impact” has a significant influence on the extreme fluctuation in earnings from the petroleum product segment. In FY2009, crude oil prices showed an upward trend again; consequently, apparent profits due to the positive direction of the “inventory valuation impact” were generated, but ultimately a low level of profit was booked for the full business year. However, the real operating income, excluding the inventory valuation impact of the petroleum product segment, recorded a significant loss. For FY2010, it is expected to secure a surplus due to each oil company’s effort to improve the supply and demand situation, as well as economic recovery and demand growth due to the intensely hot summer.

Each oil company has been taking various counter-
measures such as exporting petroleum products, reinforcing their oil exploration business, and investing in new businesses to strengthen their management base. In recent years, various business efforts have been made, such as the improvement in the supply and demand situation through reformulating the wholesale pricing scheme to properly reflect crude oil price fluctuations and the reduction of excess facilities.

To cope with such rapid and substantial changes in the business environment, it is essential for each oil company to properly analyze the situation and take further rigorous measures. Though companies may be forced to reexamine investments in facilities and R&D which are necessary for business execution, it is necessary for each company to make utmost efforts to make a more efficient and stronger corporate structure by taking careful but even further thoroughgoing restructuring measures.
Appropriate Safety and Disaster-prevention 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 fire-breaks are also installed between all facilities. Each plant facility and storage tank is also designed to withstand massive earthquakes. In the case of the Great Hanshin-Awaji Earthquake in January 1995, there were almost no fires or oil spill incidents at refineries and oil storage terminals in the area.

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 for 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.

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 fire-fighting 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

PAJ set up a policy named “PAJ Mutual Support Policy for Petroleum Refinery/Facility Disasters”, assuming a case in which wide-area and extensive
Thorough Safety Measures

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, Pressure Vessels, Outside Storage Tanks, Rotating Machines, Electrical Equipment and Process Control Instruments” to improve the reliability of facility maintenance.

3. Introducing New Inspection Technology

Improving inspection technology 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 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.
PAJ Oil Spill Response Stockpiles

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 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.

Cases Involving OSR Equipment Lending

As of October 2010, PAJ had lent out OSR equipment 25 times (13 times for domestic spills) since the establishment of the first stockpile base in November 1993.

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, and the submergence of a large-scale barge in the Arabian Gulf in January 1998. 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.

Education & Training

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 anti-disaster drills conducted by local Coast Guard headquarters or anti-disaster 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.

Research & Development on Oil Spill Response

PAJ has conducted research and development activities on OSR for many years. To cite one typical example, 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.

Oil Slick Detection Technology Using Satellite Imagery

Satellite monitoring is considered an important technology for the detection of oil slicks in a spill incident at sea. In particular, a synthetic aperture radar
(SAR) carried by a satellite is a promising tool because it works without being influenced by the weather. However, oil slick detection by SAR data is not in practical use yet as it is difficult to detect a slick when the surface of the sea is too rough or too smooth. PAJ applied a new analytical processing method for oil slick recognition that uses SAR data, and has made progress toward technology that would increase the probability of recognizing a slick even in such extreme sea conditions.

**Hosting of International Oil Spill Conferences**

PAJ invites oil spill specialists from Japan and abroad to its international oil spill conferences held every year (14 symposia and one workshop were held between 1990 and 2010). The purposes are to exchange information among participants about responses to major oil spill incidents, recent developments of international compensation systems, and technology development regarding oil spills. Recently, many cases of large scale oil spills have occurred not from large crude oil tankers but from inland pipelines and from deepwater oilfields, such as the offshore rig explosion in the Gulf of Mexico in April 2010. PAJ will hold its 2011 international workshop by inviting parties concerned about such oil spill accidents from the US, China and Australia.
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 denitification 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.

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.
Countermeasures 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 emission. 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 3,000 tons in FY2009, a 97% 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

- **Capital Investment**
  - Heavy Oil Desulfurization ±550
  - Unleaded Gasoline ±300

- **Environmental Measures**
  - Court Decision on Yokkaichi Pollution Lawsuit (1967-1972)
  - Establishment of the Agency of Environment (1971)
  - Automobile Emission Control (1970)
  - Diesel Vehicle Emission Control - Short-term (1993)
  - Long-term (1997-99)
  - Setup of Benzene Environmental Standard (1996-2000)
  - 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 - Long-term (1997-99)

- **Indirect Desulfurization Unit**
- **Direct Desulfurization Unit**

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Capacity</th>
<th>Unit: 1,000 b/d</th>
<th>Number of Facility Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>1,200 (37)</td>
<td>Direct Desulfurization Unit</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>1,441 (44)</td>
<td>Indirect Desulfurization Unit</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>1,387 (41)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>1,358 (43)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>1,447 (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>1,448 (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>1,451 (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1,460 (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>1,460 (40)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unit: billion yen

Source: PAJ
Quality Improvement in Automotive Fuels

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 Law on Quality Control of Gasoline and Other Fuels (Fuel Quality Control Law) 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 Law has been amended since then to reflect the national concern regarding further quality improvement.

Through the progress of deregulation, alcohol-

---

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

* 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.
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 Law. Consequently, several fires involving vehicles using the alcohol-blended fuel were reported. To ensure consumers’ safety, METI banned the sale of such alcohol-blended fuel effective August 2003 and amended the Fuel Quality Control Law 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 were 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.

**Sulfur-free Gasoline and Diesel Fuel**

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 after-treatment 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 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 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

Status of Approach Based on Kyoto Protocol

The Kyoto Protocol stipulates a concrete approach to the United Nations Framework Convention on Climate Change (UNFCCC) aiming at stabilizing the concentration of atmospheric greenhouse gas (GHG) and at maintaining the current climate ever afterwards. The protocol sets legally binding numerical targets for GHG emission reduction for 2008-12 versus 1990 in industrialized countries (a 6% reduction for Japan).

However, the U.S. decided to withdraw from the Kyoto Protocol in 2001, and no emission reduction obligation is stipulated for developing countries, including countries with massive emissions like China. Therefore, the coverage of reduction obligations is limited to about one-third of the global amount of emissions, and its overall effect is said to be questionable on a global basis.

Discussion on Post-Kyoto Protocol

A series of conferences were held including COP with a goal to establish a new global GHG reduction agreement for the period after 2013 when the first commitment period under the Kyoto Protocol terminates. However, especially with lack of accord between developed and developing countries, a concrete agreement has not yet been reached.

At the UNFCCC summit meeting in September 2009 and also at COP15 at the end of 2009, Japan presented a plan for a reduction of 25% below the 1990 level, premised on “the agreement of establishing a fair and effective international framework by all major countries and an agreement on these ambitious targets.” This is generally recognized in Japan as the most severe target among those proposed by major countries such as the EU (a 20% reduction and a conditional maximum reduction vs. the 1990 level) and the US (a 17% reduction vs. the 2005 level, equivalent to a 3% reduction vs. the 1990 level).

Also at COP16, held in November/December 2010, Japan opposed the extension of the present Kyoto Protocol where only some of advanced countries bear a reduction obligation.

Domestic Trends Regarding the Climate Change Issue

Measures for the First Commitment Period of Kyoto Protocol

A flash report on FY2009 GHG emissions shows a 1.5% increase vs. the 1990 level, although a 5.6% decrease was recorded vs. FY2008. Further measures are necessary to achieve the 6% reduction target set for the first commitment period.

The industrial sector achieved a reduction of around 20% versus the FY1990 level, However, the business/other sector as well as the household sector increased about 30% versus the same period.

Movement toward Post-Kyoto Protocol

The government is continuing the examination by experts utilizing model analysis regarding the cost, impact on the economy and public financial burden necessary to achieve Japan’s 25% GHG reduction tar-

<table>
<thead>
<tr>
<th>COP 15 Copenhagen Accord – 2020 Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Japan</strong></td>
</tr>
<tr>
<td>-25% vs 1990</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>EU</strong></td>
</tr>
<tr>
<td>-20%~30% vs 1990</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>US</strong></td>
</tr>
<tr>
<td>-17% vs 2005</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>China</strong></td>
</tr>
<tr>
<td>-40%~45% vs 2005</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*1 Each country’s target assumes enactment of domestic laws and other countries’ reduction level.
*2 8% annual growth set in the 11th five-year plan is assumed.

<table>
<thead>
<tr>
<th>Marginal Cost of 2020 Target by Country</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>$\text{t CO}_2$$</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Japan</strong></td>
</tr>
<tr>
<td>$600 $476 $135 $3 *3</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>US</strong></td>
</tr>
<tr>
<td>$3 $60 $135 $3 *3 $ *3</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>EU</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>China</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*3 Note: -45% vs 2005 for China, and -30% vs 1990 for EU

Source: Research Institute of Innovative Technology for the Earth
The Global Warming Issue and Oil

Target presented at COP15. In consistency with Japan Business Federation’s (Nippon Keidanren) Voluntary Action Plan, “trial implementation of emission trading in an integrated domestic market” was started in FY2009, and many oil refining companies are participating in this scheme.

Full-scale discussion hereafter begins to realize the 25% reduction target and also to introduce an environmental tax and emission trading as the economic approach to the global warming issue. The petroleum industry expects to realize a substantial GHG reduction commitment through international cooperation with a focus on further improvement in efficient use and technology development of energy.

The government listed the following as a domestic policy for global warming countermeasures in the future: ① establishing a domestic emission trading scheme, ② introduction of a domestic global warming countermeasures tax, and ③ establishing a system to purchase the whole quantity of renewable energy at a fixed price.

Regarding the domestic emission trading scheme, the government stated, in December 2010, that it would examine thoroughly this scheme in consideration of the effect of introducing new taxes, a renewable energy purchasing system and a possible new international framework. However, there is a possibility among governmental councils to study setting up the reduction target by looking at the cap-and-trade system in which the administration sets the emission cap that is currently used in European countries, and also considering the introduction of innovative reduction technology.

Reacting to the introduction of the government’s restrictive measures, Japanese industry, including the petroleum industry, announced the policy of achieving a low-carbon society that harmonized the environment with the economy by releasing a “Low-carbon Society Action Plan” in line with the Japan Business Federation’s ongoing Voluntary Action Plan.

The petroleum industry agreed to this outline and prepared “Petroleum Industry’s Action Plan for Low-carbon Society” with a main focus on energy conservation at oil refineries.

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 PAJ member company 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 FY2009 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 in FY2010 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) sophisticated operation control through innovative technology for process control and optimal operation, (2) expanding common use of heat among facilities and adding waste heat recovery units, (3) operating facility maintenance efficiently, and (4) adopting high-efficiency facilities and catalysts. These measures are being evaluated at the “National Excellent Energy Conservation Examples Convention” 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 New Energy and Industrial Technology Development Organization (NEDO), 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

<table>
<thead>
<tr>
<th>Energy Saving Projects at Refineries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Refining plants</strong></td>
</tr>
<tr>
<td>Thorough insulation of tower, tank and piping</td>
</tr>
<tr>
<td>Installation, cleaning and replacement of furnace air-preheater, and installation of waste heat boiler</td>
</tr>
<tr>
<td>Installation 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 turbine (recovery of pressure energy)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy Saving Technologies Included in NEDO’s Support Projects on Energy Use Rationalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Install high performance trays in the distillation column</td>
</tr>
<tr>
<td>2. Install heat exchanger to recover heat at top pump-around of distillation column</td>
</tr>
<tr>
<td>3. Utilize the idle heat exchanger of heavy oil thermal cracking unit with existing air-fin cooler to recover heat diffused from the existing air-fin cooler of distillate stream to pre-heat feedstock stream</td>
</tr>
<tr>
<td>4. Increase capacity of feedstock line from the direct desulfurization unit to the fluid catalytic cracking (FCC) unit to directly increase fresh feedstock</td>
</tr>
<tr>
<td>5. Reduce load for make-up gas compressor of the direct desulfurization unit by installing automated flow capacity adjustment system</td>
</tr>
<tr>
<td>6. Recover waste heat efficiently from the furnace of atmospheric distillation unit</td>
</tr>
<tr>
<td>7. Install new heat exchangers at the feedstock furnace to reduce fuel consumption</td>
</tr>
<tr>
<td>8. Install an exhaust gas turbine for power generation at the FCC unit and reduce captive power generation</td>
</tr>
</tbody>
</table>
The Global Warming Issue and Oil

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.

As a result of these efforts, Japanese refineries have a world-leading level of energy efficiency.

**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.
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 technologically 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, 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-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 “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

Sales of Bio-Gasoline (Biotechnology Gasoline)

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 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. This received high acclaim from consumers, municipal governments and business owners due to its strong environmental considerations. 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 2011, bio-gasoline was being sold at about 2,120 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 Structure, 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 abatement measures in urban areas.

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 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

![Source: Biofuel Sustainability Study Group (April 2009)](image)

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

![Source: Interim Report of the Study Group on Sustainability Standards for the Introduction of Biofuel (March 2010)](image)

(Note)
1. High-yielding rice (1) is produced in a paddy field with water management and high-yielding rice (2) is without water management
2. LCA of gasoline GHG emission is assumed as 81.8g-CO₂/MJ
3. In case of local production for local consumption, zero GHG emission during transportation is assumed

Utilization of Biomass Fuel

operating procedures. The interim report issued in March 2010 is summarized as follows. ① As one of the sustainability standards for biomass fuel, the 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, and 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 (energy security, 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.

<table>
<thead>
<tr>
<th>Biofuel Marketing Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bio-Gasoline Sales</strong></td>
</tr>
<tr>
<td><strong>Introduction of Bio-ETBE</strong></td>
</tr>
<tr>
<td>April 2007 - March 2009 Test Marketing</td>
</tr>
<tr>
<td><strong>FY2009 Expanded Marketing</strong></td>
</tr>
<tr>
<td><strong>FY2010 Full Marketing</strong></td>
</tr>
<tr>
<td>[Bio-ETBE 0.2 million kl]</td>
</tr>
<tr>
<td>0.21 million kl of Crude Oil Equivalent</td>
</tr>
<tr>
<td>[Bio-ETBE 0.84 million kl]</td>
</tr>
<tr>
<td>(Quantity of bio-ETBE introduction)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maintenance of Domestic Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Import Terminal Maintenance</td>
</tr>
<tr>
<td>Summer 2008: Contract</td>
</tr>
<tr>
<td>Start to use</td>
</tr>
<tr>
<td>② Ocean Tanker Procurement</td>
</tr>
<tr>
<td>Summer 2008: Contract</td>
</tr>
<tr>
<td>Start to ship</td>
</tr>
<tr>
<td>③ Coastal Tanker Procurement</td>
</tr>
<tr>
<td>Winter 2008: Contract</td>
</tr>
<tr>
<td>Start to ship</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bio-ETBE Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2008</td>
</tr>
<tr>
<td>Memorandum Conclusion in Brazil, Purchase Contract with US company</td>
</tr>
<tr>
<td>September 2009</td>
</tr>
<tr>
<td>Start to Trade Domestic Ethanol</td>
</tr>
</tbody>
</table>

*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 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. In 2003, an HS-FCC plant was constructed in Saudi Arabia and was 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.

Characteristics of IGCC

<table>
<thead>
<tr>
<th></th>
<th>IGCC</th>
<th>BTG*1 (Conventional Oil Thermal Power Generation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generating Efficiency</td>
<td>46%</td>
<td>39%</td>
</tr>
<tr>
<td>CO₂ Emission</td>
<td>598g-CO₂/kWh</td>
<td>706g-CO₂/kWh</td>
</tr>
<tr>
<td>Emission Gas Level*2</td>
<td>☀</td>
<td>⊗</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
  - Oxygen
  - Steam
  - Asphalt
- Gasification Unit
  - Hydrogen
  - Carbon Monoxide
  - Synthetic Gas
- Compound Generation Unit
  - Gas Turbine
  - Steam Turbine
  - Generator
  - Electricity
  - Waste Heat Boiler
  - Steam Turbine Exhaust
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 High Energy Efficiency Oil Utilization System 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 Petroleum Energy Center (PEC), 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”.

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”

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%.
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.
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.

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

For promotion of fuel cells, the petroleum industry is making positive efforts in the following areas:

• Technology development of fuel cell systems for use in cold regions like Hokkaido and for use in cases of earthquakes

• Field performance testing of LPG and kerosene type fuel cell systems in households and commercial outlets

• Infrastructure development for fuel cell popularization such as deregulation and the establishment of domestic/international standards

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 are participating in the national demonstration projects (JHFC*1/NEDO*2 Projects) to operate various type of hydrogen filling stations.

Future plans include the early establishment of a hydrogen supply infrastructure in four metropolitan areas to keep abreast of automobile manufacturers’ progress in the mass production of fuel cell vehicles scheduled for 2015. Furthermore, technology development to produce hydrogen from kerosene at a filling station site is ongoing from FY2008. This includes a hydrogen manufacturing process using membrane separation technology.

*1 METI’s Japan Hydrogen & Fuel Cell Demonstration Program
*2 New Energy and Industrial Technology Development Organization

Efforts toward New Technologies

Aiming at developing the highly efficient utilization of petroleum and supplying high quality products, 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
Efforts toward Developing New Energies

(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 (JTOP: Japan Auto-Oil Program) was initiated 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.

**Enhancement of 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.

**R&D on Safety Management Systems for Oil Refining and Storage Facilities**

Aiming at the improvement of its own safety and security standards at refining and storage sites, the petroleum industry is reviewing nondestructive inspection methods and compiling field inspection data in order to develop self-inspection standards.

Regarding the facilities in operation, the petroleum industry is preparing fitness-for-service evaluation standards, in cooperation with API and ASME, to assess the material strength and the remaining life of the facilities based on the inspection data acquired for these facilities in service.

In addition, as Japan is an earthquake-prone country, an ongoing research study is steadily collecting data regarding the effect of longer-cycle seismic vibration on oil storage facilities that will contribute to safety control in the future.

---

**Set up on the Highway**

After the introduction of FCV, nationwide expansion of FCV sales and the maintenance of hydrogen supply infrastructure will proceed.

**Early Establishment in Four Metropolitan Areas**

* Early Establishment of Hydrogen Supply Infrastructure
Appendix

Location of Refineries and Crude Distillation Capacity in Japan (as of Jul 2011)

(Total: 27 Refineries (4,619,224 b/d)

TOTAL: 27 Refineries (4,619,224 b/d)
## Overview of the Japanese Petroleum Industry [Oil Refiners and Primary Oil Distributors (Motouri)]

<table>
<thead>
<tr>
<th>Category</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Oil Companies</td>
<td>16 Companies (as of August 2011)</td>
</tr>
<tr>
<td>Total Capital</td>
<td>563.0 billion yen (as of Mar 2011)</td>
</tr>
<tr>
<td>Annual Sales Revenue</td>
<td>22.754 trillion yen (FY2010)</td>
</tr>
<tr>
<td>Total Number of Employees</td>
<td>Approx. 20,500 (as of the end of FY2010)</td>
</tr>
<tr>
<td>Crude &amp; Product Import Volume</td>
<td>247.4 million kl (FY2010)</td>
</tr>
<tr>
<td>Crude &amp; Product Import Amount</td>
<td>143.4 billion dollar (FY2010)</td>
</tr>
<tr>
<td>Oil Dependence on Imports</td>
<td>99.6% (FY2010)</td>
</tr>
</tbody>
</table>

## Main Product Specifications in Japan

<table>
<thead>
<tr>
<th>Product</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motor Gasoline</strong> (JIS K2202)</td>
<td>Lead Density (max.) 0.783g/cm³ (15°C) RVP 44~78kPa, RON (min.) Premium 96; Regular 89, Sulfur content (max.) 0.0010wt%, MTBE (max.) 1vol%, Ethanol (max.) 7vol%, Oz content (max.) 3vol%, 1.3wt%</td>
</tr>
<tr>
<td><strong>Kerosene</strong> (JIS K2203)</td>
<td>Sulfur content (max.) 0.0080wt% (for fuel cell: 0.0010wt%), Smoke point (min.) 23mm (in winter season: 21mm)</td>
</tr>
<tr>
<td><strong>Gas Oil</strong> (JIS K2204)</td>
<td>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; No.2, No.3, Special No.3: 50 Smoke point (min.) Special No.1, No.1: 21mm; No.2, No.3: 23mm, Cetane index (min.) Special No.1, No.1: 50; No.2, No.3, Special No.3: 45</td>
</tr>
<tr>
<td><strong>Fuel Oil A</strong> (JIS K2205)</td>
<td>Kinematic viscosity (max.) 20mm²/S (50°C), Density (max.) 0.86 (15°C), Pour point (max.) 5°C, Sulfur content (max.) No.1: 0.5wt%; No.2: 2.0wt%</td>
</tr>
<tr>
<td><strong>Fuel Oil B</strong> (JIS K2205)</td>
<td>Kinematic viscosity (max.) 50mm²/S (50°C), Pour point (max.) 10°C, Sulfur content (max.) 3.0wt%</td>
</tr>
<tr>
<td><strong>Fuel Oil C</strong> (JIS K2205)</td>
<td>Kinematic viscosity (max.) No.1 250mm²/S (50°C), No.2 400mm²/S (50°C), No.3 400mm²/S~1000mm²/S (50°C), Pour point (max.) No.1 3.5wt%; No.2, No.3 no specification</td>
</tr>
</tbody>
</table>

Note: 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/statish.html