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- Overview of the Japanese Petroleum Industry
- Location of Refineries and Crude Distillation Capacity in Japan
- Domestic Demand for Main Petroleum Products
  
  PAJ’s Oil Statistics Website for details
- Main Product Specifications in Japan
Regarding crude oil prices in 2008, West Texas Intermediate (WTI) prices jumped to 100.09 US dollars per Bbl briefly on January 3, crossing the 100 US dollar mark for the first time in history, and rose close to 150 US dollars in July. Then prices tumbled to the 30 US dollar level in December. 2008 was a year of turmoil like never before.

The rapid hike in crude oil prices up to the end of 2007 was thought to be attributable to three factors: the world’s tight oil supply situation, an increase in geopolitical risks due to deteriorating public safety in oil producing countries, and an influx of speculative money in the oil market. After entering 2008 the tight oil supply situation gradually eased, but without obvious changes in the geopolitical risks, and crude oil prices showed a steep rise, approaching 150 US dollars per Bbl. The soaring prices were thought to be a result of the extended influence of speculative funds. However, world leaders were increasingly concerned about high crude oil prices at the Jeddah Energy Meeting (a conference among the oil producing and consuming countries) in June 2008, and the G-8 Hokkaido Toyako Summit in July showed strong support for tighter monitoring of speculative funds. In line with this support, the outflow of such funds from the oil market has been taking place gradually. In addition, the financial shock which started in the United States and the subsequent simultaneous slowdown of the world economy affected the decline in oil demand, which was thought to accelerate the fall in crude oil prices.

In response to a steep rise in crude oil prices up to July, the national average price of regular gasoline in the domestic market exceeded 185 yen per liter in August. As a result of the increased replacement demand for smaller or more energy-efficient vehicles, gasoline demand in 2008 decreased far more than originally anticipated. With the spread of energy saving and fuel conversion, the demand for other fuels also showed a decline versus the previous year, except Fuel Oil C demand for thermal power generation, which increased due to the shutdown of the Kashiwazaki Kariwa Nuclear Power Plant.

Furthermore, the measures for setting the provisional tax rates of the Gasoline Tax and Diesel Fuel Transaction Tax under the Special Taxation Measures Law and the Local Taxation Law expired on March 31, 2008, and the provisional tax rates lapsed for one month in April. Like the unstable situation in the Japanese Diet, turmoil held sway in the oil market in 2008.

With the support of drivers against the shift of the Specific Revenue Source for Road Construction of the Gasoline Tax and Diesel Fuel Transaction Tax into the General Account Budget, the petroleum industry, in cooperation with the automobile industry and the petroleum retail industry, argued against such a shift. Unfortunately, the Special Revenue Source for Road Construction was ultimately incorporated into the General Account Budget. As for the issue of dual taxation (Consumption Tax on Gasoline Tax), however, certain results were accomplished by incorporating such phrases as “seek solutions to the problem of tax burden adjustment” into the ruling Liberal Democratic Party’s FY2009 Tax Reform Package.

Regarding global warming, the petroleum industry has been making proactive efforts, as an advanced environmental industry, to reduce CO2 emissions from its refining operations by 13% vs. FY 1990 by FY 2010. In addition, the petroleum industry has been steadily preparing for the smooth full-scale launching of biomass fuels in FY2010.

This brochure has been created to give a better understanding of the current situation and the future efforts of the petroleum industry in Japan.
The Petroleum Association of Japan (PAJ), incorporated in November 1955, is composed of 16 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 2009

Business Activities

Along with such changes in the business environment as the rapid increase in crude oil prices in recent years, the subsequent sharp drop in crude oil prices due to the global economic slowdown, and increasingly intense competition among various energies, the petroleum industry in Japan has been working positively as “an advanced environmental industry” to take global warming countermeasures, while enhancing rationalization, efficiency improvement and sophisticated business operations. While a downward trend in domestic oil demand has become obvious, oil will continue to constitute a large share of the primary energy supply as an excellent energy source in view of its convenience as well as its economic and utilization efficiencies. Therefore, as an energy industry needed to sustain the nation’s economy, the petroleum industry is 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.

Based on a long-term perspective, PAJ is actively addressing various policy issues in line with the following business activity plans:

1. Maintaining the competitive and optimum scale of a huge oil supply chain, covering everything from crude oil imports and refining to distribution and marketing
2. Developing effective and advanced use of oil
3. Dealing with environmental and safety issues
4. Gaining public and consumer understanding of and trust in the petroleum industry.

Especially for fiscal 2009, PAJ is proactively addressing various issues and activities as listed below and contributing to the development of the petroleum industry:

II. Projects and Main Activities in Fiscal Year 2009

1. Urging comprehensive reexamination of petroleum-related taxes, ensuring equity in taxation among energy sources, and achieving tax relief
2. Addressing the global warming issue
   (1) Action toward the introduction of bio-ETBE (ethyl-tertiary-butyl-ether)
   (2) Reexamination of the Voluntary Action Plan and complete accomplishment of the first commitment period
   (3) Response to the establishment of a new framework for a Post-Kyoto Protocol
   (4) Development of countermeasures for issues related to automotive fuels
   (5) Undertaking governmental subsidy programs for environmental protection
3. Strengthening the competitiveness of the petroleum...
4. Promoting various uses of petroleum products
   (1) Development of countermeasures for issues related to automotive fuels such as promotion of biofuels
   (2) Enhancement of promotional activities to encourage broad use of PAJ's High Energy Efficiency Oil Utilization Systems
   (3) Research and development of automotive fuels, lubricating oils and advanced combustion technologies that meet environmental requirements

5. Promotion of 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) Comprehensive study for risk management in the event of 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. Action plans for 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. Promotion of activities for reinforcement of the petroleum industry's foundation
   (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 (16)

- 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.
- Nippon Oil Corporation
- Nippon Petroleum Refining Co., Ltd.
- Japan Energy Corporation
- ExxonMobil Y.K.
- Seibu Oil Co., Ltd.

Former Member & Friend of PAJ (1)

- Kygnus Sekiyu K.K.
Sluggish Product Demand

For many years, petroleum product demand in Japan increased in line with the country’s high economic growth rate. The oil crises forced demand in the industrial sector to decrease significantly for several years. However, total fuel oil demand maintained its increase mainly due to the steady rise in demand in the transportation and household sectors.

After 1996, though, total fuel demand started to decrease as a result of shrinking demand from electric power plants and progress in rationalization of distribution networks. In the transportation sector, gasoline demand started to decrease in 2005 due to the limited increase in the passenger vehicle population and the decrease in fuel consumption due to the introduction of tighter fuel consumption standards for new vehicles. Diesel fuel demand has decreased since 1996 reflecting distribution rationalization.

As for the household sector, fuel demand for hot-water supply and home heating has shown a gradual decline due to the popularization of electric and gas appliances and of energy-efficient housing. The industrial sector’s fuel demand continues to show a decrease as a result of energy conservation measures and a shift to alternative energy sources in view of maintaining business competitiveness as well as coping with global warming countermeasures. In the energy conversion sector, including electric power generation, the fuel oil share in thermal power generation is projected to decline, depending on the operational status of nuclear power plants, because of the construction of new power plants shifting to LNG and other non-oil fuels.

From FY1980 to FY2007, the percentage of gasoline plus naphtha demand to total fuel oil demand climbed from 29.1% to 49.3%, while the ratio of heavy fuels (Fuel Oil B and C) declined from 37.9% to 11.6%. In sum, fuel oil demand is showing a remarkable change toward a lighter fuel demand structure.

Building a Flexible Supply System

The major portion of petroleum product supply in Japan is covered by domestic production, and product import plays only a complementary role. In FY2007 the total domestic production volume of fuel products was about 98.5% of total petroleum product demand.

During the Gulf Crisis in August 1990, the imported volume of petroleum products dropped sharply due to a ban on petroleum imports from Kuwait and Iraq as well as to customers refraining from purchasing high-priced products. In this situation, Japanese oil refiners increased their crude processing volume and secured a stable supply of petroleum products.

The Japanese petroleum industry has been upgrading manufacturing facilities like heavy oil cracking units to cope with the changes in demand structure and to provide a flexible supply of domestic petroleum products in case of unexpected changes in demand.

The industry considers the “Domestic Petroleum Refining System” to be the most appropriate petroleum product supply system in Japan, since it has been able to deliver a stable and efficient supply of products as well as ensure product quality even after the abolition of the Petroleum Industry Law at the end of 2001. Importing crude oil and processing it at domestic refineries to produce petroleum products forms the core of the system, and imported products have only a supplemental role.

Total petroleum product demand for FY2007 was 218.5 million KL, 2.4% down from FY2006. Demand for naphtha for petrochemical feedstock exceeded the previous year’s figure. Gasoline demand decreased three years in a row. With the remarkable spread of the energy shift in the civil, industrial and business sectors, demand for kerosene and heavy fuels also decreased significantly from the previous year.
### Petroleum Product (Fuel) Domestic Demand Trends

<table>
<thead>
<tr>
<th>(FY)</th>
<th>Fuel Oil B,C</th>
<th>Fuel Oil A</th>
<th>Diesel Fuel</th>
<th>Kerosene</th>
<th>Naphtha</th>
<th>Gasoline</th>
<th>Jet Fuel</th>
<th>Total Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>79,199</td>
<td>21,083</td>
<td>21,564</td>
<td>23,566</td>
<td>26,297</td>
<td>34,543</td>
<td>2,967</td>
<td>209,219</td>
</tr>
<tr>
<td>1990</td>
<td>46,623</td>
<td>27,066</td>
<td>37,680</td>
<td>26,701</td>
<td>31,423</td>
<td>44,783</td>
<td></td>
<td>218,012</td>
</tr>
<tr>
<td>2000</td>
<td>31,364</td>
<td>29,516</td>
<td>41,745</td>
<td>29,924</td>
<td>47,686</td>
<td></td>
<td>58,372</td>
<td>243,218</td>
</tr>
<tr>
<td>2005</td>
<td>27,009</td>
<td>27,780</td>
<td>37,116</td>
<td>28,265</td>
<td>49,388</td>
<td>61,421</td>
<td></td>
<td>236,109</td>
</tr>
<tr>
<td>2008</td>
<td>23,158</td>
<td>17,891</td>
<td>33,722</td>
<td>20,250</td>
<td>42,873</td>
<td>57,473</td>
<td></td>
<td>201,042</td>
</tr>
</tbody>
</table>

Source: METI
Petroleum Product Domestic Demand by Usage (FY2007)

<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>Gasoline</td>
<td>58,982</td>
<td>34,161</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>96,681</td>
</tr>
<tr>
<td>Aviation</td>
<td>Gasoline</td>
<td>5</td>
<td>5,916</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5,921</td>
</tr>
<tr>
<td>Transportation &amp; Marine</td>
<td>Gasoline</td>
<td>2,190</td>
<td>406</td>
<td>4,404</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6,756</td>
</tr>
<tr>
<td>Agriculture &amp; Fisheries</td>
<td>Gasoline</td>
<td>89</td>
<td>4,733</td>
<td>64</td>
<td>15,762</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>29,053</td>
</tr>
<tr>
<td>Mining &amp; Manufacturing</td>
<td>Gasoline</td>
<td>1,531</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,531</td>
</tr>
<tr>
<td>Municipal Gas</td>
<td>Gasoline</td>
<td>199</td>
<td>14,256</td>
<td>11,348</td>
<td>858</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>26,661</td>
</tr>
<tr>
<td>Electric Power</td>
<td>Gasoline</td>
<td>15,749</td>
<td>8,449</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>38,821</td>
</tr>
<tr>
<td>Household &amp; Commercial</td>
<td>Gasoline</td>
<td>48,548</td>
<td>5,916</td>
<td>22,672</td>
<td>35,557</td>
<td>46,710</td>
<td>12,174</td>
<td>33,069</td>
<td>1,939</td>
<td></td>
<td>265,660</td>
</tr>
<tr>
<td>Chemical Feedstock</td>
<td>Gasoline</td>
<td>825</td>
<td>6,087</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Gasoline</td>
<td>59,076</td>
<td>48,548</td>
<td>5,916</td>
<td>22,672</td>
<td>35,557</td>
<td>46,710</td>
<td>12,174</td>
<td>33,069</td>
<td>1,939</td>
<td>265,660</td>
</tr>
</tbody>
</table>

Petroleum Supply and Demand (FY2008)

<table>
<thead>
<tr>
<th>Item</th>
<th>FY</th>
<th>2007</th>
<th>2008</th>
<th>% vs. Prev. Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil</td>
<td>Import</td>
<td>242,029</td>
<td>234,406</td>
<td>96.9</td>
</tr>
<tr>
<td></td>
<td>Processed</td>
<td>233,633</td>
<td>223,974</td>
<td>95.9</td>
</tr>
<tr>
<td>Product (Fuel Oil)</td>
<td>Opening Inventory</td>
<td>11,718</td>
<td>11,544</td>
<td>98.5</td>
</tr>
<tr>
<td></td>
<td>Production</td>
<td>217,689</td>
<td>208,759</td>
<td>95.9</td>
</tr>
<tr>
<td></td>
<td>Import</td>
<td>32,102</td>
<td>29,327</td>
<td>91.4</td>
</tr>
<tr>
<td></td>
<td>Total Supply</td>
<td>249,790</td>
<td>238,086</td>
<td>95.3</td>
</tr>
<tr>
<td></td>
<td>Domestic</td>
<td>218,487</td>
<td>201,042</td>
<td>92.0</td>
</tr>
<tr>
<td></td>
<td>Export</td>
<td>29,001</td>
<td>34,153</td>
<td>117.8</td>
</tr>
<tr>
<td></td>
<td>Total Demand</td>
<td>247,488</td>
<td>235,195</td>
<td>95.0</td>
</tr>
<tr>
<td></td>
<td>Closing Inventory</td>
<td>11,544</td>
<td>11,793</td>
<td>102.2</td>
</tr>
</tbody>
</table>

source: METI
Crude Oil Import Volume

The crude import volume in FY2007 was 242.0 million KL, 1.4% up from the previous year. 86.4% of total crude oil is imported from Middle Eastern countries, followed by Southeast Asian countries (5.2%) and European countries (3.6%).

In the early 1970s, more than 80% of crude oil came from Middle Eastern countries, but the ratio went down to 68% in 1987 mostly as a result of the government and the industry's efforts to diversify crude supply sources by taking into account the experiences of the oil crises. However, in the 1990s imports from non-Middle Eastern countries such as China, Indonesia and Mexico declined gradually, and in consequence the crude oil supply dependency on Middle Eastern countries today exceeds the 80% level again.

Regarding crude oil imports by country, Saudi Arabia had the top share (27.6% of total import volume) as it had in the previous year, and the United Arab Emirates (23.8%) and Iran (12.2%) followed. OPEC countries' import volume share reached a low of 71.6% in FY1985, but their share then trended upward and reached 87.7% in FY2007.

Oil majors held 70% of the crude oil supply share in the past. However, their share dropped to 18.0% in FY2007 primarily due to the nationalization of oil majors’ assets by the governments of oil-producing countries. The national oil companies of oil-producing countries like Saudi Arabia increased their supply shares dramatically and reached 75.3% in FY2007.

Current Status of Petroleum Product Imports/Exports

Imported naphtha for petrochemical feedstock has accounted for about 80% of total product imports in the past several years. Total import volume of fuel products in FY2007 was 32.1 million KL, a 9.0% decrease from the previous year.

Although imports of Fuel Oil C increased by 43.9% due to a large increase in demand for thermal power generation, the following fuels showed a drastic decrease in import volumes from the previous year due to the influence of sluggish domestic demand combined with high product prices in offshore markets; gasoline fell by 62.8%, kerosene by 69.7%, and Fuel Oil A by 66.8%.

The volume ratio of imported fuels to domestic fuel product demand was 15.1%. While the import portion of naphtha itself accounted for 54.1%, that of total fuel products was 3.5%. This clearly indicates the supplemental position of imported products in the domestic product supply.

Regarding product imports by country, the Middle East and Korea are the major sources of naphtha imports, while other products are mainly coming from Asia with a central focus on Korea.

On the other hand, total export volume of fuel products rose to 29.0 million KL, a 24.5% increase from the previous year. Jet fuel oil and Fuel Oil C, that are shipped for fueling international aircraft and ocean liners respectively, made up a major share of total product export volume. Reflecting a slowdown in the domestic market and an active overseas market for middle distillates, export volume for diesel fuel rose substantially. Changes in middle distillate volumes versus the previous year are jet fuel up by 16.6%, diesel fuel up by 82.4% and Fuel Oil C down by 2.4%.
Crude Oil Imports by Source

<table>
<thead>
<tr>
<th>Year</th>
<th>OPEC</th>
<th>Other Non-OPEC Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>UAE 14.7</td>
<td>Saudi Arabia 33.0</td>
</tr>
<tr>
<td>1990</td>
<td>UAE 21.4</td>
<td>Saudi Arabia 19.5</td>
</tr>
<tr>
<td>2000</td>
<td>UAE 25.6</td>
<td>Saudi Arabia 21.6</td>
</tr>
<tr>
<td>2008</td>
<td>UAE 22.8</td>
<td>Saudi Arabia 28.2</td>
</tr>
</tbody>
</table>

Note: Due to withdraw from OPEC on Jan. 2009, the figure of Indonesia in FY2008 was counted on OPEC before Dec. 2008, and on Others as a Non-OPEC country after Jan. 2009.

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>
<th>Japanese Oil Development Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>70.0</td>
<td>7.7</td>
<td>14.3</td>
<td>8.0</td>
</tr>
<tr>
<td>1980</td>
<td>44.5</td>
<td>3.3</td>
<td>44.4</td>
<td>7.8</td>
</tr>
<tr>
<td>1985</td>
<td>26.1</td>
<td>3.7</td>
<td>59.7</td>
<td>10.5</td>
</tr>
<tr>
<td>1990</td>
<td>27.8</td>
<td>1.9</td>
<td>61.3</td>
<td>9.0</td>
</tr>
<tr>
<td>1995</td>
<td>23.9</td>
<td>1.5</td>
<td>64.2</td>
<td>10.4</td>
</tr>
<tr>
<td>2000</td>
<td>22.2</td>
<td>2.2</td>
<td>67.3</td>
<td>8.3</td>
</tr>
<tr>
<td>2005</td>
<td>18.8</td>
<td>1.8</td>
<td>75.0</td>
<td>4.4</td>
</tr>
<tr>
<td>2008</td>
<td>17.0</td>
<td>3.2</td>
<td>75.0</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Source: METI
Crude Oil Import Trends and Dependence on OPEC and Middle East

Petroleum Product Import & Export Composition (FY2008)

Major Petroleum Products by Importing & Exporting Country

Domestic Oil Supply & Demand Trend
4. Establish a policy framework for treating all energy sources impartially and promoting their advanced usage. To achieve “the optimum energy mix” in a true sense, the government should provide an equal footing regarding competitive conditions on taxation, stockpiling obligations, etc. among all energy sources.

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 accounts for 50% of Japan’s primary energy supply and will remain an important energy source in the future from the viewpoints of economic efficiency and convenience” and “Japan will promote building a strong business foundation in the petroleum industry”.

Upon compilation of the Basic Energy Plan, a report titled “Energy Supply-Demand Outlook toward 2030” was drawn up in October 2004. The following points were clearly stated in this report:

1. Oil will still remain the central player in primary energy 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.
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 nuclear development of Iran. Amid mounting international concern over energy security, many countries are gearing up the restructuring of their national energy strategies.

Under these circumstances, in May 2006, the Ministry of Economy, Trade and Industry (METI) compiled a report on the New National Energy Strategies (the “New Strategies”) mainly focusing on energy security. In this report, the following five quantitative targets were shown as guiding the long-term direction that the government and the private sector should move in together by 2030:

1. To improve energy efficiency by 30%
2. To reduce the dependence on oil in the primary energy supply to less than 40%
3. To set the dependence on oil in the transportation sector at approximately 80%
4. To maintain the dependence on nuclear fuel in power generation at 30 to 40%
5. To increase the share of independently developed crude oil in total crude oil imports to about 40%

Revisions to the Basic Energy Plan

In the midst of ongoing restructuring of the energy policy which shifted the emphasis to security due to changes in the circumstances surrounding energy, METI revised the Basic Energy Plan in February 2007. The revised plan has set up the objectives of 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.).

The oil-related revisions include the following points:

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 effective utilization of oil

In response to this revised Basic Energy Plan, the Energy Supply-Demand Outlook, issued in March 2008, indicates the supply-demand forecast in 2020 as a milestone in addition to that of 2030, taking into account the quantitative analysis of technologies to realize the numeric targets in the “New Strategies”. This outlook states 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 40% in 2030.

During the deliberation of this revision, the petroleum industry indicated the importance of the following points:
1. The basic scheme of the Law Concerning Promotion of the Development and Introduction of Alternative Energy (Alternative Energy Law), a core law for current energy policy, is to exclude oil right at the beginning. This is inconsistent with the fundamental principles stipulated in the Basic Act on Energy Policy.

2. Consequently, it is important to create new legislation such as the Advanced Energy Use Promotion Law (provisional title), to resolve such an inconsistency. This outlook also focuses on the supply-demand forecast as well as CO₂ emissions, and the public financial burden in 2020, as the global warming issue becomes an urgent task.

Reexamination of Japan’s Petroleum Policies

METI started its deliberation on the petroleum situation and the nation’s course of future petroleum policies in December 2005 and compiled its report in May 2006. The main gist of the report is as follows:

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 to create advanced 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 this report, the petroleum industry, as the central player in energy security, is expected to work on further rationalization and efficient improvement of its core oil business to become a stronger industry. It is also expected to make efforts to shift toward becoming a totally integrated energy industry. The report clearly points out that the new technologies for processing heavy crude oils/residuals and the clean and advanced utilization of petroleum resources are not necessarily encouraged by the Alternative Energy Law enacted in 1980, when oil’s share of the primary energy supply was some 80%, and the Law on the Promotion of the Use of New Energy (New Energy Law) enacted in 1997. The report states that new utilization of petroleum resources should be appraised from the viewpoint of energy efficiency.

Crude oil prices continued to rise further and remained hovering at 70-90 US dollars/Bbl in 2007, and then shot over 100 US dollars/Bbl at the beginning of 2008. Under such circumstances, 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 fuel 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 export and petrochemical, tie-ups in refining operations and disposal of facilities, and further business tie-ups beyond the existing framework of companies.

From the viewpoint of advanced 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 of technological innovations. This implies that we should promote the advanced use of all unused or unutilized energies including, but not limited to, oil in an effective and efficient manner as necessary countermeasures for energy security and the prevention of global warming. PAJ requests all stakeholders to support such new legislation, the Advanced Energy Use Promotion Law.
Future Energy Policy

(provisional title), for promoting the effective and efficient use of energies that we have advocated for some time now.

Toward the Advancement of Energy Supply Structure

With growing concern about global environmental problems after the G8 Hokkaido Toyako Summit in 2008, many have argued for developing a low-carbon society in the nation. Movements regarding global environmental issues in foreign countries have also become active, for example, the EU’s effort to obtain an agreement for a mid-term reduction target of greenhouse gas emissions and the U.S. Obama Administration’s proactive stance toward environmental issues as a core economic policy. Those movements are pressing the energy industry for drastic changes. From now on, it is requested to develop 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 on the reexamination of its alternative energy policy and the increased use of nonfossil energies. This report with the title of "Toward the Advancement of Energy Supply Structure", issued in January 2009, illustrates the vulnerability of Japan’s energy supply structure. For example, the report takes notes of its huge offshore energy dependency and its dependency on fossil fuels for over 80% of its supply in an unstable oil market where a sharp drop in oil prices due to worldwide financial instability after autumn 2008 could follow soaring oil prices in the global market. Then the report emphasized the following proposals:

1. The importance of taking medium and long-term measures such as global warming countermeasures and formation of a low-carbon society
2. The necessity for reexamining energy policies, taking into account the Basic Act on Energy Policy (an unified settlement of the 3E)

Specifically, the concept of “oil substitution” was eliminated through the reexamination of policy measures in the Alternative Energy Law which aims at only reducing reliance on oil. Thereafter, two bills, "Bill on the Promotion of the Use of Nonfossil Energy Sources and Effective use of Fossil Energy Source Materials by Energy Suppliers" and "Bill to Amend the Act on the Promotion of the Development and Introduction of Alternative Energy", through control over energy suppliers to take such measures as listed below, were 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 and new energies)
3. Advanced and effective use of fossil resources (crude oil, natural gas and coal)

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 advanced 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:

1. To reexamine the alternative energy policies for which the purpose is merely restraining oil usage
2. To conduct an objective assessment of each energy’s characteristics based on the basic principles of
the Basic Act on Energy Policy and to enhance the corresponding development of an advanced 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.

In working out the concrete system design in the future, it is important to take the following elements into account:

1. To make use of private-sector dynamism to the utmost extent by ensuring fair competition among energy businesses, and by encouraging ingenuity and voluntary initiatives by private businesses
2. To be feasible in view of energy security, sustainability and cost-effectiveness
3. To set out a strategic direction which aims at strengthening the competitiveness of Japanese industries
PAJ therefore expects that a flexible and practical framework should be developed by government

---

*Toward the Advancement of Energy Supply Structure
Outline of Interim Report of the Advisory Committee for Natural Resources and Energy (January 2009)

1. Appropriate Direction of Energy Supply-Demand Structure in Future

  - Outlook in 2020 and 2030 → Propose the maximum introduction of advanced technologies
  - The best case scenario should be the benchmark for Japan’s target


Horizons until 2050
Innovative technology development (The Cool Earth*)
Dissemination of advanced technology development

A Society with the World’s Highest Level of Energy Conservation

2. System Design toward Advanced Energy Supply Structure

< Energy Conservation Law >
1. Setting energy-saving standard by sector
   (housing, buildings, electric appliances, automobiles, factories, and offices)
2. Efforts and follow-up by each party concerned

< Study to Establish New System Framework >

- Deliberation of Appropriate Policy Mix
  Control measures should be introduced among energy suppliers, referring to the Energy Conservation Law (ECL)

  1. Nationwide goal setting
  2. Disclosure of action taken by electric power, oil and gas industries
  3. Systematic implementation by each business operator
  4. Follow-up and launching of measures to ensure goal attainment

- Points of Consideration:
  - Role of central & local governments
  - Impartiality among sectors
  - Emergency responses in disasters
  - Relationship with ECL, RPS*2

*1 The Cool Earth—Innovative Energy Technology Program, which enhances innovative technologies in terms of structures, materials, and systems, and will contribute to substantial global reductions of greenhouse gases by 2050 (March 2008)
*2 Renewables Portfolio Standard
hand in hand with the private sector, considering the current status of each energy business and listening to energy suppliers’ voices.

**Energy Supply and Demand Performance for FY2006**

Final energy consumption for FY2006 showed a 0.2% decrease from the previous year to 15,977 Peta-joule (PJ), or 413 million KL in crude oil equivalent. Reflecting steady production of production activities, industrial sector demand increased by 1.9%, while demand in household and business sectors decreased by 3.5% and 1.4%, respectively, due to a decline in heating oil demand and a relatively cool summer season. As a result, total fuel demand decreased by 1.1%.

The total primary energy supply for FY2006 remained at approximately the same level as the previous year, 23,770 PJ, or 614 million KL in crude equivalent. Net domestic supply, excluding exports, was 0.2% down from the previous year to 22,699 PJ, or 586 million KL in crude equivalent. Growth percentages of the domestic energy supply by energy source from the previous year were: 0.6% down for nuclear energy, a remarkable 10.4% up for natural gas, 1.2% up for coal, and 5.3% down for oil.

Oil still accounted for almost half of the primary energy supply in Japan; 47.1% on a total energy supply basis and 44.1% on a domestic energy supply basis.

### Long-term Final Energy Consumption Outlook

<table>
<thead>
<tr>
<th>(FY)</th>
<th>2006</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
</table>
|       | Business-as-
usual Case | Additional
Measures Case | Political
Initiative Case | Business-as-
usual Case | Additional
Measures Case | Political
Initiative Case |
| Final Energy Consumption | 413 | 100% | 449 | 100% | 416 | 100% | 390 | 100% | 469 | 100% | 412 | 100% | 365 | 100% |
| Industry | 185 | 45% | 180 | 40% | 180 | 43% | 178 | 46% | 179 | 38% | 179 | 43% | 176 | 48% |
| Household & Commercial | 131 | 32% | 169 | 38% | 142 | 34% | 129 | 33% | 192 | 41% | 147 | 36% | 121 | 33% |
| • Household | 54 | 13% | 64 | 14% | 58 | 14% | 53 | 14% | 70 | 15% | 59 | 14% | 48 | 13% |
| • Commercial, etc | 76 | 19% | 105 | 23% | 84 | 20% | 76 | 19% | 122 | 26% | 89 | 21% | 72 | 20% |
| Transportation | 97 | 23% | 100 | 22% | 94 | 23% | 83 | 21% | 97 | 21% | 86 | 21% | 69 | 19% |

### Long-term Primary Energy Supply Outlook

<table>
<thead>
<tr>
<th>(FY)</th>
<th>2006</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
</table>
|       | Business-as-
usual Case | Additional
Measures Case | Political
Initiative Case | Business-as-
usual Case | Additional
Measures Case | Political
Initiative Case |
| Primary Energy Domestic Supply | 586 | 651 | 601 | 561 | 665 | 601 | 526 |
| Oil | 240 | 41% | 248 | 38% | 232 | 39% | 209 | 37% | 245 | 36% | 220 | 37% | 183 | 35% |
| LP Gas | 19 | 3% | 19 | 3% | 19 | 3% | 18 | 3% | 19 | 3% | 19 | 3% | 18 | 3% |
| Coal | 125 | 21% | 136 | 21% | 121 | 20% | 110 | 20% | 146 | 21% | 123 | 20% | 95 | 18% |
| Natural Gas | 97 | 17% | 107 | 16% | 87 | 14% | 79 | 14% | 129 | 19% | 94 | 16% | 73 | 14% |
| Nuclear Power | 69 | 12% | 99 | 15% | 99 | 17% | 99 | 18% | 99 | 15% | 99 | 17% | 99 | 15% |
| Hydropower | 18 | 3% | 19 | 3% | 19 | 3% | 19 | 3% | 19 | 3% | 19 | 3% | 19 | 4% |
| Geothermal | 1 | 0% | 1 | 0% | 1 | 0% | 1 | 0% | 1 | 0% | 1 | 0% | 1 | 0% |
| New Energy | 17 | 3% | 22 | 3% | 22 | 4% | 26 | 5% | 26 | 4% | 26 | 4% | 38 | 7% |

**source:** METI
### Primary Energy Supply Trends

<table>
<thead>
<tr>
<th>Year (FY)</th>
<th>Oil incl. LPG</th>
<th>Coal</th>
<th>Natural Gas</th>
<th>Nuclear Power</th>
<th>Hydropower, Geothermal</th>
<th>New Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>77.4</td>
<td>15.5</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td>1980</td>
<td>66.1</td>
<td>17.0</td>
<td>6.1</td>
<td>4.7</td>
<td>5.3</td>
<td>4.1</td>
</tr>
<tr>
<td>1985</td>
<td>56.3</td>
<td>19.4</td>
<td>9.4</td>
<td>8.9</td>
<td>4.8</td>
<td>4.3</td>
</tr>
<tr>
<td>1990</td>
<td>57.1</td>
<td>16.7</td>
<td>10.2</td>
<td>9.3</td>
<td>4.1</td>
<td>5.2</td>
</tr>
<tr>
<td>1995</td>
<td>54.8</td>
<td>16.5</td>
<td>10.9</td>
<td>11.9</td>
<td>3.4</td>
<td>5.8</td>
</tr>
<tr>
<td>2000</td>
<td>50.8</td>
<td>18.1</td>
<td>13.0</td>
<td>12.2</td>
<td>3.3</td>
<td>6.1</td>
</tr>
<tr>
<td>2005</td>
<td>49.0</td>
<td>20.3</td>
<td>13.8</td>
<td>11.2</td>
<td>2.9</td>
<td>6.4</td>
</tr>
<tr>
<td>2007</td>
<td>47.0</td>
<td>21.3</td>
<td>16.3</td>
<td>9.7</td>
<td>2.8</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Source: METI

### Final Energy Consumption Trends

<table>
<thead>
<tr>
<th>Year (FY)</th>
<th>Industrial</th>
<th>Civil</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>187</td>
<td>52</td>
<td>47</td>
</tr>
<tr>
<td>1980</td>
<td>164</td>
<td>61</td>
<td>59</td>
</tr>
<tr>
<td>1985</td>
<td>157</td>
<td>71</td>
<td>64</td>
</tr>
<tr>
<td>1990</td>
<td>181</td>
<td>95</td>
<td>83</td>
</tr>
<tr>
<td>1995</td>
<td>185</td>
<td>112</td>
<td>98</td>
</tr>
<tr>
<td>2000</td>
<td>187</td>
<td>125</td>
<td>101</td>
</tr>
<tr>
<td>2005</td>
<td>182</td>
<td>133</td>
<td>98</td>
</tr>
<tr>
<td>2007</td>
<td>185</td>
<td>128</td>
<td>95</td>
</tr>
</tbody>
</table>

Source: METI
Oil continues to provide the major part of the nation’s energy supply; however, its weak supply structure remains unchanged. Therefore, securing a stable oil supply is a core element of the energy policy, and the establishment of a system to respond appropriately in emergency situations such as oil supply shortages is an important policy issue. Oil stockpiling also makes a significant contribution to the stable supply of energy in Japan, which depends largely on energy imports, since oil is the only energy for which a large-scale reserve is maintained in this nation.

To that end, METI amended the Petroleum Reserve Law, effective January 1, 2002, as a new oil policy framework after the abolition of the Petroleum Industry Law. The amendment aims to develop a new system for emergency response such as comprehensive information gathering on oil refiners, importers and distributors (in terms of volumes stored and transacted, etc.), and for ordering the release of the government oil stockpiles. The Petroleum Council’s Subcommittee on Petroleum Stockpiling and Emergency Preparedness was set up in March 2005 as stipulated in the amended law that the petroleum stockpiling policy should be reexamined three years after the enforcement, giving consideration to the enforcement status and the international circumstances surrounding oil. The committee issued its final report in July, recommending reduction of the private sector’s stockpiling obligation from 70 days to 60-65 days, an increase in the government’s stockpile, and maintenance of registration requirements for oil importers, etc.

In response to the serious damage from Hurricane Katrina to oil refineries and oil production facilities on the US Gulf Coast in late August 2005, the International Energy Agency (IEA) decided to carry out a coordinated emergency drawdown of oil stockpiles of member countries on September 2 of that year. In line with the government’s policy to cooperate with the IEA, oil companies in Japan exported gasoline to the USA, reduced crude oil imports and accomplished a 1.59 million KL reduction in stockpiles beyond the quota for Japan of 1.16 million KL.

Japan’s national oil stockpiling has been made in the form of crude oil, as its oil stockpiling system has been assuming the interruption of crude oil imports from the Middle East, and assuming Japan has been holding ample refining capacity. The tight supply-demand conditions in the oil market triggered by the US hurricane damage show the significance of combined efforts between oil consuming countries and oil producing countries to stabilize the market, because a regional shortage of a specific oil product could have enormous impact on the international oil markets that are being increasingly unified. For this reason, Japan needs to further improve and enhance its stockpiling system. As part of the national stockpiling, currently only in the form of crude oil, product stockpiling of kerosene will begin from autumn 2009.

### Increasing Role of Oil Stockpiling

Though oil constitutes about 50% of the nation’s primary energy supply, virtually all crude oil is dependent on imports, especially from the Middle East, which supplied about 86% in FY2007. This substantially exceeds the figure of 81% in FY1972, just before the first oil crisis.

After the first oil crisis, the IEA was established and placed a 90-day equivalent stockpiling obligation on member countries. To comply with this requirement, the Petroleum Reserve Law was enacted in 1975 (enforced in April 1976), starting with private sector oil stockpiling, and this was followed by government stockpiling by Japan National Oil Corporation (JNOC) in 1978.

Today, the government holds 51 million KL of crude oil in its own stockpile and requires the private sectors, e.g., oil refiners and importers, to have a 70-day equivalent oil stock. The actual private sector stockpile
## Overview of Past Emergency Period

<table>
<thead>
<tr>
<th>Time</th>
<th>1st Oil Crisis</th>
<th>2nd Oil Crisis</th>
<th>Gulf Crisis</th>
<th>Hurricane Katrina</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background</strong></td>
<td>Crude oil supply cut due to oil export suspension by Arab countries at the outbreak of the 4th Middle East War</td>
<td>Suspension of Iranian crude export and interruption of tanker traffic in the Gulf due to the Iranian Revolution</td>
<td>Invasion of Kuwait by Iraq resulted in economic sanctions, and escalated into the Gulf War</td>
<td>Damage to oil-related facilities in the Gulf of Mexico area in the USA due to the destructive hurricane Katrina</td>
</tr>
<tr>
<td><strong>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>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</strong></td>
<td>67 (as of Oct 1973) 67 Days</td>
<td>92 (as of Dec 1978) 85 Days</td>
<td>142 (as of Dec 1990) 88 Days</td>
<td>170 (as of Sep 2005) 80 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

<table>
<thead>
<tr>
<th>1st Oil Crisis</th>
<th>2nd Oil Crisis</th>
<th>Gulf Crisis</th>
<th>Hurricane Katrina</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overview of Past Emergency Period</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoarding of toilet paper, etc.</td>
<td>Partial release of private oil stockpiles (Apr ’79–Aug ’80)</td>
<td>Voluntary ban on purchasing crude oil at high prices</td>
<td>Voluntary ban on gasoline imports</td>
</tr>
<tr>
<td>Setting of wholesale &amp; retail prices by Administrative Guidance (Mar–Aug ’75)</td>
<td>Setting of wholesale prices by Administrative Guidance (Mar ’79–Apr ’82)</td>
<td>Restriction of fuel imports and shift to a domestic production structure</td>
<td>Partial release of private oil stockpiles (3 days)</td>
</tr>
<tr>
<td>Setting of Standard Prices by the Petroleum Industry Law (Dec ’75–May ’76)</td>
<td>Implementation of energy saving measures such as target temperatures for air conditioning</td>
<td>Setting of wholesale prices by Administrative Guidance &amp; Moving to “Monthly Settlement Method” (Sep ’86–Apr ’91)</td>
<td></td>
</tr>
<tr>
<td>Restraint of large lot electric power use and voluntary ban on private vehicles</td>
<td>Introduction of lighter summer clothing</td>
<td>Partial release of private oil stockpiles (4 days)</td>
<td></td>
</tr>
<tr>
<td>Enforcement of two laws for emergency responses (Dec ’73)</td>
<td>Enforcement of Energy Saving Law (Jun ’79)</td>
<td>Implementation of energy saving measures such as higher air conditioning temperatures during summer and environmentally-friendly driving campaign in government &amp; private sectors</td>
<td></td>
</tr>
<tr>
<td>Enforcement of Petroleum Reserve Law (Apr ’76)</td>
<td>Enforcement of Alternative Energy Promotion Law (May ’80)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 Government Statistics  #2 Oil Information Center
Current Status of Oil Stockpiling in Japan (as of Dec 2008)

Private Stockpiling

<table>
<thead>
<tr>
<th>Stockpile Days</th>
<th>83 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockpiling Volume</td>
<td>40.0 million kl</td>
</tr>
<tr>
<td>Obligation Days</td>
<td>70 days of domestic demand</td>
</tr>
<tr>
<td>Holding Method</td>
<td>Through production and distribution processes</td>
</tr>
<tr>
<td>Holding Location</td>
<td>Private sector tanks in refineries and oil terminals</td>
</tr>
<tr>
<td>Composition</td>
<td>Crude oil: 50%, Oil products: 50%</td>
</tr>
<tr>
<td>Administrative Body</td>
<td>Oil refiners and importers</td>
</tr>
</tbody>
</table>

Effect of Stockpile Release

1. Prompt supply to distribution markets as stockpiles are held at refineries and oil terminals
2. Flexible releasing of stockpiles depending on crude procurement status and seasonal demand fluctuation
3. Weak psychological effect on the market, compared with the government announcement on releasing of its stockpiles

Cases of Stockpile Release

1. 2nd Oil Crisis (Mar 1979~Aug 1980)
2. Gulf Crisis in response to CERM (Jan~Mar 1991)
3. Hurricane Katrina aftermath (Sep~Dec 2005)

Government Stockpiling

<table>
<thead>
<tr>
<th>Stockpile Days</th>
<th>100 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockpiling Volume</td>
<td>48.3 million kl</td>
</tr>
<tr>
<td>Obligation Days</td>
<td>50 million kl (attained in Feb 1998)</td>
</tr>
<tr>
<td>Holding Method</td>
<td>In sealed designated storage tanks</td>
</tr>
<tr>
<td>Holding Location</td>
<td>① Tanks of national stockpiling bases, ② Tanks borrowed from private sector</td>
</tr>
<tr>
<td>Composition</td>
<td>Crude oil: 100%</td>
</tr>
<tr>
<td>Administrative Body</td>
<td>Oil refiners and importers</td>
</tr>
</tbody>
</table>

Effect of Stockpile Release

1. strong psychological effect on the market when the government announces its decision to release its stockpiling to increase oil supply in the market
2. Reduced mobility of released stockpiling, compared with the private sector release, as reserves are stored at remote national stockpiling bases

Cases of Stockpile Release

None

Financial Measures

Subsidy for oil purchasing costs and tank construction costs

Cost Recovery

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

Japan held a 142-day equivalent oil stockpile at the time of the Arabian Gulf crisis and could respond to the situation in a calm manner in terms of domestic supply. The stockpile effectively contributed to the stabilization of oil product supply and prices, and its significance was recognized again. Internationally, the IEA member countries decided to take the CERM (Coordinated Emergency Response Measures) to release oil reserves of 2.5 million barrels per day (400 thousand KL/day) to the oil market, and Japan drew down a 4-day equivalent private sector stockpile (2.5 million KL) during the period of January to March 1991.

In response to the serious damage from Hurricane Katrina, Japan supplied a 3-day equivalent private sector stockpile to the oil market in accordance with the CERM taken by the IEA to supply 2 million barrels to the oil market for 30 days (60 million barrels in total). The supply from the private sector stockpile continued until January 4, 2006 and the total supply volume sub-

Securing Stable Supply
stantially exceeded the quota for Japan.

Taking into account the recent circumstances surrounding oil (e.g., a demand increase in Asia, shrinking surplus oil production capability of OPEC, and violent fluctuations in crude oil prices due to geopolitical uncertainties), it is highly probable that the risks of an oil supply shortage to Japan and other emergency situations will become more and more complicated and harder to predict. Should such situations occur and bring about a supply shortage to Japan, which is highly dependent on oil imports, the shortage could have enormous impact on people’s lives and the economy; therefore, the role of oil stockpiling is becoming increasingly important.

**Toward New Emergency Countermeasures**

As the nation’s oil supply structure is fragile, the frameworks of the stockpiling policy were (1) to maintain 50 million KL of the government reserves, (2) to utilize part of the private sector’s tanks and (3) to maintain a 70-day equivalent private sector stockpile.

The Subcommittee on Petroleum Stockpiling and Emergency Preparedness of the Petroleum Council of the Advisory Committee for Natural Resources and Energy started to discuss the nation’s future stockpiling policy in March 2005 and issued its report on reassignment of both government and private sectors’ roles, appropriate levels of each sector’s reserves, and other matters in August that year. The report recommended mitigating the private sector’s stockpile obligation from 70 days to a level of 60-65 days and increasing the government sector stockpile with appropriate timing in order not to lower the nation’s energy security level.

The Petroleum Council’s Petroleum Policy Subcommittee was set up in December 2005 and started to reexamine the nation’s petroleum policies. The Subcommittee also deliberated on the strategic oil stockpiling policy, giving proper consideration to rapid changes in the circumstances since the time the Subcommittee on Petroleum Stockpiling and Emergency Preparedness compiled the previous report in August 2005. The report issued by the Petroleum Policy Subcommittee in May 2006 pointed out the necessity of reconstructing and maintaining the nation’s stockpiling system for prompter and more effective responses to emergencies. As concrete response measures, it mainly recommended increasing the stockpile volume (strengthening mid- and long-term security by increasing the government stockpile), introducing government product reserves, and improving the stockpiling system for more effective operations (diversification of options for oil release such as bor-
row/loan and time swapping).

In FY2007, due to the recent situation where stockpiling days have been gradually increasing in accordance with a decrease in domestic oil demand, 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 regard to international cooperation, there are some recent movements like a successful international bid won by a Japanese oil company for preferential sales/purchase of its crude oil stockpile for 2008 and thereafter, based on an intergovernmental agreement concluded with New Zealand.

Outline of Japan’s Response Measures for an Emergency Period (as of Apr 2009)

- **Oil Stockpiling Measures**
  - Revised Petroleum Stockpiling Act
  - JOGMEC*
  - Maintain reserves
  - Registration of oil refiners, importers & distributors for information gathering

- **Oil Supply Measures**
  - Control Measures on Oil Consumption
  - Supply Measures on Major Commodities
  - Petroleum Supply & Demand Adjustment Act
  - Emergency Declaration
  - Stop making up oil reserves
  - Draw down oil reserves
  - Establish oil supply targets
  - Restrict oil consumption
  - Restrict operations at SS
  - Cooperative actions by the oil industry under government direction/supervision
  - Order oil holdings, sales/deliveries
  - Mediate/guide oil supplies
  - Indicate production/import plans
  - Determine standard prices
  - Indicate commodity production
  - Indicate commodity imports
  - Indicate commodity holdings
  - 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 stopped 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 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 139 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 73 have performed well in commercial production (end of August 2008) The import share of crude oil from independent crude oil and gas development projects is about 19% 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 with oil and gas producing countries as well as to provide companies with various financial and technical support measures to compete with foreign firms. 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 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.
Major Independent Oil Development Projects by Japanese Firms (as of the end of Nov 2008)

- Arabian Oil
- The Egyptian Petroleum Development
- Japan Ohamet Oil and Gas
- Teikoku Oil Algeria
- Teikoku Oil Suez SOB
- Teikoku Oil Nile NQR
- INPEX Libya
- Japex Libya
- Teikoku Oil Libya UK
- Moeko Libya

- ITOCHU Oil Exploration (Azerbaijan)
- INPEX North Caspian Sea
- INPEX Southwest Caspian Sea
- INPEX BTC Pipeline
- ITOCHU Oil Exploration (BTC)

- Sakhalin Oil and Gas Development
- Sakhalin Energy Investment

- New Huanan Oil Development
- Japex New Nanhai
- INMC Pearl River Mouth Oil Development

- Nippon Oil Exploration (Malaysia)
- Nippon Oil Exploration (Sarawak)
- Universe Gas & Oil Company
- INPEX Corporation
- INPEX Tengah
- INPEX Offshore Northeast Mahakam
- Indonesia Natural Gas Resources Muturi
- KG Winagat Petroleum
- KG Bago Petroleum
- Nippon Oil Exploration (Berau)
- KG Berau Petroleum
- Japan Papua New Guinea Petroleum
- Southern Highlands Petroleum
- Murray Petroleum
- INPEX Offshore North Mahakam
- INPEX Offshore Southeast Mahakam
- JAPEX Buton
- INPEX SERAM SEA

- Mitsubishi E&P Australia
- CIECO Exploration & Production (Australia)

Remarks: ○ projects in production

Source: Japan Petroleum Development Association
Global Trends Regarding the Climate Change Issue

The first commitment period of the greenhouse gas (GHG) reduction stipulated by the Kyoto Protocol started in 2008 and the period for Japan’s 6% reduction commitment was started as well. It has been decided to agree on an international negotiation concerning the framework of global warming issues for time frames following the termination of the first commitment period after December 2012 at the Fifteenth Conference of Parties (COP15) in Copenhagen at the end of 2009.

The Kyoto Protocol is a global convention adopted at the Third Conference of Parties (COP3) in Kyoto in 1997 to give shape to the United Nations Framework Convention on Climate Change (UNFCCC), signed in 1992, aimed at stabilizing the concentration of atmospheric GHG. The protocol stipulates legally binding numerical targets for GHG emission reduction in industrialized countries. Targets for 2008-12 versus 1990 were an 8% reduction for the EU, 7% for the USA and 6% 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 and India. 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. Moreover, certain problems have been pointed out from the viewpoint of fairness, such as that Japan’s efforts toward energy conservation since the oil crises were not taken into consideration because the base year was set in 1990, the EU countries only have to jointly achieve the target volume (EU Bubble) and, furthermore, the EU is entitled to have expanded room for reduction due to the subsequent participation of Eastern European nations.

In view of such problems with the Kyoto Protocol, it is necessary for Japan to take the lead in international negotiations among all the main GHG emitting countries in order to set up an impartial reduction target, country by country, by compiling the amount that can be reduced by each industrial sector (by a sector-to-sector approach), taking into account the emission reduction potential and costs for reduction. To that end, the “Action Plan for Achieving a Low-Carbon Society” (Cabinet decision in July 2008), aims at reducing Japan’s GHG by 60-80% by 2050 as Japan’s long-term target, and offering other nations Japan’s comparative edge in energy conservation technologies, as well as enhancing further technology development.

Domestic Global Warming Countermeasures

In Japan, the Cabinet adopted the Kyoto Protocol Target Achievement Plan in April 2005 (and revised it in March 2008) under the Law Concerning the Promotion of Measures to Cope with Global Warming (Global Warming Countermeasures Law), and domestic countermeasures for mitigating global warming for the first commitment period have been conducted under this program to achieve the nation’s 6% reduction commitment. The basic principle of the plan involves the simultaneous pursuit of environmental preservation and economic development, the enhancement of technology innovation, and the involvement of all parties—national and local governments, business entities and individuals. It will be a difficult to achieve the target under the current circumstances. (A flash report of 2007 GHG emissions shows they are 8.7% up versus 1990) The government, however, considers that the target can be achieved if each of the concerned parties including the national and local governments tackles this problem actively in its sector.

The petroleum industry is required to take the lead in realizing the following measures: (1) operational...
**CO₂ Emissions Originating from Fossil Fuels by Country**

Kyoto Protocol covers only 30% of the world CO₂ emissions including Russia.

**2006 CO₂ Emission**
- 28 billion t

**Flash base**
- Japan 4%
- Russia 6%
- China 20%
- USA 20%
- India 5%
- Germany 3%
- UK 2%
- Italy 2%
- Canada 2%
- France 1%
- Australia 1%

Withdrawn from Kyoto Protocol

**Others** 32%

source: OECD/IEA CO₂ Emissions from Fuel Combustion

**Trends in Japan's GHG Emissions by sector**

- Industrial Sector
  - 482 (From base year +1.3%)
  - 476 (From base year -6%)  

- Transportation Sector
  - 248 (From base year +14.6%)
  - 249 (From base year +7.7%)

- Commercial Sector
  - 164 (From base year +41.7%)
  - 164 (From base year +43.7%)

- Household Sector
  - 127 (From base year +41.1%)
  - 127 (From base year +43.5%)

- Energy Conversion Sector
  - 68 (From base year +17.7%)
  - 79.8 (From base year +17.7%)

source: Ministry of Environment (MOE)

**Outlook for GHG Emission in FY2010 and Shortfall of Reduction Amount**

- GHG Emission (million ton CO₂)
  - 2006: 1,261 (+3.2%)
  - 2007: 1,308 (+10.5%)
  - Kyoto Protocol reduction commitment (2008-2012): 1,254 (+0.6%)

- Target to secure
  - Forest sink 3.8%
  - Kyoto Mechanism 1.6%

One time effect due to lower nuclear power plant utilization

Assuming 84.2% of nuclear power plant utilization

9.3% of emission reduction is required

4.3% of reduction is required
(if 84.2% of nuclear power plant utilization is assumed)

- Base Year
- 1990
- 2005
- 2006 (Flash base)
- Kyoto Protocol reduction commitment (2008-2012)
- Fiscal year

**Additional Measures to Make up the Shortfall and their Contribution**

- Promotion of Voluntary Action Plan: 18.2 approx.
- Improvement of Energy Conservation Measures in Houses and Other Buildings: 2.0 approx.
- Enhancement of Energy Management in Business Sites: 3.0 approx.
- Improvement of Fuel Efficiency of Automobiles: 3.5 approx.
- Measures for Greenery, Industrial Waste and Three CFC Substitutes: 3.6 approx.
- Promotion of New Energy Measures: 1.3 approx.

**Outlook in FY2010 Incorporating Additional Measures**

The 6% reduction target prescribed in the Kyoto Protocol can be achieved as each entity in each sector will tackle this task so that an effect of more than 37 million ton CO₂ is expected to be reduced.

source: Global Warming Prevention Headquarters (Nov., 2008)
collaboration among nearby plants in an industrial complex, (2) enhanced use of biomass fuels for transportation, (3) launching sulfur-free (sulfur content of less than 10ppm) automotive fuels, (4) dissemination of clean diesel vehicles, and (5) efficient use of oil.

On the other hand, the “Action Plan for Achieving a Low-Carbon Society” illustrates the direction of the medium- and long-term domestic measures and international negotiations after 2012, with an emphasis on the importance of innovative technology development and dissemination of existing advanced technologies. This program also proposes “trial implementation of emission trading in an integrated domestic market.” Aiming to maintain consistency with Japan Business Federation’s (Nippon Keidanren) Voluntary Action Plan, recruitment of participants in this trial emission trading scheme, which enables setting voluntary targets including a primary unit for trading, was started in autumn 2008. Many oil refining companies have expressed their desire to participate.

The petroleum industry’s position on the global warming issue is:
• As a basic principle, simultaneous pursuit of environmental preservation and economic development should be made.
• Regulatory measures for economic control such as the launching of an environmental tax and a “Cap & Trade” method of emission trading should not be taken.
• Every effort to achieve the reduction target under the Voluntary Action Plan on the Environment by Nippon Keidanren should be made.
• Substantial GHG reduction commitment should be realized with a focus on energy conservation by all people and through international cooperation.

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 FY2010 for the improvement of unit energy consumption at oil refineries. In particular, the unit energy consumption at oil refineries in FY2007 was improved by 15% 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.

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.
Energy saving at refineries

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, and four of those projects by two oil companies were registered by the United Nation’s CDM Board as of February 2008.

Environmental Tax (Carbon Tax)

There is a school of thought which sees imposing taxes and levies on fossil fuel consumption and CO₂ emission as an economic incentive for global warming mitigation. Environmental taxes were first launched in the early 1990s in the Scandinavian countries (Finland, Norway, Sweden and Denmark) and the Netherlands.

Petroleum Industry’s "Voluntary Action Plan for Global Environmental Conservation"

Around the year 2000, increases in existing taxes for the purpose of environmental conservation were made in Italy and Germany, and the climate change surcharge, a sort of energy tax, was established in the United Kingdom. Though the detailed schemes vary, revenues from those taxes are incorporated into general revenue and are commonly used for social insurance budgets and corporate/income tax reduction. It is rare for them to be specifically used for global warming countermeasures.

The Ministry of Environment proposed a new tax scheme, levying 2,400 yen/carbon ton as an average rate combining all types of fossil fuels (approx. 1.5 yen per liter for gasoline), in October 2005. However, because of strong objections against such taxation from many industrial circles, the recent arguments are rather more focused on greening of the overall taxation system, including reexamination of the existing fossil fuel tax levy. The ruling Liberal Democratic Party indicated the future direction of drastic tax reform in its FY2009 Tax Reform Package as follows: (1) to enhance greening of the overall taxation system so as to promote a low-carbon society, and (2) to carefully study environmental taxation, considering its positioning among overall policy measures, effects and impacts on international competitiveness, and its relationship with existing taxation, as well as seeking taxpayers’ understanding and cooperation. As a result, the actual study has been postponed until the time of drastic tax reform scheduled for FY2011.

Petroleum Industry’s Position on Launching Environmental Taxation

The petroleum industry strongly opposes environmental taxation from the following viewpoints:

- The CO₂ reduction effect through price hikes is extremely low, and a new tax reduces the international competitiveness of industries. If a production plant moves to a developing nation where there is low energy efficiency, it goes against the mitigation of global warming and the effect is
questionable.
• Thorough examination of the usage of the existing budget for global warming countermeasures, approximately 1.2 trillion yen, should be carried out first. Subsidy-oriented policy measures go against the spirit of the administrative reform movement.
• A tax on CO₂ emission has already been imposed by the Petroleum & Coal Tax. As the current petroleum-related taxes amount to 44 dollars per barrel, or 5.5 trillion yen per year, the relationship with a future rise in the consumption tax, which would be used for environmental conservation, is uncertain and whether there will be fair burden sharing appears questionable.

Shifting to Diesel Vehicles (Diesel Shift)

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

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

Clean diesel vehicles, together with hybrid and electric ones, are regarded as key players in the environmentally friendly vehicle market in the short and medium term. Therefore, market creation and widespread utilization of clean diesel vehicles are emerging issues. The petroleum industry looks forward to significantly expanding the clean diesel vehicle market based on the above strategy, and will continue collaborating with the central and local governments as well as the automobile industry.
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 FY 2010, 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", the petroleum industry is steadily striving to meet the whole quantity of the targeted amount as an accountable fuel supplier. 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 will introduce 200,000KL of bio-ETBE blended gasoline in FY 2009 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, after consultation with the office of the Fair Trade Commission. 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.

Although bio-ethanol is drawing attention as a biomass fuel, there are several concerns as follows. Its domestic production is practically not viable due to Japan’s limited cropland and high production costs. 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). The raw material is a high-priced agricultural crop. Its calorific value is 30% less than that of gasoline (Fuel Economy).

Moreover, if bio-ethanol is blended directly with gasoline, a small quantity of water contamination would result in the phase separation of gasoline and ethanol. This increases the possibility of fuel quality change (a lowered octane number), corrosion and deterioration of distribution/marketing facilities, and it might threaten the safety of consumers. Furthermore, 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. As a high tax rate is imposed on gasoline, there may be a possibility of unscrupulous blending in the distribution stage for tax evasion and marketing of inferior quality gasoline.

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.

**Aiming at the Introduction of 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 Biofuels” was published in December 2007.

According to the report, there is a history for which the introduction of biofuels produced in a country or its region is based on local production, agricultural/industrial promotion and the energy security of each country. Furthermore, the report states that effective use of biomass resources should be evaluated not only as fuel but in combination with electricity and heat uses. This implies that introduction of biomass fuel should be focused on consideration of the biomass amount and the cost of making fuel rather than just to consider it as a means to reduce greenhouse gas emissions. Although biomass resources are considered renewable, the current approach is likely to cause food supply problems and problems of environmental destruction. As these resources are also fundamental for clothing, food and household goods, therefore, the report recommends that thorough consideration should be made as to which would be the most appropriate and practical approach to cope with the various concerns.

Since Japan is a country of limited natural resources, the principle of 3E energy policy (energy security, environmental consideration and efficient supply) should be achieved in a well-balanced manner and the use of biofuels as automotive fuel is not an exceptional case. In order to expand the promotion of biofuels in future, it is essential to consider “stable supply”, and, in the long term to develop innovative technologies for manufacturing low cost biofuel by utilizing plants and trees that do not conflict with food production or supply.

Based on the results of this 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.

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**Bio-ETBE Gasoline Marketing Schedule**

<table>
<thead>
<tr>
<th>Bio-Gasoline Sales Introduction of Bio-ETBE</th>
<th>2007 50 service stations</th>
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</thead>
<tbody>
<tr>
<td>Supply of Bio-ETBE</td>
<td>2008 100 service stations</td>
</tr>
</tbody>
</table>

1. Importing bio-ethanol (bio-ETBE)
2. Procuring bio-ethanol (import/domestic)

April 2007 - March 2009 Test Marketing

FY2009 Launching

FY2010 Commitment

Approx. 0.2 million kl

0.84 million kl (0.2 million kl of Crude Oil Equivalent)

Domestic production of bio-ETBE

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

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 (45%) can be achieved. Also, a strong CO₂ emission-reduction effect (11% 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>
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<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>
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</table>

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

■ IGCC: Integrated Gasification Combined Cycle

Air Separation Unit

Asphalt → Oxygen → Steam → Hydrogen + Carbon Monoxide → Synthetic Gas → Gasification Unit

Gasification Unit

Compound Generation Unit

Gas Turbine → Steam Turbine → Generator

Electricity

Air Separation Unit

Air → Nitrogen

Steam Turbine

Waste Heat Boiler

Gas Turbine Exhaust

Gas Turbine

35
Effective Petroleum Product Use during Consumption

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

Environmentally Friendly High Efficiency Boiler

Jointly with the Petroleum Energy Center (PEC), PAJ developed and commercialized a high efficiency, 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” (80 ppm).

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. This activity has been subsidized as the “High Efficiency Boiler Introduction Project” under the government’s introduction support system since FY2008.

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 con-
Conventional water heater (83% efficiency), “Eco-Feel” required 12% less kerosene for burning and decreased CO₂ emissions by 13%.

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.

High Efficiency Kerosene-based Heat Pump and Co-generation System

The petroleum industry is promoting kerosene-based heat pumps for business use and co-generation systems for providing electricity and heat to business and industrial facilities.

In recent years, public concern has been increasing in regard to contingency plans for a disaster in metropolitan areas which experience frequent earthquakes. In the Great Hanshin Earthquake of 1995 and the Niigata-Chuetsu Earthquake of 2004, many quake victims were forced to lodge in school gymnasiums, which were not designed as shelters and had no proper heating system. They spent an uncomfortable time there for a long period because of delays in securing electricity and gas supply in the disaster area.

As a result of these experiences, the petroleum industry considers a stand-alone electricity and heat supply system very important when a disaster occurs. The industry, therefore, is promoting the installation of a kerosene-based supply system at evacuation facilities (school buildings and gymnasiums) and elder care facilities. Promotional activities are also directed at horticultural farmers’ facilities as the farmers are attracted by the environmental benefits of such a system.

A housing complex in Sapporo with an oil-based central heating unit
### 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. From FY2009 sales activity of fuel cells will start for household use under the trade name of “Ene-Farm.”

### Stationary Fuel Cell System

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

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

The advantages of using petroleum fuels are:

1. Hydrogen for generating electricity can be produced from common fuels such as kerosene and LPG; these fuels’ supply infrastructures have already been established nationwide and storage and transportation are easy.

2. Kerosene and LPG supply infrastructures are highly disaster resistant, as shown at the time of the Great Hanshin Earthquake and the Niigata-Chuetsu Earthquake. Petroleum-based fuel cells would be an effective energy supply system in the event of natural disasters.

### Petroleum Industry’s Efforts

The petroleum industry has accumulated advanced technologies and know-how regarding hydrogen production from petroleum fuels for many years. With that know-how and the fuel supply infrastructures, field demonstrations of a system of fuel cells using petroleum fuels have been carried out in households throughout the country from FY2005. A household use fuel cell system fueled by kerosene was commercialized in March 2006. In addition, the system development and field testing of fuel cells for business use has started, aimed at installation in small- and medium-scale commercial facilities like shops and restaurants.

### 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
tion 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 filling stations for hydrogen produced from various petroleum fuels. In December 2006, a field demonstration was conducted for the first time, as part of the JHFC Project, at a hydrogen filling station annexed to an existing service station. From FY2009, a new project will start for the verification of longer travelling distances of fuel cell vehicles equipped with a 70-megapascal (MPa) hydrogen storage tank. In this connection, the filling systems at Asahi, Daikoku, Kasumigaseki and Senju hydrogen stations were modified to supply 70MPa hydrogen. 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

Location of Hydrogen Stations (Kanto Area)

Senju Hydrogen Station
by Tokyo Gas Co., Ltd. and Taiyo Nippon Sanso Corp.

Relocatable Hydrogen Station (Kasumigaseki Station)
by Taiyo Nippon Sanso Corp.

Kawasaki Hydrogen Station
by Japan Air Gases, Ltd.

Sagamihara Hydrogen Station

Yokohama-Asahi Hydrogen Station
Naphtha Reforming by Nippon Oil Corp.

Yokohama-Daikoku Hydrogen Station
SteamCracking Natural Gas Reforming by Cosmo Oil Co., Ltd.

Ariake Hydrogen Station
Desulfurized Gasoline Reforming by Showa Shell Sekiyu K.K. and Iwatani International Corp.

Relocatable Hydrogen Station (Funabashi Hydrogen Station)
High-Pressure Hydrogen by Japan Oil Energy Corp. and Taiyo Nippon Sanso Corp.

Ichihara Hydrogen Station
Kerosene Reforming by Iwatani Kosen Co., Ltd. and NEDO Project

□ Hydrogen stations operated by oil companies are shown in blue
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 (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.

R&D on Fuel Combustion Technologies for Commercial and Household Use

In order to contribute to the preservation of air quality and the improvement of indoor living environments, the petroleum industry is carrying out a study to reduce nitrogen oxides (NOₓ) from oil fuel burning equipment and to promote energy saving from such equipment.

These studies include (1) the development of fuel-efficient burners, (2) establishment of the test methodology for oil fuel burning equipment for household use, and (3) research on high temperature combustion technology.

The oil industry is also assessing the effect of fuels with various physical characteristics on the quality of combustion gas.

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.
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. Over the period 1968-2002, the industry invested a total of 1.5 trillion yen in environmental measures.

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) emission 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 average sulfur content of refinery fuel has been significantly reduced in recent years to less than 0.5% from 1.5% in 1970.

The process which reduces products’ sulfur content (such as the heavy oil desulfurization units and hydrotreating units for kerosene, gas oil and lubricating oil) generates by-product gas with a high concentration of hydrogen sulfide. The by-product gas is treated in a sulfur recovery unit to collect sulfur. The remaining sulfur compounds are then processed in a tail-gas processing unit.

Nitrogen Oxide Reduction Measures

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

Soot and Dust Reduction Measures

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

Volatile Organic Compounds Reduction Measures

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

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%. As a result, about 235 tons of benzene emission reduction was achieved in FY2006 in comparison with the FY1999 level.

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. Wastewater from refining processes 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 5,000 tons in FY2007, a 94.9% 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 Regulations and Petroleum Industry Facility Investment

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


Court Decision on Yokkaichi Pollution Lawsuit (1967-1972)
Automobile Emission Control (1970)
Setup of Benzene Environmental Standard (1996-2000)

Environmental Measures

Establishment of the Agency of Environment (1971)

Capital Investment

Heavy Oil Desulfurization

Unleaded Gasoline

Low-Sulfur Diesel Fuel

Further Reduction in Sulfur Content of Gasoline and Diesel Fuel ±300 (Estimate)

Lower Benzene ±140

source: PAJ

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

- Direct Desulfurization Unit
- Indirect Desulfurization Unit

unit: 1,000 b/d
(): number of facility units


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 including lead and sulfur contents for gasoline quality, and on 3 items including sulfur 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.

The Fuel Quality Control Law – Compulsory Standard (as of Feb 2009)

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
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<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td></td>
<td>Diesel</td>
<td></td>
<td>Kerosene</td>
<td></td>
</tr>
<tr>
<td>Lead</td>
<td>Non-detectable</td>
<td>Cetane Index</td>
<td>45 min.</td>
<td>Sulfur content</td>
<td>0.008 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>Flash Point</td>
<td>40°C min.</td>
</tr>
<tr>
<td>MTBE</td>
<td>7 vol% max.</td>
<td>Distillation, T90%</td>
<td>360°C max.</td>
<td>Color, Saybolt</td>
<td>+25 min.</td>
</tr>
<tr>
<td>Benzene</td>
<td>1 vol% max.</td>
<td>FAME*</td>
<td>0.1 mass% max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kerosene</td>
<td>4 vol% max.</td>
<td>Triglyceride*</td>
<td>0.01 mass% max.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methanol</td>
<td>Non-detectable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washed Gum</td>
<td>5 mg/100 ml max.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>Orange</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen content</td>
<td>1.3 mass% max.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td>3.0 vol% max.</td>
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</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 0.5 mass%. In such a case, additional standards include:
  • Triglyceride: 0.01 mass% max. • Methanol: 0.01 mass% max. • Acid Value: 0.13 mgKOH/g max.
  • Formic Acid + Acetic Acid + Propionic Acid: 0.003 mass% max. • Acid Stability: 0.12 mgKOH/g max.
Through the progress of deregulation, alcohol-blended automotive fuel was introduced onto the market by product importers. The quality and performance of the alcohol-blended fuel were not covered by the scope of the Fuel Quality Control 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 was established for newcomers in the business for blending ethanol and equivalent products in gasoline.

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

*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 aftertreatment devices, such as a diesel particulate filter (DPF), together with the reduction of diesel sulfur content. In this way, the requirement for diesel sulfur was lowered to 50 ppm or less by the end of 2004.

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

In view of the urgent need for reduction of diesel emissions, 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).

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

The petroleum industry has invested 300 billion yen of capital resources in developing cleaner fuel production technologies, and later 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.
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 firebreaks 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 fulltime 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 firefloats 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 a floating tank occurs.

The petroleum industry is proceeding with a plan to reinforce the wide-area joint disaster prevention organizations (12 nationwide blocks) by installing mass foam discharging systems, in cooperation with the national stockpiling facilities, the petrochemical industry and the electric power industry.

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 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 continuous 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.
Preparation for Major Oil Spill Incidents

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.

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 December 2008, PAJ had lent out OSR equipment 23 times (12 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. The purposes are to exchange information among participants about responses to major oil spill incidents, recent movements of international compensation systems, and technology development regarding oil spills.

PAJ’s OSR Website

It includes information on lending equipment, training, R&D and international conferences.

http://www.pcs.gr.jp
Progress in Deregulation

Amid the ongoing globalization and easing of regulations in the Japanese economy, 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 Fuels 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 to establish specific response measures and an increase in the volume of the government oil stockpiling. Taking into account the above report and others, the Petroleum Industry Law was abolished at the end of December 2001. At the same time, the Petroleum Reserve Law was amended, effective January 2002, to strengthen the infrastructure for emergency responses. As a result, major petroleum industry regulations are limited to oil stockpiling requirements by the new Petroleum Stockpiling Act, and to fuel quality by the Act on Quality Control of Gasoline and Other Fuels.

Business Environment Changes after Deregulation

With deregulation and the abolition of the Fuel Import Restriction Law as a turning point, the petroleum industry has been forced to face a difficult business environment under sluggish market conditions and worsening corporate profits due to severe price competition in distribution markets. For this reason, each oil company has been making efforts to lower its operating costs in every aspect of business, such as the rationalization of refining and distribution functions,

PAJ's Oil Statistics Weekly Website
https://stats.paj.gr.jp/
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, it has become much more important for the petroleum industry to conduct business activities under market mechanisms.

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, containing supply, demand, and import data on crude oil and petroleum products, refining capacities, etc., and the first report was issued 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 will continue to extend its information coverage and expects the establishment of a transparent oil market by providing real-time oil supply information which can be used to allow the full functioning of market mechanisms.
Establishment of Fair and Equal Competitive Conditions among Energy Sources

More intensified competition than ever among energy sources is projected with the progress of deregulation. In such a situation, compared with other energies, oil is unfavorably treated to a significant degree in terms of taxation and its stockpiling obligations. At the time of FY2003 tax revisions, 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 emission 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) after April 2007 when the final tax rates were applied as shown below:

- Oil : 2,040 yen/KL
- Coal : 700 yen/ton
  (1,050 yen/KL on an oil calorie equivalent basis)
- LNG : 1,080 yen/ton
  (757 yen/kiloliter on an oil calorie equivalent basis)
- Import LPG : 1,080 yen/ton
  (822 yen/kiloliter on an oil calorie equivalent basis)

In addition, new fuels like alcohol fuels and compressed natural gas for CNG vehicles do not have any Diesel Oil Transaction Tax or Gasoline Tax imposed on them. Since those fuels are for use in automobiles, the impartiality of tax imposition is being seriously ignored.

Oil stockpiling is a very useful policy measure as a pillar for energy security during an oil crisis. As for the stockpiling obligation of imported energy resources other than oil, 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 are necessary from the viewpoint of maintaining a stable energy supply. 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. An unprecedentedly large-scale and rapid market reorganization has occurred since then. The Japanese petroleum industry entered a period with only the fol-
ollowing four groups of oil companies in 2000: Nippon Oil & Cosmo Oil Group, ExxonMobil Group, Japan Energy & Showa-Shell Group, and Idemitsu Kosan.

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, further reorganizations beyond conventional business tie-ups have been accelerated as a management integration plan, mainly led by Nippon Oil, was announced, in view of recent high crude oil prices and fierce competition in the total energy market.

With the progress of such reorganization, each oil company made efforts to streamline its own refineries, storage terminals and service stations. Consequently, Japan’s total refining capacity decreased by 0.52 million barrels per day (BPD) or nearly 10% during the past 9 years from 5.35 BPD in March 2000 to 4.83 million BPD in January 2008. The total workforce of refiners and Motouri was reduced significantly during the past 10 years, and at the end of March 2008 it was about 20,000 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 as an industry-wide issue. Even after the reorganization into the four groups, Japan’s Exxon Mobil group integrated its business operations by merging Esso Sekiyu and Mobil Sekiyu, and then consolidated Tonen General Sekiyu’s in June 2002. Idemitsu Kosan closed its Hyogo Refinery near Osaka in April 2003 and its affiliate Okinawa Sekiyu Seisei’s refinery in Okinawa in November 2003 to resolve its group’s facility surplus. At the same time, it extended its business alliance with Nippon Oil to the refining function in addition to the current distribution function.

Moreover, in June 2006, Nippon Oil and Japan Energy concluded a wide-ranging business tie-up agreement and announced their business merger in April 2010. This movement is an example of management efforts toward further rationalization and efficiency improvement apart from the existing four-group structure.

In particular, not only a conventional “Horizontal” tie-ups such as in scrap-and-build or disposal of facilities and business functions, but also “Vertical” alliances or mergers between exploration & development (upstream) and refining and marketing (downstream) operations can be seen.

Besides, some oil companies are expanding into other energy businesses such as electric power, LNG and new energies like fuel cells, solar power and geothermal generation in order to become integrated energy firms. With 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 through Refinery Integration for Group-operation (RING) projects, while working on further rationalization and efficiency improvement of their core oil business.
Oil Distribution & Marketing

Distribution Rationalization & 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 October 1999, further efficiency improvement and cost reduction in the industry are expected.

In addition, deregulation in coastal and land transportation has been executed from the viewpoint of the industry’s efficiency improvement in physical distribution.

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 were allowed by regulation amendments in November 1993, and “ultra-compact” tank trucks (more compact than conventional trucks but with the same cargo capacity) as well as those with a cargo capacity of 30 kiloliters were developed by further partial mitigation of the regulation and the safety standards in October 2003. In addition, 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.

Management Climate Changes Regarding Service Stations

The Japanese petroleum industry entered a period of full-scale globalization and liberalization after the deregulation of petroleum product imports more than 10 years ago and after the abolition of the Petroleum Industry Law in December 2001. Since that time, the industry has faced unprecedented structural changes in the oil distribution market, as the domestic oil market became linked with international markets. To cope with such changes, it has become the most pressing issue for the refining industry, primary oil distributors (Motouri) and the retail (SS) industry to make efforts to establish a sound distribution market by further upgrading quality, promoting value-added sales activities and improving operational efficiency.

Rapid Increase in Numbers of Self-service SS

One of the SS diversified models, implemented in April 1998, was a manned self-service SS, where a qualified SS attendant could watch car drivers’ refueling operations from a remote control booth. About ten years since their launch, over 7,000 self-service SS are in operation. This accounted for about 16% of the total SS in Japan in FY2007.

Self-service SS were first developed by foreign capital companies, with long experience in the USA and Europe, and by small and medium-sized Motouri in the early stages of introduction. As other major domestic capital companies actively joined the development in 2002, the number of self-service SS doubled in a year. Although this upward trend temporarily slowed down after 2003, sales agents 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, self-service SS are also increasing and may trigger a severe price war in the future.

### Safety Measures at Self-service SS

The number of gasoline spill incidents caused by drivers at self-service stations is increasing. 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 counter-measures 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 comply with the Fire Service Law and improve safety.

### Responses to Environmental Problems 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 sub-

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### Main Distribution Channels of Petroleum Products

#### (1) Gasoline

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

#### (2) Kerosene

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

#### (3) Automotive Diesel Fuel

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

#### (4) Fuel Oil (A,B,C)

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

* National Federation of Agricultural Cooperative Associations
stances 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.

As for soil and groundwater pollution at SS, the Agency for Natural Resources and Energy introduced a subsidy scheme from FY2003. The scheme is to provide SS operators with financial assistance for a part of the total costs when they remove or replace their aging underground storage tanks that have a high risk of oil leakage. Considering the importance of this problem, PAJ has created the “SS Soil Environment Safety Book” for early identification and prevention of soil pollution at SS.

Living in Harmony with the Local Community

From the perspective of corporate social responsibility, 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, as they can be delivered to SS and consumers through various means such as vessels and tank trucks from nearby refineries or oil storage terminals.

For example, 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 every effort 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 the preferential fuel supply to the important facilities for deploying disaster relief operations. PAJ will also make an effort to maintain people’s daily lives by supplying fuels through nearby SS which are able to carry on business in such areas.
Exorbitant Amounts & High Rates of Petroleum-related Taxes

Because oil accounts for about 50% 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 multistage way, such tax revenues have reached nearly 4.8 trillion yen per year (FY2009 budget). Currently, customs duty and various taxes are imposed on crude oil and petroleum products. Customs duty is imposed on imported petroleum products and the 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/Prefectural)
- Jet Fuel: Aircraft Fuel Tax (National)
- LPG: Petroleum Gas Tax (National)

In addition, about 1.2 trillion yen of general consumption tax is also levied on those petroleum products (5% of product sales price). Consequently, total petroleum-related taxes amount to about 5.5 trillion yen, equivalent to about 44 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 & Unfair Petroleum-related Taxes

At the time of the introduction of the consumption taxation in April 1989, the streamlining of existing indirect taxes was carried out so as not to increase consumers’ overall tax burden. However, the 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 sim-
**Petroleum-related Taxes per Liter of Gasoline (as of Jul 2009)**

(Example: Gasoline Retail Price at 125 yen/ℓ)

- **Double Taxation**: 2.8 yen (Consumption Tax 6.0 yen) - Consumption Tax on Net Gasoline Price 3.2 yen
- **Gasoline Tax**: 53.8 yen
- **Petroleum and Coal Tax**: 2.04 yen
- **Net Gasoline Price**: 63.2 yen

**Revenue and Disbursement of Petroleum-related Taxes (FY2009 Budget)**

- **Petroleum Product Custom Duty**: 3.2 billion yen
- **Gasoline Tax**: 2.628 trillion yen
- **Local Gasoline Tax**: 281.2 billion yen
- **Petroleum Gas Tax**: 13 billion yen
- **Diesel Fuel Transaction Tax**: 927.7 billion yen
- **Aviation Fuel Tax**: 98.1 billion yen
- **Petroleum and Coal Tax**: 510 billion yen
- **Total Tax Revenue**: 4.4742 trillion yen

**Ratio of Petroleum-related Taxes in Total National Taxes (FY2009 Budget)**

- **Corporate Tax**: 22.1%
- **Income Tax**: 32.6%
- **Liquor Tax**: 3.0%
- **Tobacco Consumption Tax**: 2.2%
- **Automobile Tonnage Tax**: 2.0%
- **Consumption Tax**: 21.2%
- **Stamp Duty**: 2.1%
- **Gasoline Tax**: 6.1%
- **Petroleum and Coal Tax**: 1.3%
- **Petroleum Gas Tax**: 1.3%
- **Stamp Duty**: 2.1%
- **Inheritance Tax**: 3.2%
- **Direct Tax**: 57.8%
- **Indirect Tax**: 42.2%
- **Total Petroleum-related Taxes**: 7.4%

In response to the government plan to incorporate the Specific Revenue Sources for Road Construction such as from Gasoline Tax into the General Account Budget, the ruling parties clearly stated the need “to find solutions to the tax burden problems arising from dual taxation, i.e., consumption tax on gasoline tax, at

...
the time of drastic tax reform”, which is projected for 2011, in their FY2009 Tax Reform Package.

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.

Shifting of Road Construction Specific Revenue to General Revenue

Debates on the Specific Revenue Sources for Road Construction became a political issue and the application of the provisional rates of Gasoline Tax and Diesel Fuel Transaction Tax were temporarily suspended in April 2008. This event drew a great deal of social interest. Based on the Cabinet decision regarding the “Basic Policy on the Specific Revenue Sources 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, the revision of this specific revenue source will take place from FY2009.

The Gasoline Tax and Diesel Fuel Transaction Tax are treated under the law as “the Specific Revenue Sources”, the revenue from which is to be used only for road construction and maintenance under the “benefit principle” that it is fair and reasonable for beneficiaries to pay for part of a project. All the revenue from these taxes has been used for road construction and maintenance since 1954, and furthermore, the provisional tax rate, which is nearly double the original rate, has been applied since 1974 to make up for a shortfall in road construction and maintenance expenditure.

PAJ has been taking objection to a plan to shift the road budget to the general budget. Considering the above-mentioned “benefit principle” as well as the gap between public transportation availability in urban as opposed to rural areas, where people have to rely on private cars, it is strongly believed that the whole specific revenue for road construction should be used only for road maintenance and improvement as originally designated.

However, as the revenue for road construction has accumulated a large surplus in recent years due to curbs on public works projects, its uses are expanding to public works not directly associated with roads. Besides, there are criticisms of this specific revenue from those who say it tends to induce budgetary inflexibility and wasteful spending. As a part of the fiscal reform, this specific revenue will be discontinued and incorporated into general revenue as nonrestricted funds in the fiscal 2009 budget.

At the same time, the ruling parties clearly stated in their FY2009 Tax Reform Package that the following points should be examined at the coming fundamental reform of the taxation system:

- The optimum taxation system and tax rates, including provisional ones, after shifting the road construction specific revenue to general revenue
- Simplification and reduction of automobile-related taxes, including fuel taxes, through comprehensive examination of the current taxation system and rates

With the support of more than 10 million names gathered on a petition for abolishing or lowering fuel taxation and the resolution of the “tax-on-tax” situ-
Trends in Indirect Taxes Imposed on Petroleum Products since the 1973 Oil Crisis

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

Current Status of Petroleum-related Taxes and Consumption Tax (FY2009 Estimate)

- Consumption Tax Amount from Oil Product Sales: 1.02 trillion yen
- Consumption Tax on Oil Portion: 850 billion yen
- Tax-on-Tax Portion: 170 billion yen
- Sales Excluding Taxes: Approx. 16.9 trillion yen
- Petroleum-related Taxes: Approx. 4.48 trillion yen

Current Consumption Tax Rate: 5%

2010

Towards a Fundamental Reexamination of Petroleum-related Taxes

PAJ continues to make uncompromising and persistent efforts to make the tax system understood to taxpayers, i.e., automobile users.
Reinforcement of Corporate Structure

Vital Need to Reinforce Corporate Structure

The petroleum industry continues to invest in facility enhancement and R&D for various environmental measures and needs to tackle the oil resource development business for a stable and efficient energy supply.

The petroleum industry faces severe financial conditions due to soaring resource prices and a projected tight oil supply in the medium and long term. This is because the industry is required to take on 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 essential 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. 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 from 2003 to the summer of 2008 while in the same period domestic petroleum product demand was in decline. In addition, the record-breaking sharp rise followed by the great fall in crude oil prices, 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 term even in a period of falling in 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 petrochemical products, which had at times been extremely good in the past, has worsened rapidly, reflecting falling market prices and decline in demand.

The performance of the oil and gas exploration development segment made relatively good progress when backed by high crude oil prices. However, due to falling crude oil prices, its earnings results will worsen from now on.

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 profit 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 the case of using the last-in first-out (LIFO) inventory valuation method, the inventory drawdown cost is nearly equal to its acquisition cost. However, 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.

Such an “inventory valuation impact” has a significant influence on the extreme fluctuation in earnings from the petroleum product segment. In FY2008, due to soaring crude oil prices, substantial profits were achieved during the second quarter (July-Sept.), but significant losses were posted for the full business year on an industry-wide basis, because the fall in crude oil prices after the second quarter had such a negative impact.
Each oil company has been taking various countermeasures such as exporting petroleum products, reinforcing their oil exploration business, and investing in new businesses to strengthen their management base.

To cope with such rapid and substantial changes in the business environment, it is essential for each 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 essential 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.

![Sales Revenue and Ordinary Income in the Petroleum Industry (All Refineries and Primary Distributors)](chart)

![Financial Data Comparison between the Petroleum Industry and Other Industries (FY2008)](chart)
### Overview of the Japanese Petroleum Industry

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Oil Companies</strong></td>
<td>17 Companies (as of August 2009)</td>
</tr>
<tr>
<td><strong>Total Capital</strong></td>
<td>596.8 billion yen (as of Mar 2009)</td>
</tr>
<tr>
<td><strong>Annual Sales Revenue</strong></td>
<td>28.224 trillion yen (FY2008)</td>
</tr>
<tr>
<td><strong>Total Number of Employees</strong></td>
<td>Approx. 21,000 Persons (as the end of FY2008)</td>
</tr>
<tr>
<td><strong>Crude &amp; Product Import Volume</strong></td>
<td>263.73 million kl (FY2008)</td>
</tr>
<tr>
<td><strong>Crude &amp; Product Import Amount</strong></td>
<td>161.8 billion dollar (FY2008)</td>
</tr>
<tr>
<td><strong>Oil Dependence on Imports</strong></td>
<td>99.6% (FY2008)</td>
</tr>
</tbody>
</table>

### Location of Refineries and Crude Distillation Capacity in Japan (as of Jul 2009)

- **Teiseki Topping Plant (Kubiki)**: 47,244 b/d
- **Japan Energy (Mizushima)**: 205,200 b/d
- **Idemitsu (Tokuyama)**: 120,000 b/d
- **Seibu (Yamaguchi)**: 120,000 b/d
- ***N.P.R.C (Marifu)**: 127,000 b/d
- **Idemitsu (Aichi)**: 160,000 b/d
- **Taiyo (Shikoku)**: 120,000 b/d
- **Cosmo (Sakaide)**: 140,000 b/d
- **Nansei (Nishihara)**: 100,000 b/d
- **Kashima (Kashima)**: 270,000 b/d
- **Cosmo (Chiba)**: 240,000 b/d
- **Kyokuto (Chiba)**: 175,000 b/d
- **Idemitsu (Chiba)**: 220,000 b/d
- **Fuji (Sodegaura)**: 192,000 b/d
- **TonenGeneral (Kawasaki)**: 335,000 b/d
- **Toa (Keihin)**: 185,000 b/d
- ***N.P.R.C (Negishi)**: 340,000 b/d
- **Idemitsu (Osaka)**: 160,000 b/d
- **Cosmo (Yokkaichi)**: 175,000 b/d
- **Showa Yokkaichi (Yokkaichi)**: 210,000 b/d
- **Cosmo (Sakai)**: 80,000 b/d
- **TonenGeneral (Sakai)**: 156,000 b/d
- ***N.P.R.C (Osaka)**: 115,000 b/d
- **TonenGeneral (Wakayama)**: 170,000 b/d

**TOTAL: 28 Refineries (4,834,924 b/d)**

* *Nippon Petroleum Refining Company*
**Main Product Specifications in Japan**

**Motor Gasoline (JIS K2202)**
- Lead
  - Density (max.): 0.783 g/cm³ (15°C)
  - RVP: 44~78 kPa
  - Sulfur content (max.): 0.001wt%
  - Benene (max.): 1 vol%
  - MTBE (max.): 7 vol%
  - Ethanol (max.): 3 vol%
  - O₂ Content (max.): 1.3 wt%

**Kerosene (JIS K2203)**
- Sulfur content (max.): 0.008 wt% (No.1)
- Smoke point (min.): 23 mm (in winter season: 21 mm)

**Gas Oil (JIS K2204)**
- Pour point (max.): Special No.3: -30°C; No.3: -20°C; No.2: -7.5°C; No.1: -2.5°C; Special No.1: -5°C; Special No.1, No.1: 50 No.2, No.3, Special No.3: 45
- Cetane index (min.): 0.001 wt%
- Sulfur content (max.): 0.86 (15°C)

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

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

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

Note: Fuel oil classified into 3 types by viscosity. Even though Fuel Oil A has the name of “fuel oil”, it’s a kind of distillate products. 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 1.5 wt% recently (including all its grades).

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**Domestic Demand for Main Petroleum Products**

<table>
<thead>
<tr>
<th></th>
<th>Gasoline</th>
<th>Naphtha</th>
<th>Jet Fuel</th>
<th>Kerosene</th>
<th>Diesel Fuel</th>
<th>Fuel Oil A</th>
<th>Fuel Oil B/C</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
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<tr>
<td>1980</td>
<td>34,543</td>
<td>26,297</td>
<td>2,967</td>
<td>23,566</td>
<td>21,584</td>
<td>21,083</td>
<td>79,199</td>
<td>209,219</td>
</tr>
<tr>
<td>1990</td>
<td>44,783</td>
<td>31,423</td>
<td>3,739</td>
<td>26,701</td>
<td>37,680</td>
<td>27,066</td>
<td>46,823</td>
<td>218,012</td>
</tr>
<tr>
<td>2000</td>
<td>58,372</td>
<td>47,688</td>
<td>6,111</td>
<td>29,924</td>
<td>47,745</td>
<td>29,516</td>
<td>31,364</td>
<td>243,218</td>
</tr>
<tr>
<td>2005</td>
<td>61,421</td>
<td>49,388</td>
<td>5,129</td>
<td>28,265</td>
<td>37,116</td>
<td>27,780</td>
<td>27,009</td>
<td>236,109</td>
</tr>
<tr>
<td>2008</td>
<td>57,473</td>
<td>42,873</td>
<td>5,576</td>
<td>20,250</td>
<td>33,722</td>
<td>17,891</td>
<td>23,158</td>
<td>201,042</td>
</tr>
<tr>
<td>Forecast</td>
<td></td>
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<tr>
<td>2013</td>
<td>48,862</td>
<td>43,957</td>
<td>5,861</td>
<td>15,848</td>
<td>29,552</td>
<td>13,361</td>
<td>10,020</td>
<td>167,441</td>
</tr>
</tbody>
</table>

**Note:**
- Unit: 1,000 kl
- Demand Pattern (%)
- 66%