Petroleum Industry in Japan
2012
Furthermore, a severe nuclear accident, categorized as Level 7 (IAEA standard), which equaled the nuclear accident at Chernobyl, occurred at Tokyo Electric Power Company’s Fukushima No. 1 Nuclear Power Plant. It caused considerable damage to oil facilities. Six out of nine refineries in the Tohoku and Kanto regions stopped their operations. Three of those were forced to suspend refining operations for a long period of time. Besides, almost all oil storage terminals along the Eastern Japan Pacific Ocean also suspended their shipping operations. Service stations and tank trucks making deliveries in the quake-hit areas also suffered enormous damage. Consequently, confusion was seen over a wide area. For example, the situation arose in which smooth supply of petroleum products was hampered in the affected areas as well as the Tokyo metropolitan area due mainly to damage to infrastructure such as oil shipping terminals, roads and ports. This was despite the petroleum industry’s utmost efforts to store and supply oil at a sufficient volume on a nationwide basis. However, as a result of the industry’s unified efforts, working across all companies’ borders, the supply system was restored to the pre-quake level in roughly three weeks. The petroleum industry believes it could fulfill its role as the primary energy supplier.

Furthermore, from the moment of disruption of “system energy” such as electricity and city gas, oil showed its strength as the “distributed energy” that has emergency response capabilities in terms of easy delivery and storage as a fuel for heating at the evacuation centers, for emergency power systems and for emergency and evacuation vehicles. Since oil is the “last-resort” energy, it is necessary to re-evaluate oil as it can excel during emergency response and should be clearly positioned as the core energy in the government’s energy policy.

Internationally, on the other hand, the “Shale Revolution” drew attention in 2011. Mainly in the United States, the development and active production of shale gas and shale oil is moving ahead at a faster pace. The problem of dwindling oil resources can now be considered deferred for more than 50 years. Japan’s energy policy is formed on the basis that oil will be depleted in 40 to 50 years. Accordingly, enhancement of alternative energy sources has been focused on under the “Oil Use Reduction Policy.” However, it can be said that such a premise has been shown to be wrong, since the risk of depleting oil resources, including non-conventional oil resources, is diminishing in the medium and long term.

Therefore, when reexamining the future energy policy, the petroleum industry is going to make a strong appeal for the importance of promoting the effective use of oil, which is superior for emergency response and supply stability focusing on the following points:

- Do not let domestic oil demand decrease, in light of the lessons of the “the importance of oil from the Great East Japan Earthquake”
- Ensure a stable level of oil demand by maintaining and strengthening the oil supply chain during times of normal circumstances

Prices of West Texas Intermediate (WTI) in 2011 had started with the level of around 90 US dollars per barrel (US$/Bbl), and jumped to over 110 US$/Bbl in early April due to the growing tension in Libya. Meanwhile, because of various factors such as the reduced concern of the Arab Spring spilling over into the Gulf oil producing countries, the financial crisis in Europe, and the economic slowdown in advanced countries, oil prices temporarily dropped below 80 US$/Bbl in early October. After that, with the tense situation regarding Iran and its nuclear development problem as well as corresponding financial sanctions against the country, oil prices roughly stayed in the range between 85 and 105 US$/Bbl at the year’s end.

Japan’s average crude oil import price (CIF) in 2011 was 108.7 US$/Bbl, up about 30 US$ versus 2010. Though the exchange rate stayed at a strong yen (¥) level, on a yen basis, the CIF was 54,645 ¥/kiloliter (KL), ¥5,280/KL higher than the previous year.

In addition, there is a wide range of issues to be considered, such as countermeasures for global warming and settlement of double taxation, i.e., the consumption tax on the gasoline tax.

This brochure has been created to provide consumers as well as stakeholders with a better understanding of the current situation and the future efforts of the petroleum industry in Japan. We hope this brochure will help to give you a sound understanding of oil and the petroleum industry in Japan.
II. Projects and Main Activity Plans in FY2012

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

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

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

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

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

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

7. Promoting activities for a strong foundation for the petroleum industry
   (1) Conduct PR activities for better public understanding of the positioning of oil among energy sources.
   (2) Make right execution of the structural improvement projects under the government subsidies.
   (3) Support research and development operations by the Petroleum Industry Technology and Research Institute, Inc. (PITRI).
   (5) Deal with labor policy issues concerning the petroleum industry.
   (6) Enhance communication among PAJ member companies and collaboration with concerned business organizations.
PAJ Member Companies (14)

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

Former Member & Friend of PAJ (1)

- Kygnus Sekiyu K.K.
Total petroleum fuel demand for fiscal year (FY) 2010 was about 196 million kiloliters (KL), up by 0.5% from the previous year. Though the total fuel demand had exceeded 200 million KL since FY1988, it fell below the 200 million KL mark, continuing its decrease from the previous year. On the other hand, the total fuel demand for the first half of FY2010 showed a 2.5% increase versus the same term of the previous year mainly due to economic recovery, and increases in demand for gasoline, Fuel Oil B and Fuel Oil C caused by the record high temperatures during summer.

Though total fuel demand had fallen below the 200 million KL level during the early 1980s after the second oil crisis due to a drastic decrease in demand for Fuel Oil C and naphtha for industrial fuel and feedstock, respectively, other fuels demand increased fairly consistently after the Second World War. This upward trend terminated in 2000. Total fuel demand reached a peak of 246.0 million KL in 1999, and a structural downturn has continued since 2000. Peak demand volumes by fuel were: 81.5 million KL for gasoline in FY2004 and 30.8 million KL for kerosene in FY2002. As for industrial fuels (Fuel Oil B and Fuel Oil C), the peak volume was 111 million KL in FY1973.

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

### Structural Decline in Oil Demand

### Changes in Social Structure

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

### Global Warming Countermeasures

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

Total fuel oil demand for the first half (Apr–Sep) of FY2011 was 88.6 million KL, 4% down from the previous year. On a fuel-by-fuel basis, all fuels except Fuel Oil B and Fuel Oil C showed a decrease. Especially, jet fuel and kerosene decreased significantly by 22% and 17% respectively from the previous year. The rise in demand for Fuel Oil B and C was brought about by their increased use for electric power generation due to the Great East Japan Earthquake. The fuel demand for electric power will fluctuate depending on the future operating status of nuclear power plants.

It is projected that structural factors for a downward trend in Japan's petroleum product demand, excluding Fuel Oil B and Fuel Oil C, will not be changed, excluding temporary impacts such as rapid changes in crude oil prices. However, in light of the lessons learned from the Great East Japan Earthquake, in order for the petroleum industry to perform a last-resort function for energy supply, it is essential to secure a stable scale of oil demand as well as to maintain and strengthen the overall petroleum supply chain.

### Petroleum Supply System in Japan

For FY2010, the domestic yield of crude oil was a mere 890 thousand KL, equivalent to 0.4%, or 1.5 days, of the 208.3 million KL of Japan's crude processing volume. Japan, therefore, imports almost all crude oil and petroleum products for meeting domestic petroleum product consumption demand.

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

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

For the past 30 years, domestic petroleum demand has been more or less consistently declining and, at the same time, demand for so-called “white fuels” such as gasoline, naphtha and kerosene has been increasing. Oil companies, therefore, have made efforts to follow trends in supply and demand by constructing heavy oil cracking units for increasing output of “white fuels”. Any excess or deficiency beyond refining facility capacity has been supplemented by import or export of petroleum products.

With the advancement of internationalization, oil companies in recent years have tried to use product import and export more flexibly from a strategic viewpoint.
The crude import volume by region in FY2010 showed that Middle Eastern oil-producing countries accounted for 86.6%. Oil dependency on the Middle East had once dropped to 68% in FY1987 after the oil crises; however, the dependency rose again in the 1990s, because non-Middle Eastern oil producing countries such as China and Mexico gradually reduced their export of crude oils in accordance with economic growth in their countries.

Regarding crude oil imports by country, four countries, namely Saudi Arabia (29.2% of total import volume), the United Arab Emirates (20.9%), Qatar (11.6%) and Iran (9.8%), accounted for about three-quarters of Japan’s total crude import volume.

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

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

In recent years, the export volume of diesel fuel is increasing year by year, though the future trend is uncertain.
4. Provide an equal footing regarding competitive conditions on taxation, stockpiling obligations, etc. among all energy sources in order to achieve “the optimum energy mix”. As a result of industry advocacy efforts, the terms “Oil Use Reduction Policy” and “Departure from the Middle East”, conventional objectives of Japan’s basic energy policy, were eliminated from the Basic Energy Plan established in October 2003. The plan re-emphasized the significance of oil by stating “oil will remain an important energy source in the future from the viewpoints of economic efficiency and convenience”. Upon compilation of the Basic Energy Plan, a report titled “Energy Supply and Demand Outlook toward 2030” was drawn up in October 2004. The following points were clearly stated in this report:

1. Oil will remain the central player in primary energy supply in 2030.
2. The introduction of IGCC (Integrated Gasification Combined Cycle) fueled by residuals should be promoted to enhance efficient utilization of oil resources.
3. The whole concept of oil substitution policy, as well as the definition of “new energies”, will be reexamined.

Oil Remains an Important Energy even in the 21st Century

The petroleum industry has consistently advocated the following opinions for the simultaneous achievement of the energy policy’s three basic principles (3E): “securing stable energy supply,” “environmental consideration,” and “efficient supply using market mechanisms upon due consideration of the first two principles.” It stipulates the roles and responsibilities of the central government, local governments, and others. The law also provides that taking into account the next decade or so, the Basic Energy Plan should stably map out the basic direction of various measures on energy supply and demand in line with these 3E principles.

Toward the Advancement of Energy Supply Structure

After the G8 Hokkaido-Toyako Summit in 2008, arguments for realizing a low-carbon society have been spreading in the nation. Movements regarding global environmental issues in foreign countries have also become active. Those movements are pressing the energy industry for drastic changes. It is requested to develop future energy policies considering the simultaneous settlement of the global warming issue in addition to ensuring energy security to cope with the recent violent fluctuations of crude oil prices. Under these circumstances METI started deliberations, from October 2008, on the reexamination of its alternative energy policy and the increased use of nonfossil energies. Unstable conditions have continued such as a steep rise in prices of all fossil fuels including oil in 2008, but a drop in the prices due to worldwide financial instability after autumn. In these deliberations, therefore, the vulnerability of Japan’s energy supply structure has been pointed out; for example, its dependency on offshore fossil fuels for over 80% of its supply. In addition, the following proposals were emphasized: (1) the importance of considering medium- and long-term measures such as global warming countermeasures and formation of a low-carbon society and (2) the necessity for reexamining energy policies, taking into account the Basic Act on Energy Policy (a unified settlement of 3E).

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

1. Oil should be regarded as a core energy, not as a buffer energy, since oil will remain the major energy (40% of primary energy supply) even in 2030.
2. The Alternative Energy Law should be abolished and new legislation should be established to allow for the 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 compiled in January 2009:

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

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

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

This new law is intended to urge energy suppliers (electric power, city gas and oil) to expand the use of nonfossil energy resources as well as to promote effective use of fossil resources. Specifically, the notification of the criteria for judgment concerning the promotion of the effective use of fossil energies was given in July 2010.

Aiming to raise the installation ratio of Japan’s heavy oils cracking units (currently about 10%) to about 13% by FY2013, each oil refiner is obliged to attain the facility improvement in three stages depending on the current installation ratio. This will lead to new or additional installation of heavy oils cracking units, or the reduction of crude distillation units to raise the installation ratio. In addition to these, each refiner is going to work on technology development such as improvements in facility operations.

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

In recent years, the global energy conditions such as the steep rise in crude oil prices have become increasingly severe. The international energy market is facing significant structural changes such as the rapid growth of energy demand in Asian countries...
and the rising tide of resource nationalism. In addition, energy prices have fluctuated widely as the situation was made worse by various factors such as natural disasters including damage from an earthquake and a hurricane, reexamination of energy security in light of the Fukushima nuclear power plant accident, inflows of speculative money, terrorist activities and uncertainties in the Middle East like the issue of Iran’s nuclear development. Amid mounting international concern over energy security, many countries are gearing up for the restructuring of their national energy strategies.

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

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

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

1. Japan is in a situation to reexamine with a clean slate the existing Basic Energy Plan that aimed for 50% dependency on nuclear power generation in primary energy supply by 2030, since Japan faces such an unprecedented situation in light of the Great East Japan Earthquake and Fukushima No. 1 Nuclear Power Plant accident.

2. Over the years, Japan has changed its energy mix drastically from water to coal, from coal to oil, and from oil to nuclear. Countries around the world also structure their own energy strategies to meet their needs. It is always an important issue for all nations to select energies for achieving economic growth and the stability of their citizens’ lives.

3. Japan needs to speed up its new consensus building by reexamining its energy and environmental strategy from scratch, irrespective of the given premises.

It was also decided to establish the Energy and Environment Council, headed by the Minister of State for National Policy, to rethink the nation’s energy and environment strategies without exceptions across all government agencies and ministries. The Energy and Environment Council, of which the first meeting was held on June 22, 2011, issued the “Interim Compilation of Discussion Points for Formulation of Innovative Strategy for Energy and the Environment” on July 27, and decided the broad direction by illustrating the scenarios of lowering the dependence on nuclear power and shifting to a distributed energy system. Based on this direction and the basic policy, various deliberations were conducted at the following organizations:

- The Green Growth Strategy at the Energy and Environment Council
- Validation of the power generation cost of each energy source including nuclear power at Committee to Review Costs, etc. of Power Generation
- Development of the optimum energy mix for the new Basic Energy Plan at the Advisory Committee on Energy and Natural Resources
- Countermeasures against global warming at the Central Environment Council
- Issues on nuclear energy policy at the Atomic Energy Commission

Taking into account the argument points and the deliberation results at those meetings, the Energy and Environment Council decided the “Basic Principles—Towards a Proposal Defining Options for a Strategy for Energy and the Environment—” on December 21. Following this policy, redesign of the energy and environment strategy was specified in the “Strategy for Rebirth of Japan” adopted at the cabinet meeting on December 24.

Showing options for the energy and environment strategies and enhancing national debate, the drafts of the Green Growth Strategy, the new Basic Energy Plan, the new General Framework of Nuclear Energy Policy and new global warming countermeasures will be prepared through continuous deliberations in 2012. “The Innovative Strategy for Energy and Environment” is scheduled to be decided during summer 2012.

Reexamination of Japan’s Petroleum Policies

In the deliberation of energy policies, petroleum policies were also reexamined.

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

1. Thoroughly strengthen policy measures for energy saving and electricity saving, considering consumers’ behavior and changes in social infrastructure.
2. Accelerate the development and usage of renewable energies to the maximum extent possible.
3. Effectively utilize fossil fuels including an energy shift to natural gas, while taking full consideration of the environmental burden (clean use of fossil fuels).
4. Lower the dependency on nuclear power generation as much as possible.

Although oil accounts for the major portion of Japan’s primary energy supply, the petroleum industry’s advocacy points as described below are hardly incorporated into its report:

- Heighten the position of oil as a core energy, by reevaluating its superiority in disaster response capabilities in light of its ease of use in multiple roles.
- Ensure a stable scale of oil demand to maintain the oil supply chain.

Furthermore, an energy shift to natural gas was included in the report; despite the fact that the future energy strategy had not been firmly up at that stage. From now on it is essential to carry out more careful deliberations on each energy source from scratch,
without preconditions. The Innovative Strategy for Energy and Environment will be formulated around summer 2012, after undergoing a process of national debate. PAJ continues to advocate the necessity of oil and its superiority as an energy supply due to its disaster response capabilities which can most benefit affected people.

**Energy Supply and Demand Performance (FY2010 Flash Report)**

Final energy consumption for FY2010 showed a 4.0% increase from the previous year, due to the economic recovery, an extremely hot summer and a very cold winter. In comparison with the previous year by sector are: 6.8% up for the industrial sector, 2.8% up for the household and civil sector, and 0.9% up for the transportation sector.

As a result, the total final energy consumption showed an increase versus the previous year after six years of decline since FY2004. On the other hand, the total domestic primary energy supply was 22,065 petajoules (PJ), or 569.3 million KL in crude oil equivalent, up by 5.6% versus the previous year; of which oil was 8,853 PJ, or 228.4 million KL in crude oil equivalent. The oil ratio decreased by 2.0% to 40.1% from the previous year's 42.1%.

The supply ratios in the total primary energy supply are: nuclear power decreased from 11.5% to 11.3%, while coal increased from 21.0% to 22.6% and natural gas increased from 19.0% to 19.1%. Major primary energy sources other than oil showed growth from the previous year. However, even the ratio of coal, the second largest primary energy source following oil, is just half that of oil. Stable oil supply, therefore, is absolutely essential for ensuring energy security in Japan even in the future.

## Long-term Final Energy Consumption Outlook

<table>
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<tr>
<th>(FY)</th>
<th>1990</th>
<th>2005</th>
<th>2010*</th>
<th>2020</th>
<th>2030</th>
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<td>398 100%</td>
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<td>170 44%</td>
<td>180 44%</td>
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<tr>
<td>Household &amp; Commercial</td>
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<td>128 33%</td>
<td>149 35%</td>
<td>134 34%</td>
</tr>
<tr>
<td>- Household</td>
<td>43 12%</td>
<td>56 14%</td>
<td>56 14%</td>
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<td>73 19%</td>
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<tr>
<td>Transportation</td>
<td>83 23%</td>
<td>92 24%</td>
<td>88 23%</td>
<td>92 22%</td>
<td>86 22%</td>
</tr>
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**Unit: million kl crude oil equivalent**

## Long-term Primary Energy Supply Outlook

<table>
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<tr>
<th>(FY)</th>
<th>1990</th>
<th>2005</th>
<th>2010*</th>
<th>2020</th>
<th>2030</th>
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<tr>
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<td>17 3%</td>
<td>20 4%</td>
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</table>

**Unit: million kl crude oil equivalent**

* actual figure

Source: METI: The Long-term Energy Supply and Demand Outlook, in August 2009
5 Oil Stockpiling and New Emergency Countermeasures

History of Japan’s Oil Stockpiling System

With the enforcement of the Petroleum Reserve Law, enacted in December 1975, 90-day oil stockpiling held by private oil companies was started in April 1976. At the time of its start, various measures were taken such as expanding interest subsidies, the establishment of joint stockpiling companies including a rise in investment ratio, and the foundation of a subsidy scheme for oil storage locations in order to lessen the burden of the enormous cost of funds associated with the buildup of stockpiles.

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

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

Oil Stockpiling System after Deregulation

As a result of the abolition of the Provisional Measures Law on the Importation on Specific Refined Petroleum Products (Fuel Import Restriction Law) in April 1996, importation of petroleum products was virtually liberalized. After that the petroleum industry legislation under normal times have been regulated by (1) the Act on Quality Control of Gasoline and Other Fuels (Fuel Quality Act), which was reformed from the previous Gasoline Retail Business Law and (2) the amended Petroleum Reserve Law, which stipulates the requirements for new entrants of oil importers.

In response to the abolition of the Petroleum Industry Law in January 2002, the new Oil Stockpiling Act was enforced. From the viewpoints of ensuring fulfillment
### Overview of Past Emergency Periods

<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>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>
</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>
</tr>
<tr>
<td><strong>Ratio of Crude Oil Price Hike</strong></td>
<td>Arabian Light (Spot Price) 33 Times</td>
<td>Arabian Light (Spot Price) 33 Times</td>
<td>Dubai (Spot Price) 2.2 Times</td>
</tr>
<tr>
<td><strong>Code OF (Capsulated Movement)</strong></td>
<td>0 Days</td>
<td>12.8 Days</td>
<td>7 Days</td>
</tr>
<tr>
<td><strong>Gasoline (Spot Price)</strong></td>
<td>114 (May 1975)**</td>
<td>177 (Dec 1982)**</td>
<td>142 (Nov 1990)**</td>
</tr>
<tr>
<td><strong>Crude Oil Import Volume</strong></td>
<td>288.6 Million kl (FY1973)</td>
<td>277.14 Million kl (FY1979)</td>
<td>238.48 Million kl (FY2004)</td>
</tr>
<tr>
<td><strong>Crude Oil Dependence in Middle East</strong></td>
<td>23% (FY1973)</td>
<td>43% (FY1980)</td>
<td>19% (FY1990)</td>
</tr>
<tr>
<td><strong>Foreign Exchange Rate</strong></td>
<td>56.54 (Oct 1974)</td>
<td>246 (Apr 1982)</td>
<td>128 (Nov 1990)</td>
</tr>
</tbody>
</table>

### Current Status of Oil Stockpiling in Japan (as of Dec 2011)

<table>
<thead>
<tr>
<th>Stockpile Days</th>
<th>Private Stockpiling</th>
<th>Government Stockpiling</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stockpile Days</strong></td>
<td>87 days</td>
<td>116 days</td>
</tr>
<tr>
<td><strong>Stockpiling Volume</strong></td>
<td>35.7 million kl</td>
<td>47.7 million kl</td>
</tr>
<tr>
<td><strong>Obligation Days</strong></td>
<td>70 days of domestic demand</td>
<td>50 million kl (attained in Feb 1998)</td>
</tr>
<tr>
<td><strong>Holding Method</strong></td>
<td>Through production and distribution processes</td>
<td>In sealed designated storage tanks</td>
</tr>
<tr>
<td><strong>Holding Location</strong></td>
<td>Private sector in refineries and oil terminals</td>
<td>① Tanks of national stockpiling bases</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td>Crude oil : 50%</td>
<td>Oil products: 50%</td>
</tr>
<tr>
<td><strong>Administrative Body</strong></td>
<td>Oil refiners and importers</td>
<td>① 10 national stockpiling bases (23% of government reserve)</td>
</tr>
<tr>
<td><strong>Effect of Stockpile Release</strong></td>
<td>Prompt supply to distribution markets as stockpiles are held at refineries and oil terminals</td>
<td>Flexile release of stockpiles depending on crude procurement status and seasonal demand fluctuation</td>
</tr>
<tr>
<td><strong>Cases of Stockpile Release</strong></td>
<td>① 2nd Oil Crisis (Mar 1979–Aug 1980)</td>
<td>① Gulf Crisis in response to CERM (Jan–Mar 1991)</td>
</tr>
<tr>
<td><strong>Financial Measures</strong></td>
<td>Subsidy for oil purchasing costs and tank construction costs</td>
<td>Government's budget (Petroleum and Coal Tax)</td>
</tr>
<tr>
<td><strong>Cost Recovery</strong></td>
<td>Part of product cost (passing the cost on to consumers is expected)</td>
<td>Part of product cost (passing the cost on to consumers is expected)</td>
</tr>
</tbody>
</table>
system:
1. Increasing of the stockpile volume (by buildup of the government stockpile)
2. Introducing oil product reserves by the government

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

Taking into account the great difficulties experienced in petroleum product distribution at the time of the Great East Japan Earthquake in March 2011, the improvement of the government's oil product stockpiling by expanding product coverage and volumes is underway. Since such energies as solar and wind power generally have a supply instability problem, oil as the last resort of energy, which complements the supply instability, will play an ever-greater role.

It is however assumed that Japan's domestic oil demand will continue to show a structural downward trend. In order to keep playing roles as being the last resort of energy and for providing flexible responses in an emergency, it is an important policy issue to reduce dependence on the private sector stockpiling days for the stockpiling of crude oil reserves.

In FY2007, the Subcommittee on Next Generation Fuels and Petroleum Policies under 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 also discussed Japan's cooperation toward stabilization of the international oil market in an emergency, taking into account the possible direct release of its stockpile to overseas countries.

In line with such movements, a Japanese oil company successfully won an international bid in 2009 for preferential sales and purchase of its crude oil stockpile, based on an intergovernmental agreement concluded with New Zealand. In June 2009, the Agency for Natural Resources and Energy (ANRE) in Japan made an agreement on

On the other hand, in accordance with moving ahead with global warming countermeasures, promoting the introduction of renewable energies is
Japan’s Petroleum Resource Development

Petroleum resource development in Japan started in the early Meiji period (1870s) primarily in Niigata Prefecture. Currently, commercial production is carried out in Hokkaido, Akita and Niigata Prefectures. Also, exploration development activities continue to be conducted, and Yufutsu Oil/Gas Well and Minamis-Naragoka Oil/Gas Well can be noted as representative examples. These wells are currently under production. Associated natural gas produced with oil is utilized as city gas or power generation fuel in most adjacent areas and contributes to the local economies of such communities. As Japan however is the third largest oil consuming country, demand cannot be satisfied through domestic oil and gas production, because this volume is only 1.4% of the domestic consumption of oil and natural gas. Almost all petroleum resources are dependent on imports.

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

Today, Japanese firms are involved in approximately 130 oil and gas development projects around the world in areas such as the Middle East, South-East Asia, Africa, South and North America, and the former republics of the Soviet Union, of which about 70 have performed well in commercial production at the end of June 2011. The share of crude oil and natural gas from independent crude oil and gas development projects is about 24% of the total domestic demand volume.

Japan’s Independent Oil and Natural Gas Development in Future

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

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

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

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

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

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

1. The abolition of supply and demand adjustment regulations such as the need for approval for business commencement and facility investments
2. The abolition of regulations on pricing based on setting standard prices
3. The abolition of oil stockpiling and emergency responses, and proposed in its report in August 1999 to establish specific response measures and an increase in the volume of government oil stockpiling. The report also pointed out that “it is extremely important from the viewpoint of security measures to have a healthy petroleum industry which runs a stable business even in a severe management climate.”

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

In the midst of such ongoing regulatory reforms, the excess capacity of oil refining facilities became an issue under a decline in domestic oil product demand mainly attributable to the enhancement of the oil use reduction policy, the falling population, a low birthrate and aging population, a rapid increase in crude oil prices, and growing awareness of energy conservation during the economic recession after the Lehman Shock. While the petroleum industry is making voluntary efforts to reduce its refining capacity, it was decided that oil refiners need to hold at least a certain level of the capacity of heavy oil cracking units by the Law Concerning Sophisticated Methods of Energy Supply Structures. Consequently, each oil company is requested to cut its refining capacity through this regulatory measure by the end of Fiscal Year (FY) 2013. In some oil companies, the partial reduction in refining capacities as well as refinery closures have already been decided.

Regulatory Reform and Petroleum Industry

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, restructuring by large-scale workforce reductions in marketing and administrative functions, and the reengineering of corporate organizations.

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

Under such circumstances, PAJ developed the PAJ Oil Statistics Weekly, which gives the weekly supply statistics on crude oil and petroleum products, an accurate, prompt and precise database, to provide data on oil supply situations on a weekly basis in January 2003. Since then, data on petroleum product supply by area (East Japan and West Japan), petroleum product export, and refining capacity utilization ratios were added. PAJ continues to extend its information.
coverage and expects the establishment of a transparent oil market by providing up-to-date oil supply information which can be used to allow the full functioning of market mechanisms.

Establishment of Fair and Equal Competitive Conditions among Energy Sources

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

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

- Oil : 2,040 yen/Kiloliter (KL)
- Coal : 700 yen/ton
- LNG : 787 yen/KL on an oil calorie equivalent basis
- Import LPG: 822 yen/KL on an oil calorie equivalent basis

Furthermore, in the FY2012 Tax Reform Package, a rise in the tax rate of petroleum and coal tax, in accordance with the amount of CO2 emissions, was decided in phases from October 2012 as a tax for global warming countermeasures. The new tax rates for FY2016 will be 2,900 yen/KL for oil, 1,860 yen/KL for LNG and LPG, and 1,370 yen/KL for coal. Since the petroleum industry had been insisting on conducting a close investigation beforehand of the global warming countermeasures in the existing budget, which exceeds 1 trillion yen, it is regrettable that a tax hike merely for obtaining tax revenue was decided. As petroleum and coal tax is levied on crude oil, the oil companies are responsible for all tax collections and payments under open competition based on market mechanisms. Thus, no cost recovery system including such tax collections is provided. Essentially, taxes on oil consumption are considered to be borne by its end-consumers. The taxpaying capacity of oil companies reaches a critical limit during a downturn in domestic demand. The petroleum industry therefore seeks a political consideration for ensuring the collection of the tax increases.

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

Oil stockpiling became a very useful policy measure as a pillar for energy security after the oil crises. As for the stockpiling obligation of imported energy resources other than oil, however, only LPG has a 50-day requirement, but there is no obligation for natural gas. As it is assumed that natural gas demand will increase from now on, prompt actions regarding natural gas stockpiling are necessary from the viewpoint of maintaining a stable energy supply.

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

Movements toward Petroleum Industry Reorganization

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

However, excess refining capacity remains an industry-wide issue. Even after reorganization into four major nationwide groups, Japan’s ExxonMobil group further integrated with four affiliated companies into ExxonMobil Yugen Kaisha. Idemitsu Kosan closed its Hyogo Refinery in April 2003 and its affiliate Okinawa Sekiyu Seisei’s refinery in November 2003 to resolve its group’s facility surplus. At the same time, the company extended its business alliance with Nippon Oil to the refining function in addition to the current distribution function. Moreover, backed by soaring crude oil prices and strong demand for oil and petrochemical products in Asia, such movements as the formation of strong partnerships between oil companies in Japan and Middle Eastern oil producing countries through capital alliances, and the entry into Japan’s oil market by foreign capital companies from Brazil and China were seen around 2007. In 2008, to cope with recent high crude oil prices and fierce competition in the overall energy market, Nippon Oil merged with Kyushu Oil in October 2008.

Reorganization of Oil Companies in Japan (as of Jun 2012)

Petroleum Industry Rationalization in Production, Distribution and Sales Facilities (Example)
Furthermore, in July 2010 JX Nippon Oil & Energy was established as a result of the management integration between Nippon Oil and Japan Energy, which had concluded a wide-ranging business tie-up agreement from upstream operations to refining and distribution operations, fuel cell business, and technology development. Management efforts toward further rationalization and efficiency improvement apart from the existing four-group structure were conducted.

Then in January 2012, ExxonMobil Japan Group announced a change in its domestic capital ties in Japan so as to transform itself into TonenGeneral Group.

**Enhancement of Rationalization and Efficiency Improvement after Reorganization**

With the progress of such reorganization, each oil company made efforts to streamline all of its business segments such as their own refineries, fuel storage terminals and service stations. Consequently, Japan's total refining capacity decreased by 0.85 million barrels per day (BPD) or more than 16% during the past 12 years from 5.35 million BPD in March 2000 to 4.50 million BPD at the end of March 2012. In addition, on September 30, 2010, JX Nippon Oil & Energy announced plans to reduce its group's crude processing capacity by 400 thousand BPD versus December 2008 to 1.39 million BPD at the end of October 2010 as well as to move up by one year the schedule for an additional capacity reduction of 200 thousand BPD, which was originally planned to be completed by the end of March 2015, to the end of March 2014. Furthermore, Idemitsu Kosan announced the shutdown of the crude processing function (120 thousand BPD) of its Tokuyama Refinery in March 2014.

With the efforts towards management efficiency improvement and rationalization such as mergers and business consolidation, the total workforce of oil refiners and Motouri was reduced significantly during the past 16 years, and at the end of March 2011 it was about 20,000 employees, compared with about 36,000 employees at the end of March 1995.

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

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

Petroleum products are delivered to consumers by coastal tankers, tank trucks, railroad tankers and pipelines in Japan. A large portion of oil distribution is carried out by tank trucks and coastal tankers.

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

Meanwhile, deregulation in coastal and land transportation has been executed from the viewpoint of the industry's efficiency improvement in physical distribution. For example, in the area of land transportation, the introduction of tank trucks with a larger capacity was promoted, as trucks with a cargo capacity of 25-28 kiloliters (KL) were allowed by regulation amendments in November 1993, and “ultra-compact” tank trucks (more compact than conventional trucks but with the same 24KL cargo capacity) as well as those with a cargo capacity of 30KL were developed by further partial mitigation of the regulation and safety standards in October 2003. Besides, unloading of fuels at a service station (SS) by the tank truck (T/T) driver alone (SS staff presence is not required) was permitted from April 1999 to improve delivery efficiency on condition that safety countermeasures should be more strictly adhered to. The permission was expanded in October 2005 to include deliveries to tanks at kerosene distribution depots and to customer owned tanks.

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

**Distribution Rationalization and Efficiency Improvement due to Deregulation**

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

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

**Rapid Increase in Numbers of Self-service SS**

In April 1998, a manned self-service SS, where a qualified SS attendant could watch car drivers’ refueling operations, was introduced. Over 8,000 self-service SS are in operation. This accounted for about 22% of the total SS in FY 2010.

In Japan, self-service SS were first developed by foreign capital Motouri, with long experience in the USA and Europe, and by small and medium-sized Motouri in the early stages of introduction. Other major domestic capital Motouri actively joined the development after 2002. Retail dealers have recently been highly motivated to develop self-service SS. However, with increased keen competition among self-service SS, some of these have closed.

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

**Safety Measures at Self-service SS**

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

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

Issue of SS in Depopulated Areas
With fierce market competition due to declining petroleum fuel demand, the number of SS has been decreasing. Consequently, the diminishing number of SS in the depopulated areas has become an issue of concern. Due to closures of SS, the areas which face difficulty in obtaining supplies of fuels such as kerosene, an essential commodity in cold regions, and difficulty in obtaining supplies of fuels such as kerosene, an essential commodity in cold regions, and difficulty in obtaining supplies of fuels such as kerosene, an essential commodity in cold regions,

Responses to Environmental Issues at SS
The petroleum industry’s efforts in regard to environmental issues have focused mainly on refineries; however, there are many cases in which SS have earnestly dealt with environmental issues in recent years. Some examples are the notification of the emission quantities of harmful chemical substances such as benzene under the Pollutant Release and Transfer Register (PRTR) Law enforced from April 2002, and the world’s first nationwide supply of sulfur-free gasoline and diesel fuel (10ppm or less) from January 2006. Considering the importance of the soil and groundwater pollution issue at SS, PAJ has created the “SS Soil Environment Safety Book” for early identification and prevention of soil pollution at SS.

In addition, in response to the Fire and Disaster Management Agency’s issuance of a partial revision of the notification concerning the construction techniques of synthetic resin plumbing, etc. in August 2009, PAJ prepared its master specifications of the standard construction method for using synthetic resin plumbing and its fire-resistant connection boxes to be used underground in March 2010, as a part of the industry’s efforts towards this pollution prevention issue. PAJ promotes the dissemination of using such synthetic resin plumbing in view of its low risk of corrosion in underground piping. A partial revision of the fire regulation on the control of hazardous materials was made in June 2010 to cope with accidental oil spills from underground tanks (UGT). With the revised regulation, operators are obliged to take measures for the prevention of oil leak-

age from single-hull UGT in accordance with the number of years the UGT has been buried, the design performance, etc. Though this regulation stipulates a moratorium until the end of January 2013, the petroleum industry is making efforts to assess the reality of the situation and to advance measures for prevention of soil pollution.

Living in Harmony with Local Communities (Responses to Large-scale disasters)
From the perspective of corporate social responsibility (CSR), PAJ aims at living in harmony with local communities by ensuring as stable as possible a supply of petroleum products even in the event of a large-scale disaster. Petroleum products are considered to be flexible in supply at the time of disasters like earthquakes, because they can be delivered to SS and consumers through various means such as vessels and tank trucks from nearby refineries or oil storage terminals.

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

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

At the time of the Great East Japan Earthquake in March 2011, the petroleum industry suffered significantly from the earthquake and the subsequent tsunami. Though many of the oil terminals and refineries were damaged, the petroleum industry made concerted efforts to continue a stable supply of oil to the quake-hit areas. From late at night on the day of the quake, PAJ coordinated with the government to cope with the emergency supply requests for petroleum products from the disaster area. Motouri made joint use of their oil terminals which were not seriously damaged to supply products.

Using lessons learned at the time of this huge earth-

### Number of Service Stations at the End of Each Fiscal Year (Mar)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Self-service</th>
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<tbody>
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<td>1994</td>
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<td>25,048</td>
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</tr>
<tr>
<td>2008</td>
<td>25,424</td>
<td>13,086</td>
</tr>
<tr>
<td>2009</td>
<td>25,800</td>
<td>13,112</td>
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<tr>
<td>2010</td>
<td>26,176</td>
<td>13,138</td>
</tr>
<tr>
<td>2011</td>
<td>26,552</td>
<td>13,164</td>
</tr>
</tbody>
</table>

* Source: METI, Oil Information Center
Toward a Fundamental Reexamination of Petroleum-related Taxes

**Toward a Fundamental Reexamination of Petroleum-related Taxes**

Because oil accounts for about 40% of the primary energy supply and is the central energy source to support people’s daily lives and industrial activities, cost reduction is an important issue from the viewpoint of the national economy. Since exorbitant amounts and high rates of taxes are imposed on petroleum products in a multiple-layered and multi-stage way, such tax revenues have reached nearly 4.4 trillion yen per year (FY2012 budget).

Currently, customs duty and various taxes are imposed on crude oil and petroleum products. Specifically, customs duty is imposed on imported petroleum products and petroleum and coal tax (national) is levied on imported crude oil and petroleum products at the import stage. When refined products are delivered in the domestic market, the following indirect taxes are imposed:

- Gasoline: Gasoline tax and local road tax (national)
- Diesel Fuel: Diesel fuel transaction tax (local/prefecural)
- Jet Fuel: Aircraft fuel tax (national)
- LPG: Petroleum gas tax (national)

In addition, about 970 billion yen of general consumption tax is also levied on those petroleum products (5% of product sales revenue). Consequently, total petroleum-related taxes amount to about 5.38 trillion yen, equivalent to about 50 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.

### For Maintaining and Strengthening Oil Supply Chain

The petroleum industry is a typical equipment-based industry. Key characteristics of the oil supply chain are its length and broad range, covering all steps from acquiring petroleum resources and exploration development to importing, refining, distributing and marketing.

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

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

The Ministry of Economy, Trade and Industry (METI) issued its Petroleum Demand Outlook toward 2014 in March 2010. Assuming its demand trend in this outlook continues to 2020, the domestic petroleum product demand would decrease by 30% versus FY2010 and be almost 50% down from the peak year of 1999. Consequently, it would be more and more difficult to maintain the oil supply chain if this declining trend continues.

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

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

Taking into consideration the current level of oil demand by maintaining and promoting its usage mainly in the heating, hot-water supply and the transportation sectors, as well as the falling population and energy efficiency improvement in the future, PAJ assumes that approximately 180 million KL (down by 8% from 2010) of stable oil demand is the minimum necessary for sustaining the oil supply chain in 2020.

Accordingly, the “Oil Use Reduction Policy” that aims at diminishing oil demand should be revised at the time of reexamining the energy policy. The petroleum industry continues to play its stable supply role by asking consumers to use oil during their normal daily lives.

### Unreasonable and Unfair Petroleum-related Taxes

At the time of the introduction of the consumption taxation in April 1989, the streamlining, including abolition, of existing indirect taxes was carried out and adjusted with the existing taxes so as not to increase consumers’ overall tax burden. However, petroleum-related taxes were neither abolished nor reduced due to the content of the transport and distribution sectors. Since the late 1980s, indirect taxes have been raised in step with the national economic growth and living standards.

In April 2007, the Consumer Tax was introduced on various petroleum-related products.

**Multiple & Multi-stage Imposition of Petroleum-related Taxes (FY2012 Budget)**

<table>
<thead>
<tr>
<th>Petroleum Products</th>
<th>Import Stage</th>
<th>Product Stage</th>
<th>Consumption Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP Gas</td>
<td>19,000 yen/kl</td>
<td>2.3 billion yen</td>
<td></td>
</tr>
<tr>
<td>Gasoline</td>
<td>23,000 yen/kl</td>
<td>57 billion yen</td>
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</tr>
<tr>
<td>Diesel Fuel</td>
<td>32,100 yen/kl</td>
<td>890 billion yen</td>
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<tr>
<td>Jet Fuel</td>
<td>43,000 yen/kl</td>
<td>57 billion yen</td>
<td></td>
</tr>
<tr>
<td>Heavy Fuel</td>
<td>8,800 yen/kl</td>
<td>22 billion yen</td>
<td></td>
</tr>
<tr>
<td>others</td>
<td>9,800 yen/kl</td>
<td>22 billion yen</td>
<td></td>
</tr>
</tbody>
</table>

Total Petroleum-related Tax Approx. 4.41 trillion yen

Total Approx. 5.38 trillion yen (Crude Oil at 50 $/bbl and 80 yen/$)
to their connection with specific revenue sources for road construction. The government took unreasonable and unfair measures by simply adding consumption tax to petroleum product sales prices including the respective petroleum-related taxes, namely, a tax on tax. When the 3% rate of consumption tax was subsequently raised to 5% in 1997, no corrective actions were taken.

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

The government is aiming at raising the consumption tax to 10% from October 2015 as a part of the Comprehensive Reform of Social Security and Taxation System. If it is realized, the portion of the consumption tax levied on gasoline and other petroleum products, a so-called tax-on-tax treatment, which is worth 170 billion yen, will double. DPJ continues to work on the realization of adequate tax adjustment measures, especially the termination of such a tax-on-tax treatment, by returning to the basic principle at the time of launching the consumption tax.

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

The provisional tax rates on top of the official rates of gasoline tax and diesel fuel transaction tax had been raised under the beneficiaries-pay principle to secure revenues for road maintenance and improvement. By shifting such tax revenue into general revenue in April 2009, there was left no foundation for imposing provisional taxes. Since the Democratic Party of Japan (DPJ) became the ruling party by setting forth the abolition of the provisional tax rates of gasoline, etc., the DPJ abolished the provisional tax.

rate system itself. However after that, the DPJ stated that the current provisional tax level will continue to be maintained, with the reason being the prevention of revenue shortages. As a consequence, the situation of forcing taxpayers, i.e., automobile users, to bear the higher tax burden remains.

Considering the following two points, convincing explanations to automobile users are requested: (1) Drivers of gasoline and diesel fuel vehicles have to bear more taxes for general revenue. (2) There is a gap in the tax burden between urban areas and rural areas where gasoline and diesel fuel consumption is large. Regarding recent automobile fuels, in addition to CNG vehicles fueled by natural gas, electric vehicles (EV) are entering their commercialization stage. Furthermore, it is anticipated that fuel cell vehicles using hydrogen will come into practical use in the future. However, automobile fuel taxes like gasoline tax and diesel fuel transaction tax are not imposed on those fuels/energies for CNG vehicles and EV. This fact completely ignores any impartiality among fuels/energies for CNG vehicles and EV.

The petroleum industry has been paying more than five trillion yen of taxes each year, while fulfilling its responsibility for stable supply. In the government’s deliberation on FY2012 tax reform, the following view is presented: “The basic premise for lowering the tax burden levied on an automobile itself is to ensure a stable revenue source such as by increasing tax rates of fuel/energy-related taxes beforehand.” The petrol...
The global warming issue is a key issue for all humanity to be tackled for a long period of time on a worldwide basis. The petroleum industry in Japan, as an advanced environmental industry, has been taking positive actions such as participating in Nippon Keidanren’s “Action Plans for a Low-Carbon Society” and launching supply of biomass fuels.

The tax scheme for FY2012 is basically the same as the previous year’s one. Specifically, a new scheme is to add corresponding tax rates to the existing petroleum and coal tax in accordance with the amount of CO2 emissions by setting up a special treatment provision for imposing a tax for global warming countermeasures. It was decided that petroleum and coal tax, currently ¥2,040/KL, will be raised in phases to a final level of ¥2,800/KL in April 2016.

PAJ had been persistent in its opposition to choosing the easy way to introduce new taxation on global warming countermeasures from the viewpoint of a burden on the public. It is necessary to gain public understanding and consent through broad-ranging discussion on overall policy measures such as the specific plans for achieving a greenhouse gas (GHG) reduction target. It is, however, very regrettable that global warming countermeasure tax will be implemented without such discussion.

For obtaining understanding and consent of the taxpayers, i.e., energy consumers, global warming countermeasure tax should be a specific purpose tax solely for global warming countermeasures. It should not be prodigally spent tax revenue for forest preservation or local government budgets under the name of environmental countermeasures.

Petroleum and coal tax is levied on crude oil, consumers cannot recognize their tax burden directly, and all tax collection and payments are solely the responsibility of oil companies. The petroleum industry, under complete open competition, is concerned about a greater burden on oil companies due to global warming countermeasure tax, because there is a possibility of not being able to pass this tax on to consumers.
The petroleum industry continues to be requested to supply environmentally-friendly petroleum products which mitigate global warming as well as meet environmental regulations in a stable and inexpensive manner.

Though the petroleum industry faces difficult business conditions, it is essential for the industry to deal with securing stable oil supply and making investments in facilities as well as in R&D to respond to environmental requirements.

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

The recent earnings structure of the petroleum industry, however, is in an extremely severe situation, even in comparison with other industries. Under a declining trend of domestic petroleum product demand on a medium and long term basis, the main factor behind the low performance is thought attributable to the difficulty in passing the higher cost, leading to decrease in the consumer through higher product sales prices as well as in the petrochemical market.

As for the earnings of the petroleum product segment, if an oil company uses the gross average inventory valuation method for its inventory valuation, the apparent profits or losses are booked as a consequence due to the “inventory valuation impact” by the fluctuation of crude oil prices.

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

It is essential from now on for each oil company to properly assess the changes in the business environment and take further rigorous measures. Though companies may be forced to reexamine investments in facilities and R&D which are necessary for business execution, it is necessary for each company to make utmost efforts to make a more efficient and stronger corporate structure by taking care of all the above-mentioned measures such as exporting petroleum products, reinforcing their oil exploration business, and investing in new businesses to strengthen their management base. In recent years, various business efforts have been made, such as the improvement in the supply and demand situation through reformulating the wholesale pricing scheme to properly reflect crude oil price fluctuations and the reduction of excess facilities.
Thorough Safety Measures

Appropriate Safety and Disaster-Prevention Measures

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

On the hardware side, all possible safety measures are taken into consideration in facility construction, from a safety review on construction materials in the design stage to the management of construction work.

Facility layouts are planned so that safe distances are kept between the petroleum processing and storage sites and the nearby residential areas, and fire-breaks are also installed between all facilities. Each plant facility and storage tank is also designed to withstand massive earthquakes.

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

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

Disaster Prevention against Longer-Cycle Seismic/Vibration

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

Maintenance of Mobile Mutual Support Systems

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

Efforts to Develop New Technological Innovations

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

1. Introduction of Large-capacity Extinguishing Foam Cannon System

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

2. Establishment of Facility Maintenance Standards

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

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

3. Introducing New Inspection Technology

Improving inspection technology is extremely important to maintain facility operations safely. However, new inspection technologies cannot be employed based on facility staff’s own judgment since the inspection methods are specified by the existing Fire Defense Law and High Pressure Gas Safety Law. PAJ requests that the Fire and Disaster Management Agency legislature 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. The domestic Wakkanai sub-base was added in July 2010 in line with the start-up of crude loading from Sakhalin II Project site.

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

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

Cases Involving OSR Equipment Lending

As of April 2011, PAJ had lent out OSR equipment 26 times (13 times for domestic spills) since the establishment of the first stockpile base in November 1993.

A substantial quantity of large-scale oil booms, skimmers, temporary storage tanks, etc. were lent out at the request of oil owners and/or other parties concerned in such major lending cases as a tanker standing incident off Yeochon in the Republic of Korea in July 1995, a spill incident from a Russian-flagged tanker in Japanese territorial waters off Shimane Prefecture in January 1997, a tanker collision incident in the Singapore Strait in October 1997, the submergence of a large-scale barge in the Arabian Gulf in January 1998, a tanker standing incident in the Singapore Strait in October 2000, and a tanker collision incident in May 2010. Especially in the incident of the Russian tanker Nakhdouka, 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 disaster response drills conducted by local Coast Guard headquarters or disaster response cooperatives in the areas where the domestic stockpile bases are located, but also conducts periodic training courses in the bases for OSR staff of PAJ member companies and their subsidiaries nearby to familiarize staff with the handling of OSR equipment. PAJ also gives training to the stockpile base staff to train experts to be on-scene commanders by dispatching them to overseas institutions specializing in oil spill response. 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 Spill 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 spills in a spill incident at sea. In particular, a synthetic aperture radar (SAR) carried by a satellite is a promising tool because it works without being influenced by the weather. However, oil slick detection by SAR data is not in practical use yet as it is difficult to detect a slick when the surface of the sea is too rough or too smooth. PAJ applied a new analytical processing method for oil slick recognition that uses SAR data, and has made progress toward technology that would increase the probability of recognizing a slick even in such extreme sea conditions.

Hosting of International Oil Spill Conferences

PAJ invites oil spill specialists from Japan and abroad to its international oil spill conferences held every year (14 symposia and 2 workshops were held between 1990 and 2011). The purposes are to exchange information among participants about responses to major oil spill incidents, recent movements of international compensation systems, and technology development regarding oil spills. Since the disaster in the Gulf of Mexico, several accidents occurred inland and overseas, such as in the Bohai Sea and New Zealand offshore. However, the number of major incidents is gradually decreasing owing to the efforts of the parties concerned and international cooperation. In 2012, PAJ will hold its international symposium with the main topic of “Preparation for a Major Oil Spill Incident” to further enhance the preparation for oil spill incidents based on the experience learned from the Great East Japan Earthquake in March 2011. Various parties from the US and the UK concerned about oil spills are invited to the symposium.

PAJ Oil Spill Response (OSR) Equipment Stockpiles Japan & Overseas Bases

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PAJ Oil Spill Response (OSR) Equipment Stockpiles (as of Apr 2012)

<table>
<thead>
<tr>
<th>Multi Equipment</th>
<th>Name</th>
<th>Domestic</th>
<th>Overseas</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skimmer</td>
<td>Solid</td>
<td>73</td>
<td>20</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>Inflatable</td>
<td>5,093</td>
<td>1,015</td>
<td>6,108</td>
</tr>
<tr>
<td>Beach Cleaner</td>
<td>No. of Unit Capacity(ton)</td>
<td>36</td>
<td>10</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>Capacity(m3)</td>
<td>400</td>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>Recovered Oil Storage</td>
<td>No. of Unit Capacity(ton)</td>
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<td>0</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Capacity(m3)</td>
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<tr>
<td>Portable Tank</td>
<td>No. of Unit Capacity(ton)</td>
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<td>40</td>
<td>262</td>
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<td></td>
<td>Capacity(m3)</td>
<td>1,984</td>
<td>360</td>
<td>2,344</td>
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PAJ OSR Equipment Stockpiles Japan & Overseas Bases

Domestic Bases

Overseas Bases

<table>
<thead>
<tr>
<th>Domestic Base</th>
<th>Tokyo Bay</th>
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</thead>
<tbody>
<tr>
<td>#1</td>
<td></td>
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<tr>
<td>#2</td>
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<td></td>
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<table>
<thead>
<tr>
<th>Overseas Base</th>
<th>#1 Abu Dhabi</th>
</tr>
</thead>
<tbody>
<tr>
<td>#2</td>
<td></td>
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<td>#3</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td></td>
</tr>
</tbody>
</table>

PAJ Oil Spill Response (OSR) Website

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

http://www.pcs.gr.jp
Environmental Measures in the Oil Refining Sector

Various Environmental Measures

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

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

Air Pollution Control Measures

Sulfur Oxide Reduction Measures

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

Nitrogen Oxide Reduction Measures

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

Soot and Dust Reduction Measures

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

Volatile Organic Compounds Reduction Measures

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

PAJ has been making efforts to control VOC emissions under its Voluntary Action Plan, which set a target of a 30% reduction in 2010 versus the base year of 2000, and is confirming the results periodically. The reduction of emissions in FY2010 was 31% versus FY2000, and the reduction target was achieved.

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 mission. Consequently, the Air Pollution Control Law was amended, effective April 1997, to include benzene in the list of hazardous air pollutants, even though it is only emitted in small quantities.

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

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

*PRTR: Pollutant Release and Transfer Register

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

Conservation of Water Quality

Though a large quantity of heat-exchanging water is used at refineries, the water does not come into contact with oils in order to prevent water contamination. Industrial water is recycled after it is processed with oil separators to reduce the net quantity of effluents from the refineries. In the case where seawater is used for cooling, it is strictly monitored so there is no chance of polluting the environment. Wastewater from refining processes is treated first by an oil separator to recover oil contents, then goes through an advanced treatment method using chemical coaguants, activated sludge and activated charcoal. Then it is collected in a guard basin, a pond located near the final discharge point, where remaining contaminants can settle out to ensure the water’s cleanliness before its release from refinery sites.

Noise Reduction

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

Industrial Waste

Various types of industrial waste are produced at refineries, namely waste oils, sludge, spent acid and alkali, and dust captured by electrostatic collectors. To minimize industrial waste disposal volumes, each oil company reprocesses waste oils, uses sludge and dust as raw materials for cement production, and produces caustic soda from spent alkali to minimize industrial waste volumes. The reduction in industrial waste was 3,000 tons in FY2010, a 97.3% 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.
Quality Improvement in Automotive Fuels

Improvement in Gasoline and Diesel Fuel Quality

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

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

Complying with a new standard for the emission of hazardous organic compounds, the petroleum industry reduced the content of benzene in gasoline to 1% or less from January 2000. Airborne hydrocarbons are considered to be one of the main causes of photochemical smog in summer. To reduce hydrocarbon emissions from gasoline in the atmosphere, the petroleum industry voluntarily lowered the maximum vapor pressure standard for summer season gasoline from 2001, and reduced it to 65 kPa in 2005.

Low Sulfur Kerosene

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

Fuel Quality Control Law

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

At first, the compulsory standards were specified on 8 items for gasoline quality, and on 3 items for both diesel fuel and kerosene.

The Fuel Quality Control Law – Compulsory Standard (as of Apr 2012)

- **Gasoline**
  - **Item**: Lead
    - **Specification**: Non-detectable
  - **Item**: Sulfur content
    - **Specification**: 0.001 mass% max.
  - **Item**: MTBE
    - **Specification**: 3000 ppm max.
  - **Item**: Benzene
    - **Specification**: 1 vol% max.
  - **Item**: Kerosene
    - **Specification**: 4 vol% max.
  - **Item**: Methanol
    - **Specification**: Non-detectable
  - **Item**: Washed gum
    - **Specification**: 5 mg/100 ml max.
  - **Item**: Oxygen content
    - **Specification**: 1.3 mass% max.
  - **Item**: Ethanol
    - **Specification**: 2.0 vol% max.

- **Diesel Fuel**
  - **Item**: Catane index
    - **Specification**: 45 min.
  - **Item**: Sulfur content
    - **Specification**: 0.001 mass% max.
  - **Item**: Distillation: 70% vol.
    - **Specification**: 210°C max.
  - **Item**: Triglyceride
    - **Specification**: 0.1 mass% max.

- **Kerosene**
  - **Item**: Sulfur content
    - **Specification**: 0.000 mass% max.
  - **Item**: Flash point
    - **Specification**: 40°C min.
  - **Item**: Color
    - **Specification**: Light yellow +25 min.

[1] For an automobile that complies with the new standard, the fuel specification 2003 in some areas, the standard fuel specification 2003 is non-detectable.

[2] Aromatic content: 0.03 mass% max. and 0.04 vol% max. in some areas. 0.03 mass% max. and 0.04 vol% max. in some areas.


diesel fuel and kerosene quality. The Fuel Quality Control Act has been amended since then to reflect the national concern regarding further quality improvement.

Through the progress of deregulation, alcohol-blended automotive fuel was introduced onto the market by product importers. The quality and performance of the alcohol-blended fuel were not covered by the scope of the Fuel Quality Control Act. Consequently, several fires involving vehicles using the alcohol-blended fuel were reported. To ensure consumers’ safety, METI banned the sale of such alcohol-blended fuel effective August 2003 and amended the Fuel Quality Control Act to include the upper limit of alcohol-to-gasoline blending as a maximum of 3% of volume for ethanol and 1.3 % in weight for oxygenate.

In view of verification work on biofuels recently conducted in various places, effective March 2007, mandatory standards for FAME (Fatty Acid Methyl Ester), Tri-glyceride and four other materials were added to diesel fuel quality requirements in order to allow blending of bio-diesel components in diesel fuel. The additional requirements include an upper limit for blending of bio-diesel components in diesel fuel. The petroleum industry cooperated with the engine manufacturers to achieve the emission standard smoothly by reducing the fuel sulfur content of diesel fuel from 5,000 ppm to 2,000 ppm in 1992 and further to 500 ppm in October 1997. Over this period, oil refiners invested 200 billion yen to install new facilities for high-performance gasoil desulfurization.

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

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

In view of the urgent need for reduction of diesel emissions accelerated by the scheduled stricter regulation, the petroleum industry announced its partial supply of low sulfur (50 ppm max.) diesel fuel from October 2003 to meet the TGM regulation. Since then, several local governments, i.e., Osaka and Aichi, as well as large commercial diesel fuel users such as the bus and truck industries, requested an earlier introduction of low sulfur diesel fuel.

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

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

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

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

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).

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

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

The 17th Conference of the Parties (COP17) held at the end of 2011 attracted a great deal of attention as it was held to establish a new global GHG reduction framework for after 2013 when the first commitment period of the Kyoto Protocol terminated. As the Kyoto Protocol covers only a quarter of global emission levels, Japan, together with Russia and Canada, stated that they have no intention to participate in the second commitment period. This was reflected in the COP outcome document.

Prior to adopting the Kyoto Protocol, each type of Japanese business and enterprise set its own GHG reduction target, with the coordination of Keidanren (the Japan Business Federation). These targets were incorporated in “Keidanren’s Voluntary Action Plan”, and Japanese industry is striving to cope with the global warming issue as a social commitment. The industry’s proactive measures are accredited in the government’s “Kyoto Protocol Target Achievement Plan” as a central role of domestic measures until the end of FY2012.

Based on the experience of the voluntary action plan, Japanese industry, including the petroleum industry, prepared a “Low-Carbon Society Action Plan” in December 2009 to succeed Keidanren’s ongoing Action Plan, and announced to promote the policy of achieving a low-carbon society that harmonized the environment with the economy.

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

**Global Trends Regarding the Climate Change Issue**

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**Domestic Trends Regarding the Climate Change Issue**

A flash report on FY2010 GHG emissions shows a 10.3% decrease versus the 1990 level. Although a 4.4% increase was recorded versus FY2009 due to the recovery from an economic downturn and relatively hot summer followed by a cold winter, favorable forest-sink measures and Kyoto mechanism credits more than offset such an increase. The Kyoto Protocol reduction target of 6% versus the 1990 level was exceeded for three consecutive years from FY2008.

The industrial sector achieved a reduction of more than 10% versus the FY1990 level, However, the business/other sector as well as the industrial sector increased more than 30% versus the same period.

**Trends of CO2 Emission**

A flash report on FY2010 GHG emissions shows a 10.3% decrease versus the 1990 level. Although a 4.4% increase was recorded versus FY2009 due to the recovery from an economic downturn and relatively hot summer followed by a cold winter, favorable forest-sink measures and Kyoto mechanism credits more than offset such an increase. The Kyoto Protocol reduction target of 6% versus the 1990 level was exceeded for three consecutive years from FY2008.

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**Industry’s Movement toward Post-Kyoto Protocol**

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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 Efforts

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

PAJ formulated the “Voluntary Action Plan for Global Environmental Conservation by the Petroleum Industry” in February 1997 to respond to Nippon Keidanren’s initiative, and set a target to be achieved by FY2012 for the improvement of unit energy consumption at oil refineries. Especially the unit energy consumption at oil refineries in FY2010 was improved by 18% from FY1990 through the use of sophisticated heat recovery units and efficiency improvement and optimization of refining facilities. In October 2007, the petroleum industry’s target was revised upward to a 13% improvement from FY1990, incorporating the promotion of computer control and optimal operation, (2) expanding the range of measures which include (1) sophisticated energy conservation project conducted by New Energy and Industrial Technology Development Organization (NEDO), and introducing advanced energy conservation technology to refineries.

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

As a result of these efforts, Japanese refineries have many oil refineries are awarded for their excellence.

#### Refineries’ Energy Conservation Measures

Energy conservation at refineries consists of a wide range of measures which include (1) sophisticated operation control through innovative technology for process control and optimal operation, (2) expanding common use of heat among facilities and adding waste heat recovery units, (3) operating facility maintenance efficiently, and (4) adopting high-efficiency facilities and catalysts. These measures are being evaluated at the “National Excellent Energy Conservation Examples Convention (until FY2008)” and “Energy Saving Grand Prix (organization category)” carried out by the Energy Conservation Center of Japan, and useful global warming countermeasure. The petroleum industry launched the nationwide supply of sulfur-free fuels in January 2005 well in advance of government regulation.

**Promotion of Technology Development and International Cooperation**

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

### Energy Saving Projects at Refineries

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<th>Energy Saving Measures</th>
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<th>Utility plants</th>
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<td>Installation of various heat-exchangers</td>
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<td>Flare gas recovery</td>
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<td>Reducing furnance air flow rate</td>
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<td>Installation of process turbine (recovery of pressure energy)</td>
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<tr>
<th>Energy Saving Technologies Introduced</th>
<th>Energy Saving Technologies Included in NEDO’s Support Projects on Energy Use Utilization</th>
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<tr>
<td>1 Introduce variable-speed gas compressor</td>
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<tr>
<td>2 Recover waste-heat from steam-traps by capturing effluent steam</td>
<td>2 Introduce variable-speed gas compressor</td>
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<tr>
<td>3 Reduce furnance fuel consumption by replacing regular trays with high efficiency trays</td>
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<tr>
<td>4 Install desuperheater to recover steam</td>
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<tr>
<td>5 Install waste-heat boiler</td>
<td>5 Install waste-heat boiler</td>
</tr>
<tr>
<td>6 Install propylene fractionation process unit of high energy-efficiency type incorporating industrial heat-pump system</td>
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</tr>
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#### 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.

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

The petroleum industry’s commitment to a low-carbon society - Coexistence of Stable Supply and Global Warming Countermeasure through Sophisticated Use of Oil -

**Basic Policy**

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**Specific Approach to FY2020**

- **Manufacturing Stage of Petroleum Products (Refinery)**
  - Maintain and improve the world’s highest level of energy efficiency by the introduction of state-of-the-art technology and cooperation with nearby factories, considering the demands of various countries and regions.
  - Aim to achieve energy saving of 530 thousand KL (crude oil equivalent) per year on an accumulated average from FY2010 to FY2020.
  - Introduce biomass fuel for which stable and economical procurement is possible as the effect on greenhouse gas reduction using LCA, competition with food, supply stability, and ecosystem consideration are being verified.
  - Promote the use of ETBE blended biomass fuel while ensuring sustainability and stable supply in cooperation with the government, aiming at a steady introduction to meet the target amount of 500 thousand KL (crude oil equivalent) in FY2017 set by the Law Concerning Sophisticated Methods of Energy Supply Structures.
  - Corresponds to approx. 1.4 million tons of CO2 per year.

- **Consumption Stage of Oil**
  - **Renewable Energy (Biomass Fuel)**
    - Introduce biomass fuel for which stable and economical procurement is possible as the effect on greenhouse gas reduction using LCA, competition with food, supply stability, and ecosystem consideration are being verified.
  - **Clean Diesel Powered Vehicle**
    - Use the knowledge and the experience of the petroleum industry that achieves the world’s highest level of energy efficiency for personal and technical exchanges with developing countries.
  - **Oil-Based Fuel Cell**
    - Use the knowledge and the experience of the petroleum industry that achieves the world’s highest level of energy efficiency for personal and technical exchanges with developing countries.

- **Transportation and Supply Stage of Petroleum Products**
  - Further efficiency improvement in distribution system (joint use of storage points, mutual accommodation of products, etc.)
  - LED lighting at service stations, solar power generation, etc.

- **Development of Innovative Technologies (2030 - 2050)**
  - Heavy oil cracking using supercritical water
  - Membrane separation and adsorption of hydrocarbons
  - Carbon dioxide capture and storage (CCS)

- **International Cooperation**
  - Use the knowledge and the experience of the petroleum industry that achieves the world’s highest level of energy efficiency for personal and technical exchanges with developing countries.

**Opportunity for FY2020**

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

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

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

For proper dissemination of bio-ETBE gasoline, PAJ issued display guidelines, such as posting of bio-ETBE blending ratio. This provides the handling of the name and the logo of “Bio-Gasoline” when bio-ETBE blended gasoline is sold in the service stations of PAJ member companies in an effort to establish a marketing environment where consumers are assured of product quality. As of February 2012, bio-gasoline was being sold at about 2,550 service stations, and it is likely to meet 210,000KL of crude equivalent target volume.

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

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

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

Moreover, if bio-ethanol is blended directly with gasoline, 1 a small quantity of water contamination would result in the phase separation of gasoline and ethanol to increase the possibility of fuel quality change (a lowered octane number), 2 the safety of consumers might be threatened by corrosion and deterioration of distribution/marketing facilities, and 3 as the direct blending method increases gasoline vapor pressure (an indicator for gasoline volatility), it would increase the emission of poisonous materials such as the hydrocarbons that are considered to cause photochemical smog. Although the advantage of bio-ethanol regarding CO₂ reduction measures tends to be emphasized, it should not be forgotten to discuss pollution abatement measures in urban areas.

On the other hand, the bio-ETBE method which is promoted by PAJ would never cause such problems. As bio-ETBE is generally blended with gasoline at the refinery (in the production process), the evasion of tax and the circulation of inferior quality gasoline would be prevented. Therefore, the oil industry considers the refinery blending of bio-ETBE be the most appropriate method to cope with those concerns, and recommends this bio-ETBE should be used for automotive fuel.

* The Basic Act on Energy Policy is to be reviewed in FY2012, and future introduction of biomass fuel is also likely to be reviewed.

### Sustainability Standards for Biomass Fuel

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

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

“The Study Group on Sustainability Standards for the Introduction of Biofuel” was then organized in July 2009 to develop Japan’s own standards and operating procedures. The interim report issued in March 2010 is summarized as follows: ① As one of the sustainability standards for biomass fuel, the life cycle assessment (LCA) of the GHG reduction effect should be more than 50% of the GHG emission by gasoline. ② A high rate of self-sufficiency is necessary for a stable supply of biomass fuel as the current supply is limited to imported products from Brazil and to a small part of domestic products. ③ All related ministries should have a mutual view on biomass fuel’s competitive nature with food and examine the root cause analysis and the action plan. The sustainability standard of biomass fuel, which is to be introduced based on the Law Concerning Sophisticated Methods of Energy Supply Structures, will follow the directionality that had been shown by the interim report.

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

Efficient Use of Oil

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

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

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

**Characteristics of IGCC**

<table>
<thead>
<tr>
<th>IGCC</th>
<th>BTG†1 (Conventional Thermal Power Generation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generating Efficiency</td>
<td>46%</td>
</tr>
<tr>
<td>CO₂ Emission</td>
<td>519g-CO₂/kWh</td>
</tr>
<tr>
<td>Emission Gas Level†2</td>
<td>○</td>
</tr>
</tbody>
</table>

**IGCC: Integrated Gasification Combined Cycle**

Air Nitrogen

Asphalt Oxygen

Steam

Sythetic Gas

Gas Turbine

Gas Turbine

Waste Heat Boiler

**Gas Level**

- †1 BTG: Boiler Turbine Generator
- †2 Comparison based on NOx and SOx emissions

**Biofuel Marketing Schedule**

Bio-Gasoline Sales Introduction of Bio-ETBE

- April 2007 - March 2009 Test Marketing
- FY2007 50 service stations
- FY2008 100 service stations

FY2009 Expanded Marketing

- FY2009 Full Marketing
- [Bio-ETBE 0.2 million kl]
- 0.21 million kl of Crude Oil Equivalents [Bio-ETBE 0.84 million kl]

FY2010 Full Marketing

- [Bio-ETBE 0.2 million kl]

Maintenance of Domestic Infrastructure

- Import Terminal Maintenance Summer 2008: Contract
- Ocean Tanker Procurement Summer 2008: Contract
- Coastal Tanker Procurement Winter 2008: Contract
- July 2008 Memorandum Conclusion in Brazil, Purchase Contract with US company
- September 2008 Start to use
- September 2009 Start to ship
- [Bio-ETBE 0.2 million kl]

Bio-ETBE Supply

- [Bio-ETBE 0.2 million kl]

*Supported by Governmental fund (Verification Work on Distribution System) for 2 years from FY2007
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 (95%) low-nitrogen oxide (NOx) boiler fueled by Fuel Oil A, which attained NOx emission of less than 70 ppm, far below the Ministry of Environment’s “NOx Emission Guideline for Small-scale Burning Appliances”.

Lower NOx Emission Attained

High-Efficiency Water Heater, “Eco-Feel”

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

Listed below are the advantages of “Eco-Feel”

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

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

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

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

Kerosene is Friendly to Environment and Household Economy

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

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

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

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

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

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

With their high energy efficiency and low environmental burden, fuel cells are expected to become a new form of energy supply for household and automotive use. To promote the future popularization of fuel cells, the government is taking initiatives in technology development and field demonstration. The petroleum industry is also advancing its efforts to develop and spread the use of petroleum-based fuel cells as a new energy system.

Stationary Fuel Cell System

A stationary fuel cell system generates electricity, using hydrogen produced from petroleum fuels like kerosene and LPG, and oxygen in the air. The heat given off from power generation can be used for hot-water supply in kitchens and bathrooms as well as for the heat source of a floor heating system. Its major features are: (1) good energy efficiency, (2) eco-friendliness and (3) low utility costs.

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

Petroleum Industry’s Efforts

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

For Popularization of Fuel Cells

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

Hydrogen Supply to Fuel Cell Vehicles

The petroleum industry is increasing its efforts in developing hydrogen production technologies and in the field demonstration of hydrogen filling stations for fuel cell vehicles.

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Enhancement of Oil-Based Heating/Cooling Systems

In line with the “Oil-based System Promotion Policy for the 21st Century” which started in February 2001, PAJ is disseminating the advantages of oil-based heating/cooling systems to both industrial and household sectors. To support this, PITRI evaluated the performance and the comfort of “Hotto-Sumairu” (an oil based central heating and hot-water supply system) and the positive results are being effectively used for this system’s promotion.

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

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

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

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

Situation of Quake Damage to the Petroleum Facilities

The Great East Japan Earthquake, which struck at 2:46 p.m. on March 11, 2011, caused serious damage over a wide area of eastern Japan. Petroleum-related facilities were paralyzed, a stable supply of petroleum products could not be secured for some time in parts of the region.

On the day after the quake, March 12, the operating situation of petroleum facilities was as follows: Among nine refineries located in the Kanto and Tohoku region, six refineries halted production; two out of four refineries in Chiba Prefecture, two out of three in Kanagawa Prefecture, and one each in the city of Sendai and Kashiwa. A refining capacity of 1.4 million barrels per day was forced to stop operation; this accounts for around 30% of total refining capacity in Japan. Three refineries in Tokyo Bay restarted operation within two weeks. However, Sendai, Kashiwa and one of the Chiba refineries were severely damaged and the overall restoration required a long time. As for oil terminals, Hachinohe, Kamai-shi, Kesennuma, Shiogama, Onahama and Hitachi on the Pacific coast, and inland oil terminals in Morioka and Koriyama suffered quake and tsunami damage. Together with the damage to the refineries, normal product shipping operations in eastern Japan area were paralyzed.

In addition, nearly 150 tank trucks were lost in the tsunami area and western Japan, and product supply to the disaster area improved significantly. During this period, the Shiogama oil terminal was utilized jointly by rival oil companies. To make up for the production of refineries which were forced to shut down, the eastern Japanese refineries were run at a 95% operating ratio, nearly their full capacity. At the same time, oil companies stopped the export of petroleum products. The petroleum industry made maximum efforts to restore the supply system. Ten days after the quake, product shipment was restarted in the Tokyo metropolitan area and also from a part of the eastern Pacific key oil terminals, namely Shiogama and Hachinohe. By early April, the ordinary supply system was considered to be almost restored in the disaster area.

However, even in mid-April, there were places without a service station within a 10km zone, a so-called ‘service station blank zone’, in Ooouchi-machi and Rikuzen-takata-shi of Iwate Prefecture and Minami-sanriku-cho of Miyagi Prefecture. At Rikuzen-takata, a temporary service station was constructed utilizing ISO tank containers, and the Self-Defense Force Service Station (SDF) stood together with the local authorities operated hand-driven and foot-driven filling stands.

Petroleum Industry’s Response for Securing Supply

The petroleum industry made every possible response across the full range of each company’s functions to recover a stable supply of petroleum products such as gasoline and kerosene, in spite of having suffered severe damage to petroleum facilities. Firstly, the industry started delivery by tank truck from the Sea of Japan coast prefectures such as Niigata, Yamagata, Akita and Aomori where the quake damage was minimal or nonexistent. However, the longer hauling distance, roads unfamiliar to drivers and interrupted or closed sections of main roads, made such transportation full of difficulty. There was a case where 30 hours of driving was needed to travel from Niigata to Sendai.

Tank truck shipments from the Tokyo metropolitan area were also carried out. The fuel for emergency transportation was delivered via the Tohoku and Joban Expressways to evacuation centers, hospitals and public institutions. In order to strengthen the transportation capacity to the disaster area, about 300 tank trucks were shifted from the Tokyo metropolitan area and western Japan to the Tohoku region.

In addition, special freight car operations were conducted after day by day by Japan Freight Railway Company from Yokohama to Koriyama via Niigata, and to Morioka via Niigata and Aomori by making a detour around the Tohoku Main Line.

The Shiogama oil terminal, which is a large-scale facility where the quake damage was relatively slight, restarted shipping its remaining products on March 17, and started receiving products from coastal tankers on March 21. The case of coastal tankers included the transfer of a large quantity of products from refineries in Hakodate, the Tokyo metropolitan area and western Japan, and product supply to the disaster area improved significantly. During this period, the Shiogama oil terminal was utilized jointly by rival oil companies.

Petroleum Association of Japan’s Action

Immediately after the disaster, the Petroleum Association of Japan (PAJ) established emergency response headquarters, headed by Akihiko Tenbo, the PAJ president. On the next day, PAJ set up an operations room to cope with urgent supply requests to individual supply points based on the requests from the Prime Minister’s Office and the Ministry of Economy, Trade and Industry. The room responded to about 1,400 requests such as supply of fuel for emergency vehicles (firefighting, ambulance, police and SDF), for emergency power generation (hospitals and nuclear power plants) and for heating (evacuation centers and schools).

In this earthquake disaster, SDF’s rescue operations were in the spotlight. PAJ cooperated with SDF by supplying about 700 drums of fuel. In addition, PAJ also contributed about 2,000 drums of fuel to three prefectures which suffered the most serious damage.

The Great East Japan Earthquake damaged the electrical grid and the city gas lines. However, after the supply from the centralized “system energy” was stopped, petroleum immediately showed its ability to cope with the emergency as a “distributed energy” that was easy to carry and store. Oil served as the last resort to support the lives of the people by supplying heating fuel to evacuation centers and fueling emergency vehicles for residents near the nuclear plant. In this regard, the importance of oil was highlighted again.

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Overview of the Japanese Petroleum Industry [Oil Refiners and Primary Oil Distributors (Motouri)]

- **Number of Oil Companies**: 16 companies (as of Aug 2012)
- **Total Capital**: 563.0 billion yen (as of Mar 2012)
- **Annual Sales Revenue**: 25.554 trillion yen (FY2011)
- **Total Number of Employees**: Approx. 19,500 (as of the end of FY2011)
- **Crude & Product Import Volume**: 246.6 million kl (FY2011)
- **Crude & Product Import Amount**: 192.1 billion dollar (FY2011)
- **Oil Dependence on Imports**: 99.6% (FY2011)

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.): 0.010 wt%
  - Octane (min.): Premium 96; Regular 89
  - Benzene (max.): 1 vol%
  - Ethanol (max.): 3 vol%
  - Benzene (max.): 1 vol%

- **Kerosene (JIS K2203)**
  - Sulfur content (max.)
    - Smoke point (min.)
    - 23 mm (in winter season; 21 mm)

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

- **Fuel Oil A**
  - 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**
  - Kinematic viscosity (max.): 60 mm²/s (50°C)
  - Pour point (max.): 10°C
  - Sulfur content (max.): 3.0 wt%

- **Fuel Oil C**
  - Kinematic viscosity (max.): 250 mm²/s (50°C)
  - Pour point (max.): -7.5°C
  - Sulfur content (max.):
    - No.1: 0.3 wt%
    - No.2: 0.3 wt%

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

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

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

Appendix