Oil and Gas Supply, Processing and Refining in the ASEAN Region
The EC-ASEAN Energy Facility

The EC-ASEAN Energy Facility (EAEF) is a programme of cooperation between the European Commission (EC) and the Association of Southeast Asian Nations (ASEAN) to facilitate partnerships between ASEAN and European public and/or non-profit organisations in developing specific joint projects in the energy sector. The objectives of the programme are: to increase the security of energy supply of ASEAN countries and indirectly of Europe; to increase economic cooperation between countries of the European Union and ASEAN; to improve the environment of local and global levels; and to facilitate the implementation of the ASEAN Plan of Action for Energy Cooperation 1999-2004.

The projects can be implemented within four facilities (see Box 1 for detailed information): increasing market awareness; adapting institutional framework; conduction feasibility studies; and implementing demonstration projects. In conformity with the ASEAN Plan of Action for Energy Cooperation 1999-2004, the programme will focus on electricity grid; gas pipeline interconnection; clean coal technologies; energy efficiency; and renewable energy.

The target groups for the facilities are public and/or non-profit organisations in the member countries of EU and ASEAN. A group of at least three partners, two from countries of the EU and one from the countries of ASEAN, must formulate a project proposal.

The project proposals have to be submitted to the Project Management Unit (PMU) in Jakarta not later than 15 October 2002. Then a group of independent experts will constitute the Selecting Committee which will assist the PMU in objectively reviewing each project and recommending such for subsequent approval of the Project Steering Committee (PSC). A project that is approved by the PSC will then be endorsed by the EC for financial and administrative approval and a contract for each project will be signed between the EC and the project component. There will be two to three new calls for proposals during the period 2003-2005 and it is expected that about 50 to 60 energy projects will be accommodated by the facility.

The total cost of the programme is estimated to be EUR 31,510 million including the individual project partner’s contributions estimated to the amount of EUR 13 million. The commitment of the European Commission is fixed at EUR 18 million as grant and the ASEAN Centre for Energy (ACE) will make in-kind contributions to the Programme amounting to EUR 510,000. For the Call for Proposals in 2002 about EUR 6.5 million will be available.

This programme will be complementary to the EC-ASEAN COGEN III programme, which has been described in the Fourth Quarter 2001 issue of this Bulletin.

The ASEAN Centre for Energy in Jakarta hosts the PMU, which will manage the overall implementation and will serve as the Secretariat of the Programme Steering Committee (PSC) and the Selection Committee (SC). In addition, the PMU will be helpful in advising and answering inquiries during the process of preparation of project proposals by the applicants.

All information including Call for Proposals, guidelines etc. are available at: www.aseanenergy.org

Box 1. EAEF Modalities for Project Funding

<table>
<thead>
<tr>
<th>Category</th>
<th>Typical actions supported</th>
<th>Typical proponents/partners</th>
<th>EC grant maximum supported (in percent)</th>
<th>EC grant maximum amount (in Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing market awareness</td>
<td>Workshops, high level meetings, study tours, exchanges of personnel</td>
<td>Public and/or private sector</td>
<td>50</td>
<td>100,000</td>
</tr>
<tr>
<td>Adapting Institutional Frameworks</td>
<td>Master plans, strategic studies, policy formulation, secondment of experts in ASEAN, staff placement in EU, training</td>
<td>ASEAN public sector; (regulatory bodies or utilities)</td>
<td>50</td>
<td>200,000</td>
</tr>
<tr>
<td>Conducting feasibility studies</td>
<td>Provision of expertise, travel, documentation and miscellaneous costs</td>
<td>Private sector</td>
<td>50</td>
<td>500,000</td>
</tr>
<tr>
<td>Implementing demonstration projects</td>
<td>Contribution to equipment cost, training of O&amp;M staff, Independent monitoring</td>
<td>Private sector</td>
<td>15</td>
<td>500,000</td>
</tr>
</tbody>
</table>
The ASEAN Energy Bulletin is the supporting publication of key energy events to be held in the ASEAN region up to the third quarter of 2002. Some of these events are: 1) the 4th Asia Pipelines Tech and Projects to be held on 17-18 September 2002 in Bangkok, Thailand; and 2) the 3rd Annual International Business Forum for the Asia Pacific and the Indonesian Oil, Gas and Energy Sectors (IIoGE 2002) to be held in Bali International Convention Centre in Bali on 6-7 July 2002.

From the “Executive Chamber”, the Executive Director of ACE presents his perspective on the world oil data transparency initiative which seeks to provide accuracy and precision needed to ensure reliability of oil statistics and trend forecasting. The “Energy Statistics” presents the oil and gas production of major regions and countries in the world in 2000. “Dateline Energy” lines up the major conferences, meetings, and workshops in the ASEAN.

-The Editor
In Southeast Asia, Brunei Darussalam is a major oil and gas producer. The first commercial oil discovery was made in 1929 in the onshore Seria field with its commercial production starting in 1932. However, it was only after the Second World War that the Seria oil field was fully developed. Offshore production only started in 1964.

Currently, Brunei Shell Petroleum Company Sendirian Berhad (BSP) is a major oil and gas producer in the country. BSP is jointly owned by His Majesty’s Government and the Asiatic Petroleum Company Limited, a company within Royal Dutch/Shell Group. Other operating companies in Brunei Darussalam besides BSP are TotalFinaElf, operator for Block B joint-venture and Shell Deepwater Borneo Ltd, operator for Block A and CD joint-venture. During the first quarter of 1999, the Block B joint-venture, with TotalFinaElf as the operator, became the second oil and gas producer in Brunei Darussalam with the production from their offshore Maharajalela-Jamalulalam Field.

In 2001, oil and condensate production was about 195,000 barrels per day, of which, 97 percent was exported to ASEAN countries, Japan, South Korea, U.S.A, Australia, China, and India. The average gas production for 2001 is about 32 million cubic meters per day. About 85 percent of gas production in 2001 was exported in the form of LNG, about 9 percent was used as fuel for power generation, and the remaining 6 percent was used for commercial and residential purposes.

**Major Oil and Gas Fields and Infrastructures**

Figure 1 shows the major oil and gas fields, pipelines, and infrastructures in Brunei Darussalam.

BSP Co Sdn Bhd, the main oil and gas producer in the country has over 200 offshore structures, over 700 producing wells and about 1,500 pipelines stretching over 2,000 km.

Champion, Seria and South West Ampa are the main oil and gas fields. Champion field, which started producing in 1972, is the most prolific offshore field. It holds 40 percent of the country’s known reserves and produces more than 80,000 barrels a day. The field already has more than 270 wells drilled from 40 platforms. A central field complex, Champion-7, has living quarters for about 160 personnel, gaslift and compression facilities and water injection facilities.

South West Ampa field, the oldest offshore field discovered in 1963, is currently the largest gas field. Its reservoirs hold more than half of the country’s total gas reserves; and gas production from the field accounts for 60 percent of BSP’s total. Gas from its 57 gas wells is piped 39 kilometres to the Brunei LNG plant in Lumut. South West Ampa also has substantial oil reserves with 136 oil producing wells.

Close to Ampa are the Fairley and Gannet fields which produce both oil and gas. Fairley has 29 oil and 22 gas wells. The other major offshore field is Magpie, 60 kilometres north-east of Seria, which has been producing since 1977. Production is now maintained at some 4,800 barrels a day from its 32 wells, drilled from three platforms.
Currently there are two manned complex in the South Ama Area, Ama 6 and Ama 9. With the completion of Ama-Fairley Rationalisation project, Ama Field will be managed as a single area from the Ama-9 complex.

BSP also has a share of production from the Fairley-Baram field which straddles the border with Sarawak, Malaysia. In January 1992, BSP’s seventh field came on stream at Iron Duke, 13 kilometres south-west of Champion. It was the first new field to start production since Gannet in 1988. Production is now maintained at some 22,000 bpd from its 22 wells. All the wells are hooked up to Champion via the company’s multi-phase pipeline.

Onshore, the Seria field was Brunei Darussalam’s major producer until the 1970s. Today, it still contributes some 15,000 bpd from a coastal corridor 13 km long by 2.5 km wide and in 1991 produced its billionth barrel, commemorated by a monument near the site of the first well. The other onshore field is Rasau, west of the Belait River.

BBJV produces gas and condensate from its Maharajalela-Jamalulalam field where there are two platforms and 6 producing wells. The hydrocarbons are transported via a 70km pipeline to onshore at Lumut to the TotalFinaElf processing plant where the gas is processed before it is sold to Brunei LNG Sdn Bhd. The condensate is also piped to Seria oil crude terminal and exported through BSP’s existing processing facilities.

In 1999, BSP embarked on the Ama-Fairley Rationalisation project to extend the production life of the fields to the second half of the fields life for the next 20 to 30 years. Completion is expected by end of 2003. Other infrastructure projects are Champion West Development which is aimed to sustain oil production and increase gas production; Champion East gas expansion project and Egret gas development project.

Seria Crude Oil Terminal

The Seria Crude Oil Terminal (SCOT) is owned by BSP. The Seria Terminal provides collection, storage and export facilities for all the produced crude oil and condensate from BSP and BBJV. It also receives stabilised condensate from BLNG and the condensate stabilisation plant. There are also facilities for water separation, dehydration and treatment. The first direct shipments of exports from the terminal took place in 1971, prior to that, production was sent to Lutong Sarawak, Malaysia for final export.

The storage capacity at the terminal is approximately half a million cubic meters. Crude and condensate are exported through a two Single Buoy Mooring loading facilities located 10 km offshore. SBM-1 and SBM-2 can be used to transfer crude, however, condensate is only transferred using SBM-2.

Brunei Refinery Plant

There is a small refinery located in Seria which was commissioned in 1983 to meet the domestic demand for petroleum products. The refinery is owned by BSP but is operated and managed by BLNG Co Sdn Bhd. It has a crude distillation unit capacity of 10,000 bpd, and processes a mixture of onshore and offshore light crude supplied via pipeline from nearby SCOT. In 1992, a 10,000 bpd platformer unit was commissioned, processing condensate in addition to straight run naphtha from the crude distillation unit.

With the addition of the platformer unit, unleaded gasoline (RON 95) was first introduced in 1993. Fully unleaded motor-gasoline was introduced in the country since March 1, 2000. The three grade products are Premium ULG 97, Super ULG 92 and Regular RON 85.

To meet the growing domestic demand, the refinery embarked to debottleneck the crude distillation unit by 20 percent which is anticipated to be completed by 2003. The petroleum products are marketed by the Brunei Shell Marketing Company Sdn Bhd (BSM), a joint venture between His Majesty’s Government and Shell. As of June 2001, there are about 31 land-based retail stations and 5 riverine outlets.

Brunei LNG Plant

The LNG plant in Lumut is owned by Brunei LNG Sdn Bhd (BLNG), a joint venture between His Majesty’s Government (50 percent), Shell Petroleum N.V., a company in the Royal Dutch/Shell Group (25 percent) and Mitsubishi Corporation (25 percent).

The plant receives gas from BSP, mainly South West Ampa, Fairley and Gannet fields, and BBJV’s Maharajalela-Jamalulalam. It has five trains with a total annual capacity of 7.2 million tons of LNG.

The first LNG cargo was exported in 1972 to Japan. From 1973 to 1993, a 20 year contract was in place to supply 5.14 million tons LNG annually to buyers in Japan. It was later renewed for another 20 years until 2013. The annual contract quantity is 6.01 million tons LNG. There is also a long-term contract with Korean buyers for an annual supply of 0.7 million tons LNG until 2013.

Brunei LNG has embarked on a study to increase the plant capacity to around 11.2 million tons LNG by 2008. This 6th Train Expansion Study is in line with the country’s aspiration to continue LNG sales beyond 2013. BLNG is also embarking on rejuvenation programme of the existing plant to extend its operating life by another 20 years to 2033.

The LNG plant also supplies liquefied petroleum gas (LPG) to a nearby reconditioning and bottling complex. The LPG is used in residential and commercial areas as fuel for the gas cookers.

CONCLUSION

The year 2001 has been a significant year for Brunei Darussalam’s petroleum industry. In January 2001, His Royal Highness the Crown Prince of Brunei Darussalam launched the petroleum new areas located onshore and offshore deepwater Exclusive Economic Zone (EEZ). Two separate consortiums have submitted bids for these areas. Later at the end of 2001, His Majesty The Sultan and Yang Di Pertuan of Negara Brunei Darussalam consented to the formation of the Brunei National Petroleum Company Sendirian Berhad, PetroleumBRUNEI, for short which is wholly-owned by the Prime Minister’s Corporation.

The years ahead will prove to be an interesting and challenging one as new players explore the deep waters of Brunei Darussalam and PetroleumBRUNEI take a more active and participatory role to consolidate and mobilise the country’s petroleum industry.
Indonesia has a variety of energy resources, such as; oil, gas, coal, hydro, and geothermal energy which are vital and strategic to national development. But, it is oil and gas that currently play an important role as a source of domestic energy, a source of foreign exchange and state income, and as raw material for national industries. In 2000, the country’s total value of energy exports was US$ 15,154.2 million. Of this total, crude oil accounted for 41 percent, refined petroleum products 11 percent, liquefied petroleum gas (LPG) 3 percent, and liquefied natural gas (LNG) 45 percent.

The Indonesian Government controls oil and gas but the state companies are the ones involved in mining and exploration activities. The Ministry of Energy and Mineral Resources (MEMR) supervises oil and gas companies through the Directorate General of Oil and Gas. Pertamina, as the Holder of Oil and Gas Mining Authorisation, as stipulated by Law No. 8 of 1971, allows the company to enter into cooperation with other parties. State oil and gas activities include exploration, exploitation, refining and processing as well as transportation and marketing activities. Pertamina also promotes the utilisation of geothermal as a cheap source of energy fulfilling its mission of becoming an active player in the overall energy, in addition, to petrochemical business in the country. Meanwhile, the transmission and distribution of natural gas is under the responsibility of the state-owned PT Perusahaan Gas Negara (PGN) or State Gas Company.

Indonesia’s oil and gas reserves are limited. The Government, therefore, promotes the policy to diversify its energy resources by utilising other abundantly available energy resources such as geothermal, coal, and other renewable sources of energy. When substantial reserves of these resources are fully developed, Indonesia could conserve crude oil and other petroleum products and thereby ensure the sustainability and security of energy supply for many years.

Oil and Gas Supply
The oil and gas resources of Indonesia have significantly increased over the last ten years, from 69.55 billion barrels of oil and 293.24 trillion cubic feet (TCF) of gas in 1991 to 77.34 billion barrels of oil and 332.13 TCF of gas in 2000.

Oil and gas potentials have been accumulated in 60 sedimentary basins, of which, 38 basins have been explored while the other 22 basins remained unexplored. Sixteen basins are producing oil and gas, of which, eleven basins are in Western Indonesia and the remaining basins are in Eastern Indonesia.

The number of private oil companies operating in Indonesia is quite significant. Over the 1991-2000 period, about 65 standard production sharing contracts (PSCs) had been awarded to these private companies as well as 8 extended PSCs, 15 PSC JOC (Joint Operation Contract), and 35 technical assistance contracts (TACs).

In 2000, the total production of crude oil and condensate declined to 517,488.69 thousand barrels from 545,579.06 thousand barrels in 1999. The average daily production rate in 2000 was 1,413.90 thousand barrels of oil. Similarly, natural gas production declined by 4 percent from 1999 to reach 2,901,301.7 MMSCF in 2000. About 90 percent of gas produced came from production sharing contract holders and the remainder came from Pertamina. About 45.4 percent of gas produced is used for domestic consumption and the balance of 54.6 percent is exported in the form of LNG and LPG.

Oil and Gas Processing
Oil Refineries
In 2000, the country’s total oil refinery capacity was 1,057 thousand barrel stream per day.
In 2000, the quantity of crude oil processed was 363.31 million barrels, consisting of 278.9 million barrels of domestic crudes, 5.8 million barrels of condensate, and 78.6 million barrels of imported crudes. Over the period 1991-2000, the amount of petroleum products refined was 368.74 million kiloliters or an average yearly production of 36.87 million kiloliters consisting of JP5, aviation gas, aviation turbo, premium, kerosene, diesel oil, diesel fuel and fuel oil.

**Natural Gas Processing**

**Gas Plants Capacity and Production**

Natural gas processing is mainly conducted in gas plants to produce liquefied natural gas (LNG) and liquefied petroleum gas (LPG). The installed capacity of LNG plants is about 34.49 million metric tons per year (MMTPY), of which 12.85 MMTPY comes from Arun LNG plant consisting of 6 trains and 21.64 MMTPY from Badak LNG plant with 8 trains. The designed LPG plant capacity was 3,619 MMTPY. But in 2000, Arun Gas plant has stopped producing LPG. The installed capacity of LPG produced from oil refineries and petrochemical plants was about 0.862 MMTPY.

In 2000, LNG production was 27.32 million tons, a decrease of 9 percent from 1999 production of 29.8 million tons. The Arun LNG plant operated at 138 percent above its design capacity whereas Badak LNG plant operated at 132 percent above its design capacity. In the coming years, the production capacity for LNG and LPG will be expanded with the planned construction of Tangguh LNG plant in Irian Jaya and Train 1 in Bontang.

The production of LPG also declined by 8.4 percent in 2000 to reach 2.09 million tons. LPG is produced from gas plants as well as gas refineries.

Indonesia also produced petrochemical products from oil refining and gas processing. Naphtha and condensate (benzene, toluene, and xylene) and olefins (ethylene, propylene, and butadiene) are produced from oil refining which are used as raw materials for textile, rubber, synthetic, plastics, and others. Methanol, urea, and ammonia are by-products of gas processing which are then used as raw materials for adhesive, fertilizer, and others.

Pertamina operates and owns petrochemical plants that use oil and gas as raw materials. They are the methanol plant in Banyu Island in East Kalimantan, Furfuryl Alcohol (FFA) and polypropylene (polytam) Plant in Plaju, South Sumatra, and paraxylene and benzene plants in Cilacap, Central Java.

The installed capacity of the Banyu methanol plant is 330,000 tons per year, Plaju propylene plant 45,000 tons per year, paraxylene plant 270,000 tons per year and benzene plant 120,000 tons per year.

**CRUDE OIL CONSERVATION**

One way to promote crude oil conservation is to enhance the production and utilisation of natural gas in Indonesia. Natural gas is an environment friendly energy alternative but is still not optimally used. In 2000, Indonesia has about 170.31 TSCF of natural gas reserve, of which 94.75 TSCF are proven and 75.56 TSCF are probable. The future plan is to eliminate fuel subsidies and offer natural gas as energy alternative to substitute oil. In October 1999, the Ministry of Energy and Mineral Resources signed a new gas policy for Indonesia. The aim is to reduce the Government's profit share to promote the development of natural gas fields and domestic use of natural gas. Electric power plants are the largest consumer of domestic gas. A large percentage of industrial users rely on subsidised diesel fuel. Elimination of subsidies and introduction of a market mechanism for setting prices and allocating supply would encourage greater use of gas for domestic use.

Indonesia has significant non-exportable gas, because the gas resources are too remote from liquefaction facilities and too small for standalone LNG operation. There is also a geographical mismatch between location of gas reserves and energy demand location. The development of natural gas distribution and transmission infrastructure, is therefore important in utilising gas from small fields. Integrated Transmission System (ITS) to link Sumatra, Java and Kalimantan via a 3,588 kilometer gas pipeline is scheduled for completion in 2010 to deliver about 2.2 BCFD of natural gas to customers. Since October 1998, the country's transmission gas pipeline has reached a total length of 536 km with a diameter of 28 inches capable of transmitting 310 MMSCFD. As of 2000, the country's total length of distribution pipeline system was 2,486 km, consisting of a 1,379 km of steel pipe used to deliver gas to industrial customers and 1,107 km polyethylene pipe used for commercial and residential consumers.

Roughly about 60 percent of natural gas was marketed as LNG or LPG for export. There are several markets that can be economically reached by pipeline such as from Natuna to Singapore, Thailand, and South China. Therefore, the Trans - ASEAN gas pipelines and gas distribution for export is strongly considered.

Recent discoveries and expectations of further discoveries raise the possibility that Indonesia's total resources may exceed any realistic LNG sales target even with an all out marketing effort. In addition, Indonesia needs to meet growing energy demand at home. Gas-to-liquid (GTL) technology to convert natural gas to sulfur and aromatic free petroleum product as well as petrochemical feedstock is being considered in the case gas pipeline and LNG could not cover the development of gas sources. The Joint Study Agreement between PERTAMINA and Japan National Oil Corporation has been signed on 24th December 2001 to conduct joint feasibility study on the applicability of GTL.

Another option to curb the depletion rate of oil...
resources in Indonesia is to bring to full development the utilisation of geothermal energy. Indonesia’s geothermal potential is estimated at about 19,500 MW of electricity. This energy resource is environment friendly and a renewable source that moreover has a great opportunity to reduce dependency of oil for power generation. Presently, the country’s installed geothermal capacity is only 727 MW. Although issues on environmental impacts and fast declining rate of conventional energy resources have been elevated for policy debates, the development of renewable energy resources is still very slow over the past several years. Statistics indicates that renewable energy (hydropower, geothermal and biomass) utilisation accounts for only 3.4 percent of total potential reserves. Geothermal consumption in 1999 was only 7.7 BOE which is only 1 percent of total national energy consumption.

The third energy resource that has great potential to conserve Indonesia’s crude oil is coal. The coal resource of Indonesia is estimated at 38,000 million tons, but the amount of economically exploitable coal, either through open-pit or underground mining is still limited. Sixty percent of the resource is classified as low rank or lignite coal. Indonesia produces clean coal or “envirocoal” which is low in sulphur and ash content. In 2000, coal use was around 67,143.1 thousand BOE or 10.4 percent of total primary energy consumption mix. Coal consumption increased by 7.5 percent from 1999 due to increased coal demand in industries and power plants. In the future, coal will become a major energy resource of Indonesia next to oil (Figure 1).

Presently, joint research activities are being conducted by PT. Bukit Asam (PTBA), Agency for the Assessment and Application of Technology (BPPT) and NEDO of Japan to optimally utilise coal through liquefied process. The characteristics of liquefied coal as an alternative feedstock for refineries or as fuel blending components are being studied together with PERTAMINA.

In conclusion, a great effort should be given to encourage the development of alternative energy sources, otherwise the depletion rate of oil resources will accelerate sharply.

Figure 1. Energy Demand Projection 1995-2020 (By Type of Fuel, in Thousand BOE)

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil</th>
<th>Gas</th>
<th>Coal</th>
</tr>
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<tbody>
<tr>
<td>1995</td>
<td>16,000</td>
<td>14,000</td>
<td>12,000</td>
</tr>
<tr>
<td>2005</td>
<td>12,000</td>
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<td>8,000</td>
</tr>
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<td>10,000</td>
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</tr>
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<td>8,000</td>
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</tr>
<tr>
<td>2020</td>
<td>6,000</td>
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</table>

MYANMAR

Oil and Gas Supply, Processing and Refining in Myanmar

Soe Myint
ASEAN SOE Leader and Director General
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Myanmar is one of the ASEAN Member Countries that have substantial oil and gas resources. Crude oil was first known as early as the 10th century in the Yenanchaung area of central Myanmar, while organised extraction from shallow hand dug wells and oil trade among Myanmar nationals began in the 13th century. Expatriates who discovered the Chauk oilfield in central Myanmar in 1887 introduced modern oil exploration and production techniques in mid 18th century. Commercial production of crude oil commenced thereafter, with earlier records indicating a peak production level of 22,000 barrels per day (bpd) before the outbreak of World War II.

The oil and gas infrastructure was destroyed during the war and was quickly restored in the post war period. In 1963, the oil industry was nationalised and priority was given to develop this sector under the centrally planned system of administration. As a result, the sector developed rapidly with new discoveries, which allowed expansion of oil and gas infrastructure such as pipeline networks, processing and refining facilities.

Potential for Oil and Gas
Myanmar, has geographic and tectonic setting with seventeen sedimentary basins, fourteen onshore and three offshore. The onshore basins are scattered in all parts of the country with most of them located in Central Myanmar along the Ayeyarwaddy and Chindwin river basins and delta region. Out of the fourteen onshore basins, only three, namely; the Central Myanmar, Pyay Embayment and the Ayeyarwaddy Delta basins have been extensively explored. Discoveries of both oil and gas were made in all three basins, especially after the nationalisation of the oil industry in 1963. These discoveries permitted Myanmar to maintain its energy independent status by not having to depend on foreign sources for its oil.
supplies until the late eighties. The development of Yadana and the discovery of Yetagun gas resource, in collaboration with a consortia of foreign oil companies, is a direct contribution to the potential of Myanmar’s gas supply. It also marks the achievement to reform the energy sector by permitting foreign participation. Further onshore exploration and enhanced oil recovery activities by the national oil company MOGE and in collaboration with foreign oil companies are still in progress. In the offshore area, intensive exploration activities in the Rakhine and the areas adjacent to Yadana and Yetagun in the Bay of Bengal are being continued. Initial surveys and seismic studies for these areas have shown encouraging results.

In the light of the initial assessment of the oil and gas resource base and the past discoveries of oil and gas onshore and offshore, Myanmar still has potential for extending its frontiers to unexplored areas for substantial discoveries of oil and gas.

The Oil and Gas Supply Situation

The major player in the oil and gas sector in Myanmar is the Myanmar Oil and Gas Enterprise (MOGE), a government entity, organised under the Ministry of Energy. The enterprise is responsible for exploration, production and managing crude oil and gas resources in Myanmar. The enterprise has sixteen onshore oil and gas field establishments located mostly in central Myanmar and delta region (Fig.1). The present daily average production of oil is in excess of 10,000 barrels and natural gas is 120 million standard cubic feet per day (MMSCFD). The crude oil produced indigenously is refined into products for domestic consumption, while the major portion of the natural gas is utilised for power generation. A relatively small share is allocated for industrial heat and as raw material for fertilizer production. The MOGE’s partial share of natural gas amounting to 30 MMSCF from the Yadana field is recently supplemented and is being utilised for power generation and cement production in the Myaingalay area close to the landfall of the gas export pipeline to Thailand.

Following the restructuring of the national economy, resulting in reforms in the energy sector, MOGE has been, for the past decade involved in oil and gas development projects on shore and offshore with the collaboration of foreign oil companies. The overall objective of this undertaking is to increase the indigenous production of crude oil and natural gas to fulfil domestic demand and to export the excess to gain hard currency. Altogether, 47 onshore blocks and 25 offshore blocks have been demarcated. The type of development contracts, ranges from exploration and production, improved oil recovery, production sharing and reactivation of suspended fields. The operator, as well as MOGE, is enjoying the benefits from additional oil recoveries especially in the onshore blocks, contributing substantially towards meeting production targets. MOGE still seeks potential partners for collaboration in the remaining blocks. The involvement of MOGE and foreign companies in the demarcated onshore and offshore areas is also presented in Fig.1.

Refining of Crude Oil

As part of the national development plan to secure a primary energy source for the northern area of Myanmar, the MOGE is, at present, conducting extensive exploration activities independently in the Tanaing area which forms a part of the Hukawng basin and the Yebawmi area in the Chindwin basin. Test well results have indicated the presence of hydrocarbon in these areas and
drilling activity is still in progress. More encouraging results are expected in the near future.

Modern refining of crude oil in Myanmar dates back to the early 18th century. Topping units of relatively small capacities were set up at oil field areas in Central Myanmar, while earlier records indicated the establishment of a refinery by the Rangoon Oil Company (R.O.C.) at Dunneedaw in the Yangon area in 1872. Installation facilities as well as pipeline connections were also established between Central Myanmar and Thanlyin, upstream of the port of Yangon for export of crude oil to destinations in the west during that era. As the industrial revolution progressed, accompanied by an increase in demand for petroleum based fuels in Myanmar and abroad, the Burmah Oil Company B.O.C. established a refinery at Thanlyin, a convenient location for storage and export for crude oil and products in 1925.

At the end of World War II, the Burmah Oil Company rehabilitated the 6,000 bpsd refinery at Chauk equipped with a wax extraction plant in 1954 and in 1957 rehabilitated the 6,000 bpsd refinery initially equipped with a residual cracking unit at Thanlyin. At the time of nationalisation of the oil industry in 1963, the capacity of the refinery at Thanlyin was already increased to 20,000 bpsd by an additional topping unit of 14,000 bpsd capacity. The refinery was later expanded to a total capacity of 26,000 bpsd through the addition of a modern topping unit of 6,000 bpsd capacity in 1980. To further increase the yield of distillates, a delayed coking unit was added a few years later. The refinery at Thanlyin officially known as the No.1 Refinery is now equipped with three topping units, a narrow cut special boiling point unit, a 5,200 bpsd delayed coker, a candle factory, a lubricating oil blending and packaging facility, a drum manufacturing plant and a bitumen separation unit. A captive power plant of 6 MW capacity equipped with a flue gas carbon dioxide stripping facility generates steam and power for the refinery. Convenienly located upstream from the port of Yangon on the opposite bank of the Yangon River, the refinery has its own berthing facility to load and offload ocean tankers of maximum 10,000 DWT, coastal, river craft and oil barges.

One major leap in the expansion of the refining sector in Myanmar is the establishment of a modern refinery complex in 1982. Officially known as the Mann Thanbayakan Petrochemical Complex, the refinery is located on the west bank of the Ayerwaddy River in Central Myanmar. The establishment of this third refinery increased the total refining capacity to the present 51,000 bpsd. The facility is equipped with a 25,000 bpsd main topper unit, a reformer, a delayed coker, Naphtha HDS, Kero Smoke Point Improver and LPG recovery as its main configuration. Situated on the bank of the Ayerwaddy River the complex has its own berthing facility and gangway for loading and unloading bulk oil from river craft and barges. The complex is initially designed to incorporate an aromatic extraction unit in its longer-term expansion program.

**Utilisation and Processing of Gas**

In the early days, the utilisation of natural gas from the oil fields in Central Myanmar was limited to the production of steam for pipeline tracing, power generation and fuel for domestic purpose in the field establishments. Following the introduction and widespread use of gas turbines for power generation in the world power industry, the commercial utilisation of natural gas began with the establishment of the first gas turbine unit at Kyunchaung, Central Myanmar area in the early 1970’s. More effective utilisation, through production of value added products, was launched in 1970 with the start up of the Sale urea fertilizer factory in the same region. The factory, officially known as the No.1 Fertilizer Factory, is located at Sale, in Chauk Township, Magway Division. The nameplate capacity of the initial unit is 205 metric tons per day, the capacity was expanded by another 260 metric tons with the addition of unit B in 1984. The No.2 Fertilizer Factory located at Kyunchaung Pokokku Township Magway Division came on stream in 1971. The factory has a capacity of 207 metric tons per day. A third fertilizer factory was established in 1985 at Kyaw Zwa, Aung Lan Township, Magwe Division. The plant has a capacity of 600 metric tons per day, bringing the total fertilizer production capacity to 1,272 metric tons per day.

As a further step towards extensive utilisation of natural gas, a methanol plant was established in 1986 at Seiktha, Kyangin Township, Ayerwaddy Division. The 450 metric-ton per day capacity plant utilises natural gas as raw material producing AA grade methanol as final product. Initiatives to substitute compressed natural gas, methanol gasoline blend and LPG as substitute fuels for vehicles on a pilot basis was also undertaken shortly after the successful start up of the methanol plant. A scheme to strip propane and butane from wet gas produced from oil fields was also implemented in the same year with the commissioning of a LPG extraction plant at Minbu, Magwe Township. The plant has a throughput capacity of 24 MMSCF per day and is equipped with C3, C4 extraction and a naphtha recovery unit. Liquefied propane, butane and liquid naphtha are stripped as products from the rich gas produced from the nearby Mann oil field. The installation of two skid mounted LPG extraction units, one at Nyayongdon in the delta region and the other at Kyunchaung in Central Myanmar, is in progress. Commissioning of these units are expected in mid 2002.

**Future Plans**

To meet the increasing demand for fuels and fertilizer in the future, a thirty year long-term development plan with five-year plan cycle has been established commencing fiscal year 2001-2002.

As part of the first five-year plan cycle, a LPG plant having a capacity of 150,000 metric tons per year is planned at Kanbauk, the landfall area of the gas pipeline to Thailand. The plant is expected to come on stream in 2004-2005 and will utilise Yetagun gas rich in Propane and Butane fractions.

In the second five-year plan cycle, a refinery of 100,000 BOPD at Thanlyin and a urea fertilizer factory of 1,000 metric-ton per day capacity is planned to come on stream at Taikkyi in 2006-2007. Another 150,000 metric tons per year LPG plant is planned for construction and commissioning in 2008-2009 in the same Kanbauk area.

In the third cycle, another refinery of the same capacity and a urea fertilizer factory of 1,750 metric ton per day capacity is planned for on stream in 2016-2017 with location to be identified.
The total primary energy supply (TPES) of the Philippines is projected to grow at an annual average rate of 6.35 percent or to almost double from 37.20 million tons of oil equivalent (MTOE) in 2002 to 65.4 MTOE in 2011. Of the TPES, oil will dominate the supply mix with a share of 41.82 percent and 41.46 percent in 2002 and 2011, respectively. Natural gas is expected to reach 5 MTOE or roughly 8 percent of the supply mix in 2011.

Over the next ten years, a moderate level of investment for the petroleum sector, estimated at USD 7,852 million, is expected to develop the gas sector, to maintain the relatively low level of oil production, and to increase the capacity of the country’s refining and petrochemical sectors. Of this total, 74 percent will come from the upstream oil and gas sector and the remaining 26 percent from the downstream sector. The investment in downstream sector covers the development of marketing network and facilities including plant/refinery, gas pipelines, and LNG terminals.

Oil

The Philippines is a minor oil producer. In 2000, oil production was 417,866 barrels, an increase of 30 percent from 1999. The increase was attributed to the rise in production of the Nido oil field. Over the 2002-2011 planning period, a total of 47.8 million barrels of oil is expected to be produced from Malampaya, Nido, Matinloc, and Cadlao oilfields. About 50 exploratory wells will be drilled while 30,000 line kilometers of seismic data will be acquired.

In December 2001, media reports said that the Philippines may have found its first oilfield after almost three decades at Malampaya after test beneath its gas project has yielded almost 8,000 barrels of oil per day. It is considered to be the highest production rate per oil well in the country since 1971. Malampaya is estimated to have contained 50 million barrels of recoverable oil.

The Philippine Department of Energy is currently developing a petroleum resource classification system and updating the inventory of petroleum resources from 13 sedimentary basins of the country. Since September 2000, resource assessment has been completed for the Visayan basin, Central Luzon basin, West Luzon trough, and Cagayan basin. In addition, the 3-year Window of Opportunity for Petroleum Exploration was launched in June 2000 to attract foreign and local investors in petroleum exploration and development. Incentives are further identified to encourage investments in the areas lying within the Corridor of Focus, near the Malampaya infrastructure or the path of the future Trans-ASEAN Gas Pipeline (TAGP).

So far, two Geological Survey and Exploration Contracts (GSEC) were awarded to South China Resources, Inc. and Philippine National Oil company (PNOC) - Exploration Corporation, both bringing in some US$7.9 million investment for the petroleum sector of the country.

At present, about 95 percent of the country’s crude oil supply was imported from the Middle East. In 2000, the country’s crude import was 113,767 thousand barrels (MB).

In 2000, the total petroleum product import increased by 37.5 percent to 25,980 MB. About 60.4 percent was accounted for by the oil majors and the new players provided the remainder. LPG and diesel fuel remained as major imports.

In 2000, the end-year stock level of crude and refined products was recorded at 42 days. The total storage capacity for crudes and products was at 32.4 million barrels (MMB).

The country’s petroleum demand was 120,478 thousand barrels (MB) in 2000, a decrease of 7.1 percent from 1999. Onto 2011, petroleum demand is expected to grow at an annual average rate of 6 percent to reach 207,624 MB in 2011 (Table 1).

The three oil majors exported petroleum products such as fuel oil, naphtha, and reformate. Major destinations were Singapore, Japan, China, and South Korea. The total value of export was about USD 374 million.

Natural Gas

The successful launching of the Malampaya Deep Water Gas to Power Project last October 16, 2001, represents the birth of a natural gas industry in the country that will significantly reduce the country’s dependence on imported fuel for power generation. The USD 4.5 billion gas project, considered to be the single largest foreign investment ever, is a joint venture between Royal Dutch Shell Group, Texaco Inc. and the state-owned PNOC. The project will provide the country with 2.7 trillion cubic feet (Tcf) of natural gas reserve which is about 2,700 MW of gas power. Moreover, the commercial operation of Malampaya will benefit the country with dollar savings amounting to USD 700 million a year for the next 20 years while the Government is projected to earn USD
13 billion in royalties.

The country’s gas reserves are estimated between 5,805 billion cubic feet (Bcf) to 20,813 Bcf (Table 2).

Gas production in 2000 was very modest placed at 375.9 MMSCF, coming from San Antonio gas field located in Isabela province. The gas was used to power a 3 MW gas fired power plant capable of generating 21 GWh of electricity. The total amount of oil displaced was 9,865 TOE (0.07 MMBFOE), equivalent to foreign exchange savings of USD 1.8 million. Over the 2002-2011 planning period, gas production is expected to reach a total of 1.5 trillion cubic feet (Tcf) coming from Malampaya, San Antonio, and Libertad gas fields. Starting from 0.4 Bcf in 2001, gas production will be stepped up to a yearly average of 146.4 Bcf beginning 2002. A small gas field in Cebu will be reopened for initial utilisation by 2002 until 2006 when gas demand for transport and other sectors have been developed. Condensates from Malampaya field is expected to reach 53.3 million barrels over the same period.

**Refinery and Petrochemical Development Plan**

The Philippines is one of the few countries in Asia with a deregulated downstream oil industry since 1998. The objectives of deregulation were to eliminate government intervention specifically in setting of prices, attracting of more new players, and allowing market forces to influence trade decision making. There are 66 new players in the downstream oil industry, including foreign firms like PTT of Thailand, Liquegaz of Netherland’s Total of France, Petronas of Malaysia, and Coastal Petroleum of the USA. Most of the new players are in bulk marketing because of simple facility requirements. The new players have captured about 10 percent of the market. Over USD 245 million have been invested in the downstream oil industry with another USD 700 million committed over the next five years.

The big 3’s of the oil industry, namely; Petron Corporation, Pilipinas Shell Petroleum Corporation, and Caltex Philippines, Inc. own and operate their own refinery facilities. Petron Corporation is the Philippines’ largest oil refining and marketing company owned by the government through the PNOC until 1994 when the government sold 60 percent of its share holdings to Saudi Aramco and another 20 percent to private individuals through initial public offering (IPO). Its Limay, Bataan Refinery has a capacity of 180,000 bbl/d. Caltex operates a 72,000 bbl/day refinery, two terminals and more than 1,000 gas stations throughout the archipelago. Pilipinas Shell has a 137,000 bbl/ day refinery and operates over 1,000 gas stations. In 2000, the combined refinery capacity of oil majors was 419 thousand barrels per stream day (MBSD) with a refinery useitisation rate of about 72.5 percent. Oil refiners undertake refinery upgrading programmes to boost their capabilities in the production of low-sulfur diesel and fuel oil. Shell Philippines has programmed an additional reactor to the plant’s existing hydro desulfurizer-3 (HDS-3) and a new process unit for benzene hydrogenation in 2002.

There are plans to construct a USD 600 million cracker naphtha plant to be built in Bataan. The cracker will be capable of processing light and full range naphtha, ethane, and propane as feedstocks. The main products will be polymer grade ethylene and propylene. The initial capacity is about 600,000 tons/year of ethylene, with provisions for expansion. Brunei was reported to have expressed interest to invest a 35 percent equity stake. An MoU was signed between PNOC and Masshor General Contractor Sdn. Bhd for the latter to participate as general contractor in the former’s

**Table 1. Refined Petroleum Products Demand & Supply Outlook**

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2006</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Demand</td>
<td>124,239</td>
<td>154,087</td>
<td>218,004</td>
</tr>
<tr>
<td>Local Production</td>
<td>7,548</td>
<td>13,795</td>
<td>7,639</td>
</tr>
<tr>
<td>Imported</td>
<td>116,691</td>
<td>140,292</td>
<td>210,365</td>
</tr>
</tbody>
</table>

Source: Philippine Energy Plan 2002-2011

**Table 2. Estimate of Natural Gas Reserves**

<table>
<thead>
<tr>
<th>Gas Fields/Basin</th>
<th>Minimum</th>
<th>Prospective</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proven Fields</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malampaya</td>
<td>2,528</td>
<td>3,340</td>
<td>4,277</td>
</tr>
<tr>
<td>San Martin</td>
<td>243</td>
<td>359</td>
<td>454</td>
</tr>
<tr>
<td>San Antonio</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Potential basins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mindoro-Cuyo</td>
<td>2,720</td>
<td>7,060</td>
<td>11,210</td>
</tr>
<tr>
<td>Catobato</td>
<td>60</td>
<td>1,158</td>
<td>1,760</td>
</tr>
<tr>
<td>Cagayan</td>
<td>176</td>
<td>322</td>
<td>518</td>
</tr>
<tr>
<td>Central Luzon</td>
<td>78</td>
<td>637</td>
<td>2,574</td>
</tr>
<tr>
<td>Total</td>
<td>5,805</td>
<td>12,880</td>
<td>20,813</td>
</tr>
</tbody>
</table>

Source: Philippine Energy Plan 2002-2011

The Philippine oil companies are considering a new pricing mechanism based on the Mean of Platts Singapore (MOPS). MOPS tracks the prices of finished petroleum products from the region’s oil trading hub. New entrants in the industry are highly supportive of the adoption of MOPS, whereas the Big 3’s want an initial price adjustment before using MOPS.

In January 2000, the Philippines Department of Energy announced plans to accelerate the phasing out of leaded gasoline, with leaded gasoline already not available in gas stations all over Metro Manila.

Meanwhile, investments in all segments of the petrochemical chain are available, including polymer plants, polyethylene and polypropylene plants in Batangas and Bataan, PVC plants in Cavite and Bataan and Metro Manila. Plastic converters and producers of adhesives, synthetic fibres, rubber and other associated products are there. The only missing link to complete the integrated petrochemical chain is the production facilities for olefins, i.e., the cracker, which is the nucleus of a petrochemical industry.
The total primary energy consumption of Thailand is expected to increase at an average annual rate of five (5) percent from 1,627 thousand barrels of crude oil per day (KBD) in 2001 to reach 3,162 KBD in 2016. In 2001, refined petroleum products accounted for 43 percent, followed by natural gas 26 percent, renewable energy 18 percent, coal/lignite 10 percent, and hydro/imported electricity 2 percent. Onto 2016, refined petroleum products, natural gas and coal will remain as major types of fuel for Thailand (Table 1). In 2001, the total final energy consumption was 977 KBD. Of this total, refined petroleum products accounted for 56 percent, followed by renewable energy 19 percent, electricity 16 percent, coal/lignite 6 percent, and natural gas 3 percent. Overall, the 2001-2016 period, there will be not much difference in the share of final energy, except for a slight increase expected for refined petroleum products and electricity; and a decrease in the share of renewable energy (Table 2).

Oil

The state-owned Petroleum Authority of Thailand dominates the oil and gas industry in Thailand. PTT Exploration and Production (PTTEP) is the main upstream subsidiary of PTT. Thai Oil, the largest refinery is also controlled by PTT.

Thailand’s proven oil reserve is estimated at about 250 million barrels, of which 160 million barrels are offshore and 90 million barrels are onshore. The possible and probable reserves were about 450 million barrels, of which, 85 percent is offshore.

In 2001, the domestic crude oil production was 65 KBD, an increase of 12.4 percent from 2000. Major sources are the Benchamas and Tantawan oil fields operated by Chevron, with a combined production capacity of about 38 KBD and the Sirikit Field with a production capacity of 25 KBD. Most of the oil from the Benchamas and Tantawan fields will be exported because the quality does not correspond oil was imported to meet domestic oil requirements in 2001.

Gas transport market potential for Metro Manila is projected at about 86 MMSCFD of gas if only diesel engines will be converted and about 125 MMSCFD if gasoline vehicles are included.
Over the 2002 - 2006 period, oil production is expected to increase at an annual average rate of 12.1 percent. This results from Chevron’s plan to increase their production capacity to between 68 to 85 KBD. Moreover, UNOCAL’s new oil field will be on stream with a production capacity of between 13 to 15 KBD while the Sirikit oil field is expected to yield 25 KBD over the same period.

During the 2007-2011 and 2012-2016 National Plans, the production of oil will decrease sharply due to depletion of reserves. The production from the Sirikit field will begin to decrease starting 2007 onwards. Chevron’s oil production will also gradually decrease beginning from 2006 onwards while UNOCAL’s production field will be exhausted by 2007 at current production rate.

The country’s indigenous oil production will not be enough to meet domestic supply. Therefore, the Government of Thailand will have to increase oil supply by importing oil. In 2006, total oil supply will reach 890 KBD and is expected to grow by 5.1 percent and 4.9 percent over the 2007 - 2011 and 2012 - 2016 periods, respectively.

Table 3. Natural Gas Supply
(In Million Standard Cubic Feet per Day)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous</td>
<td>1,900</td>
<td>2,143</td>
<td>2,506</td>
<td>2,753</td>
</tr>
<tr>
<td>- Nam Phong</td>
<td>60</td>
<td>24</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>- Sirikit</td>
<td>57</td>
<td>51</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>- Blocks 10,11,13</td>
<td>816</td>
<td>913</td>
<td>677</td>
<td>643</td>
</tr>
<tr>
<td>- Bongkot</td>
<td>584</td>
<td>605</td>
<td>528</td>
<td>528</td>
</tr>
<tr>
<td>- Benchamas</td>
<td>170</td>
<td>198</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>- Palin</td>
<td>212</td>
<td>352</td>
<td>305</td>
<td>305</td>
</tr>
<tr>
<td>- JDA</td>
<td>-</td>
<td>-</td>
<td>250</td>
<td>450</td>
</tr>
<tr>
<td>- Arthit</td>
<td>-</td>
<td>-</td>
<td>550</td>
<td>550</td>
</tr>
<tr>
<td>- Jampuree/Chaba</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Import</td>
<td>496</td>
<td>891</td>
<td>794</td>
<td>794</td>
</tr>
<tr>
<td>- Yadana</td>
<td>377</td>
<td>448</td>
<td>378</td>
<td>378</td>
</tr>
<tr>
<td>- Yetagun</td>
<td>119</td>
<td>443</td>
<td>416</td>
<td>416</td>
</tr>
<tr>
<td>Total</td>
<td>2,396</td>
<td>3,034</td>
<td>3,300</td>
<td>3,547</td>
</tr>
</tbody>
</table>

Table 4. Petroleum Refining Capacity
(In Thousand Barrels per Day)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thai Oil</td>
<td>210</td>
<td>210</td>
<td>210</td>
<td>240</td>
</tr>
<tr>
<td>Rayong</td>
<td>145</td>
<td>145</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Star</td>
<td>145</td>
<td>145</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Esso</td>
<td>145</td>
<td>145</td>
<td>165</td>
<td>195</td>
</tr>
<tr>
<td>Bangkok</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>TPI</td>
<td>215</td>
<td>215</td>
<td>215</td>
<td>215</td>
</tr>
<tr>
<td>Others</td>
<td>15</td>
<td>45</td>
<td>195</td>
<td>445</td>
</tr>
<tr>
<td>Total</td>
<td>995</td>
<td>1,025</td>
<td>1,205</td>
<td>1,515</td>
</tr>
</tbody>
</table>

Table 5. Refined Petroleum Product Demand
(In Thousand Barrels per Day)

<table>
<thead>
<tr>
<th>Type</th>
<th>2001</th>
<th>2006</th>
<th>2011</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>76</td>
<td>97</td>
<td>121</td>
<td>147</td>
</tr>
<tr>
<td>Gasoline</td>
<td>118</td>
<td>152</td>
<td>201</td>
<td>259</td>
</tr>
<tr>
<td>Kerosene/Jet</td>
<td>65</td>
<td>83</td>
<td>102</td>
<td>125</td>
</tr>
<tr>
<td>Diesel</td>
<td>262</td>
<td>331</td>
<td>427</td>
<td>538</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>78</td>
<td>82</td>
<td>103</td>
<td>130</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>746</td>
<td>954</td>
<td>1,199</td>
</tr>
</tbody>
</table>

Over the 2002 - 2006 period, oil production is expected to increase at an annual average rate of 12.1 percent. This results from Chevron’s plan to increase their production capacity to between 68 to 85 KBD. Moreover, UNOCAL’s new oil field will be on stream with a production capacity of between 13 to 15 KBD while the Sirikit oil field is expected to yield 25 KBD over the same period.

During the 2007-2011 and 2012-2016 National Plans, the production of oil will decrease sharply due to depletion of reserves. The production from the Sirikit field will begin to decrease starting 2007 onwards. Chevron’s oil production will also gradually decrease beginning from 2006 onwards while UNOCAL’s production field will be exhausted by 2007 at current production rate.

The country’s indigenous oil production will not be enough to meet domestic supply. Therefore, the Government of Thailand will have to increase oil supply by importing oil. In 2006, total oil supply will reach 890 KBD and is expected to grow by 5.1 percent and 4.9 percent over the 2007 - 2011 and 2012 - 2016 periods, respectively.

Natural Gas
Thailand has an estimated proven gas reserve of 11.8 trillion cubic feet Tcf) and it produced about 630 Bcf in 2000. Total gas supply is met by indigenous production and import and a large chunk of it is used for power generation. Bongkot is the largest gas field of Thailand, located some 400 miles south of Bangkok in the Gulf of Thailand.

In 2001, natural gas supply was 2,396 million standard cubic feet per day (MMSCFD). Gas supply was met by import (496 MMSCFD) from Yetagun and Yanada gas fields of Myanmar and by local production (1,900 MMSCFD) from nine major gas fields (Table 3). The gas from Myanmar is transported via a 416 mile pipeline to the power plant of the Electricity Generating Authority of Thailand (EGAT) in Ratchaburi province. A connecting pipeline has been constructed to deliver excess gas from Ratchaburi to Bangkok area.

Gas Processing and Petroleum Refinery
The total refining capacity of Thailand from seven oil refineries was 995 KBD in 2001 and is expected to increase to reach 1,515 KBD in 2016 (Table 4). In 2002, another small-scale refinery with a capacity of 30 KBD will be operational, thus bringing the total refinery capacity to 1,025. There are four (4) natural gas separation plants with total capacity of 1,180 MMSCFD and one (1) small-sized 44 MMSCFD gas processing unit located in Palang Petch at Sirikit Oil Field. This is an additional supply sources of natural gasoline and LPG.
In 2001, the production of refined petroleum products increased by 0.2 percent to 727 KBD, excluding naphtha and asphalt compared from previous year. Most refineries have not operated at full capacity as domestic demand remains low and some have faced liquidity problems. Onto 2016, the production of refined petroleum products will be enough to meet domestic demand with some excess production for export (Table 5 and Table 6).

### Table 6. Production of Refined Petroleum Products
(In Thousand Barrels per Day)

<table>
<thead>
<tr>
<th>Type</th>
<th>2001</th>
<th>2006</th>
<th>2011</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPG</td>
<td>102</td>
<td>117</td>
<td>145</td>
<td>151</td>
</tr>
<tr>
<td>Gasoline</td>
<td>143</td>
<td>155</td>
<td>205</td>
<td>254</td>
</tr>
<tr>
<td>Kerosene/Jet</td>
<td>83</td>
<td>83</td>
<td>110</td>
<td>135</td>
</tr>
<tr>
<td>Diesel</td>
<td>287</td>
<td>356</td>
<td>459</td>
<td>554</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>111</td>
<td>138</td>
<td>173</td>
<td>204</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>726</strong></td>
<td><strong>849</strong></td>
<td><strong>1,092</strong></td>
<td><strong>1,298</strong></td>
</tr>
</tbody>
</table>

**Oil and Gas Supply, Processing and Refining in Vietnam**

The petroleum sector of Vietnam is expected to support and stimulate the country’s economic growth. Its oil and gas resources can help attract foreign investment and meet future energy demand. Crude oil exports are already the country’s largest foreign exchange earner, and natural gas reserves provide an environmentally clean way to meet domestic energy needs and could lead to exports. The Government of Vietnam, therefore, promotes the policy to diversify energy resources to have a balanced energy system anchored on the principle of efficient and rational use of energy. Among the measures to achieve this are to enhance exploration activities and increase utilisation of natural gas and associated gas sources; to build oil refineries; and to enhance exploration, survey, and exploitation of new energy resources.

In 2001, the country’s crude oil and natural gas reserves were estimated at about 390 million tons and 600 billion cubic meters (bcm), respectively. In the next 20 years, the country’s annual production is projected to reach 25 to 30 million tons of crude oil and 15 to 20 bcm of natural gas.

### Developments in the Petroleum Sector

Petrovietnam, a state-owned enterprise, undertakes all upstream oil and gas activities. It conducts petroleum operations and forges contracts with organisations and individuals. Petroleum contracts can be production sharing, joint venture, or other forms such as model contract specified in the law. Rights and obligations of the contractors as well as royalties, taxes, and fees are also specified.

The development of the petroleum sector is governed by the Petroleum Law of 1993 with its implementing rules and regulations approved in December 1996. The law provides provisions for petroleum exploration, development, and production. However, most production sharing contracts (PSCs) were formulated for oil exploration and do not cover gas.
Winning bidders for exploration blocks sign contracts with Petrovietnam, subject to the approval and issue of licenses by the Ministry of Planning and Investment. Petrovietnam, acting as the ministry’s technical agent during bidding, block awarding and contract negotiations, takes over administration of petroleum contracts. Petrovietnam supervises contractors, receives operational data, makes periodic reports, and monitors compliance.

Presently, the continental shelf of Vietnam remains largely unexplored relative to those of its neighbors, including China, Indonesia, Malaysia, and Thailand. Petrovietnam has made intense efforts to attract international oil companies to explore the country’s sedimentary basins and recent discoveries of commercial quantities of oil and gas have revived interest in exploration.

To bring oil and gas resources to full development, Vietnam is trying its best to provide the right framework for private sector participation including the availability of fiscal incentives to encourage hydrocarbon exploration and development; an efficient and transparent system to oversee contracts and award acreage for exploration; and clear and consistent gas pricing policy, and development of special provision for marginal fields.

Vietnam has 9 onshore and offshore basins. Significant discoveries of oil and gas have been made in at least 5 basins, namely: Cuu Long, Nam Con Son, Malay-Thu Chu, Song Hong, and Hanoi Trough.

Most hydrocarbon production in Vietnam comes from the Bach Ho Field, which is operated by Vietsovprod. Other sources of oil production are the Dai Hung of BP Petroleum, Rang Dong, and Ruby fields and a small structure in the Malay-Thu Chu basin. Between 2000 and the first 8 months of 2001, five (5) new fields have been discovered. The fields are: Su Tu Den (Cuu Long JOC), Su Tu Vang (Cuu Long JOC), Kim Long – B (Unocal), AcQuy – B.52 (Unocal), and Ca Voi – 52 (Unocal). These fields, particularly Su Tu Den field have shown great promise to substantially increase the commercial production of oil in the future.

The Bach Ho offshore field, located in the Cuu Long Basin, is about 120 km southeast of Vung Tau and is the largest hydrocarbon accumulation discovered so far, with potential oil reserves of more than 900 million barrels. The field was brought on stream in 1986 and has produced 355 million barrels of oil and 8.7 bcm of gas. Daily production from the field is 160,000 barrels of oil and 3.8 million cubic meters of associated gas. Part of the gas is used to generate power in Ba Ria and Phu My through a 16-inch pipeline operated by Petrovietnam. The rest is flared. A central compressor platform was completed in 1998, extending the transmission capacity of the pipeline to about 1.5 bcm a year. Oil and gas production from Bach Ho is expected to be maintained until 2001 but then will decline to half the current level by 2004 and 2005 and to one quarter by 2008-2009.

Vietnam’s total daily production rate of oil is around 320,000 barrels per day and 150 MMSCFD of associated gas coming from Bach Ho, Rong, Dai Hung, Rang Dong, Ruby, Bunga Kekwa (PM 3 CAA) and Tien Hai.

Gas Supply
In 2000, the total gas production of Vietnam was about 1.5 bcm mainly used for power generation and a small fraction for LPG production. Gas supply sources were mainly concentrated in Nam Con Son, Cuu Long, Malay – Thochu, and Red River basins.

In Vietnam, gas has two main uses, namely; as fuel for power generation and as feedstock for industries and petrochemical industry.

Gas as Fuel
The liquefied petroleum gas (LPG) is the first gas product used in Vietnam. LPG has been imported since 1970 in small quantities as fuel for power generation and as feedstock for industries and petrochemical industry.

The Bach Ho gas pipeline. It consists of 107 km offshore and 7 km onshore pipeline. The pipeline has a diameter of 16 inches with capacity of delivering 2 BCM / year of gas. The associated
gas is delivered from Bach Ho field to Ba Ria power station. The government is reviewing the plan to increase the capacity of the gas pipeline instead of constructing a new pipeline if more gas supplies are available in the area. The pipeline is 100 percent owned by Petrovietnam.

Rang Dong - Bach Ho gas pipeline. It is an offshore pipeline funded by Petrovietnam within the Cuu Long area to deliver gas from Rang Dong field to shore to meet increasing gas demand. The pipeline is 60 km long with a diameter of 16 inches capable of transporting between 1 to 1.5 bcm per year of natural gas.

Nam Con Son gas pipeline. This pipeline under construction through a joint business contract of Petrovietnam and BP Statoil. It consists of a 365 km offshore pipeline and another 35 onshore pipeline with a diameter of 26 inches. When fully developed, the pipeline can deliver about 7 bcm of gas a year. However, in the initial year, it will deliver 2.7 bcm of gas a year from Lan Tay and Lan Do gas fields to end users in South East area and Ho Chi Minh City. The first gas will be available at the end of 2002.

Phu My gas distribution centre. It is developed by Petrovietnam to coordinate the gas supplies from Cuu Long and Nam Con Son basins to end-users in South East area.

Phu My - Thu Duc gas pipeline. This pipeline will be operational in 2003-2004. It involves a pipeline length of 71 km with capacity of 3 bcm per year. It will supply gas to Hiep Phuoc, Thu Duc and Ho Chi Minh City.

South West gas pipeline. It consists of two (2) independent gas pipelines, namely; 1) PM3-CAA - Ca Mau Power – Fertilizer Complex gas pipeline which is planned for operation in 2005; and 2) Blocks B, 48/95 and 52/97 gas pipeline in the Gulf of Thailand, a joint venture of UNOCAL and Petrovietnam.

Gulf of Tonkin delta gas gathering and transportation pipeline. This pipeline links some of the marginal gas fields that have been discovered or to be discovered into a cluster of gas supplies. It will be developed apace with the development of new gas fields.

Gas Pipeline in the Centre. Studies are ongoing to investigate the viability of putting up a pipeline to deliver and use Da Nang gas.

Dinh Co Gas Processing Plant. It was constructed in 1998 with a processing capacity of 1.5 bcm of wet gas. Annually, it produces 1.2 bcm of lean gas; 250,000 tons of LPG; and 130,000 tons of condensate. The plant was planned for upgrading in 2001-2002 to bring the production of wet gas to 2 bcm. Consequently, it will increase the yearly production of lean gas to 1.5 bcm; LPG to 350,000 tons; and condensate to 150,000 tons. Additional gas supply will be sourced from Rang Dong gas field.

Nam Con Son gas processing terminal. Two processing lines are planned for construction. The first line will be built in 2002-2003 together with the Nam Con Son gas pipeline to control the dew point of the lean gas and to recover about 69,000 tons of condensate a year from the Lan Tay and Lan Do fields. The second line is planned in 2004 - 2006 to process gas and recover additional condensate from new fields. It targets an annual production of about 4.5 - 5 bcm per year of wet gas and 69,000 tons of condensate to be used in the steam cracking process for ethylene production. If feasible, the volume of gas supplies and terminal capacity will be increased to between 6 - 7 bcm. At this capacity, it would result in an additional LPG production line of over 400,000 tons and 161,000 tons of condensate.

Petroleum Refinery

Presently, Vietnam has no refinery and all petroleum products are imported. In 1999, the total petroleum product consumption was 7 million tons and is projected to increase to 12 million tons in 2005. In view of this, the Prime Minister of Vietnam tasked Petrovietnam to build two refineries to ensure the long-term security of energy supply and economic stability of the nation. The two refineries are the Dung Quat Refinery or Refinery No. 1 to be put on stream in 2004 and Refinery No. 2 at Nghi Son, Thanh Hoa to be made operational in 2008.

The Dung Quat Refinery is a joint venture of Petrovietnam and Zarubeznheft of Russia with each having an interest of 50 percent. It was granted an investment license by the Ministry of Investment and Planning under the name of VIETRO SS Refinery Joint Venture. The refinery is being built at Dung Quat Bay, Quang Ngai province and is expected to process 6.5 million tons of crude oil a year. The estimated annual production of refined products are: 150 thousand tons of propylene; 286 thousand tons of LPG; 1, 401 thousand tons of unleaded gasoline (92); 535 thousand tons of unleaded gasoline (83); 282 thousand tons of kerosene /jet fuel; 2,084 thousand tons of auto diesel, 1,327 million tons of industrial diesel; and 116 thousand tons of fuel oil.

The second refinery has a projected capacity of 5.7 million tons per year with a total investment requirement of USD 2 billion.

References:

ASEM Green
Independent Power Producer Network GrIPP-Net

A Program fully financed by the European Commission to establish a thematic network on Green IPPs on renewable energy projects among the stakeholders in Europe and Southeast Asia.

The Program will be executed by six partners, namely: University of Karlsruhe, Germany, as Coordinator; Foundation for International Human Resources Development, Bangkok, Thailand; Netherlands Energy Research Foundation (ECN); ASEAN Centre for Energy (ACE), Indonesia; Risoe National Laboratory, Denmark; and University of the Philippines.

The duration of the program is 24 months beginning in January 2002.

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any thanks to the contributors to this issue for providing oil data of their respective countries with hardly any reservation.

We hope the World Oil Data Transparency Initiative, which seeks to provide accuracy and precision needed to ensure reliability of oil statistics and trend forecasting, would find the same ease in collecting data.

Involved in this initiative are the International Energy Agency (IEA), the Asia-Pacific Energy Research Centre of APEC, the EUROSTAT of the European Commission, the Organisation for Energy Development in Latin America (OLADE), the Organisation of Petroleum Exporting Countries (OPEC), and the United Nations.

Since June 2001, these organisations are undertaking the Joint Oil Data Exercise (JO DE). This activity was agreed upon during the "International Meeting on Improving Oil Data Transparency" held in Bangkok on 2-3 April 2001 where ACE was an active participant. The exercise is expected to wind up by March 2003.

The target of collecting data on monthly intervals seems to be a major factor that impeded the exercise. While most countries have easily accomplished the data forms on two-month intervals, it required extension of a September 2002 target for completion of the exercise to March 2003 so that the intervals could be reduced to one month. This decision was made in the project's meeting in Mexico on 23-25 May 2002.

After the JO DE exercise, ACE expects to adopt the scheme in the ASEAN region. At present, we are in the process of building the ASEAN Energy Database System which will be home for the oil data that will be collected under the world oil data management scheme. Cooperation of everyone is absolutely necessary.
World's Natural Gas Production in 2000
Unit: Billion cubic meters

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Source: BP Statistical Review 2001

World's Oil Production in 2000
Unit: Thousand barrels per day

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Source: BP Statistical Review 2001

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