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# "A Survey of Natural Gas Production, Consumption and Trade in ASEAN"

by

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# A Survey of Natural Gas Production, Consumption and Trade in ASEAN

by

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March 1986

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## Abstract

The paper presents an overview of the supply and demand for natural gas in ASEAN countries for the period up to the early 1980s and beyond. Some possible cooperative measures among these countries are also suggested concerning natural gas development. A brief review on the role of natural gas in the world energy scene is also made.

Among all commercial energy sources, in 1980 natural gas ranked second after crude oil in ASEAN's energy consumption and production. In 1981, the proven reserves of oil and gas in ASEAN was about 2% of the world total, and ASEAN accounted for 13% and 6% of all natural gas produced and consumed in developing countries respectively. It is likely that ASEAN's proven reserves of natural gas will increase in the future, and natural gas will be the fastest growing energy in ASEAN.

Indonesia is by far the largest gas producer in ASEAN, followed by Malaysia. Most of their gas production have been for export in the form of LNG, mainly to Japan. In the future, although most production increases are planned for LNG export to Japan and South Korea, more gas will also be used domestically, in petrochemical industries, some large industries (such as cement and steel), and power generation.

In Thailand, all natural gas produced has been consumed as a fuel in power generation and a cement plant. Recently, the country began to operate a gas separation plant which yielded LPG and other feedstocks for future use in petrochemical industries and a fertilizer plant. In Philippines and Singapore, no significant amount of natural gas has been found. Consequently, it has not played any

In Thailand, all natural gas produced has been consumed as a fuel in power generation and a cement plant. Recently, the country began to operate a gas separation plant which yielded LPG and other feedstocks for future use in petrochemical industries and a fertilizer plant. In Philippines and Singapore, no significant amount of natural gas has been found. Consequently, it has not played any role in the energy scene of these two countries.

Four areas of cooperation among ASEAN countries on natural gas development are identified:

1. Efforts should be made to clearly define their shared boundaries in offshore areas where natural gas is likely to be discovered. Where territorial claims are overlapping, an agreement on resource sharing should be developed.

2. The plans on natural gas utilization, particularly in petrochemicals, fertilizer and steel, in each individual ASEAN country should be based on economic and financial viability, rather than simply on the existence of natural gas. This is to avoid excess supplies of gas-related products behind the wall of tariff and non-tariff protection in the region.

3. Possibilities should be explored in building a network of gas pipelines linking some or all ASEAN countries in order to increase the region's energy self-reliance.

4. Some mutual benefit can be expected from the sharing of knowledge and information among ASEAN countries on laws, regulations, sale contracts and some technical aspects concerning natural gas.

Contents

# A Survey of Natural Gas Production, Consumption and Trade in ASEAN

## 1. Introduction

The oil price explosion since 1973/74 has prodded the world to diversify its energy sources away from oil, to which the main alternative sources so far have been coal and natural gas. The higher oil prices have also stimulated petroleum exploration and production in both oil-importing and oil-exporting countries. The natural gas found as a by-product in some oilfields is now put to commercial use instead of being flared as in the past era of cheap oil. In some cases exploration activities resulted in the discovery of abundant natural gas as the main product. The large world reserves of natural gas should be one of the main factors which will increase its share in world energy use in the foreseeable future.

The impacts of the oil crisis on each individual economy in the Association of Southeast Asian Nations (ASEAN) vary from country to country, depending on whether the country has a deficit or a surplus in oil. Nevertheless, most have stepped up their efforts in encouraging oil companies to explore for petroleum in their territories, both onshore and offshore. As a result, not only oil, but also natural gas has been found in large quantities in Indonesia, Malaysia, and Thailand. The utili-

zation of natural gas in these countries, both for domestic consumption and export, has increased significantly since the late 1970's. It is expected that the 1980's will witness sharp increases in natural gas production and consumption in ASEAN. Although natural gas is not likely to equal crude oil in terms of commercial value, it has a good potential to become one of the major energy sources in the region.

This paper attempts to present an overview of natural gas demand and supply in the ASEAN countries. Some suggestions will also be made on policies and possible cooperative measures among these countries for their mutual benefits to be derived from this non-renewable resource. The next section discusses the past and present role of natural gas in the world energy scene, as well as its projected consumption and supply in the next 15 years. The paper then deals with the demand and supply situation of natural gas in the ASEAN countries during the past decade. Projections are also made for natural gas demand and supply in each of these countries during the period up to 1990. Finally, some possible cooperative actions on the resource among the ASEAN countries are discussed and tentatively suggested.

## 2. Natural Gas in The World Energy Scene

### 2.1 Background Information(1)

Natural gas is a clean burning fuel with easy combustion control and low emission. The main uses of natural gas are for stationary heating purposes, electricity generation, and as a feedstock for the manufacture of petrochemical products. However, its use is still geographically limited, as over 80% of world gas consumption is produced locally, compared with the corresponding figure of about 40% for oil. This is due to the fact that natural gas is more difficult and costly to be transported than oil. The transportation of natural gas can be done either through pipelines carrying gaseous natural gas or by tankers specially built for shipping liquefied natural gas (LNG). Both modes of transport are inherently inflexible and capital intensive. Therefore, the transport cost per unit of heat delivered for natural gas is higher than that for oil over the same distance. Moreover, the storage of natural gas is more costly and limited than in the case of oil. Although research efforts are being intensified to reduce the huge capital cost of transporting natural gas, particularly in the form of LNG, no technological breakthrough is foreseen which will substantially reduce this cost difference.

The fact that most gas consumption is not internationally traded has insulated the natural gas business from those

international political events which have affected the oil business. Furthermore, the important supply areas for natural gas tend to be politically more stable than the Middle East which is the main supplier of traded oil. Consequently, natural gas is relatively more stable and predictable than oil in terms of supply and price. This comparative stability and its "clean fuel" characteristic make natural gas an attractive alternative to oil, especially for countries which are conscious about their environmental problem.

Because of high costs in transportation and storage of natural gas, security in supply and market becomes very important for both buyers and sellers of natural gas in the world market. In most cases, therefore, supply contracts are of a long-term nature with discrete prices usually linked with oil prices and are specific to one or one group of gasfields. Obviously, with such long-term contracts dominating the business, there is no spot market for natural gas, as exists for oil.

## 2.2 World Reserves

As of 1982, the world proven reserves of natural gas were estimated to be about 2,900 trillion cubic feet (tcf) which were equivalent to over 500 billion barrels of crude oil. The amount is more than 75% of the world proven reserves of crude oil.

Table 1. World Natural Gas Reserves, 1982

| | Tcf | % of total |
|---|---|---|
| North America | 353 | 12.34 |
| South America | 110 | 3.84 |
| Middle East | 731 | 25.56 |
| Europe | 141 | 4.93 |
| Africa | 184 | 6.42 |
| Communist Countries | 1,201 | 41.98 |
| Others | 141 | 4.93 |
| Total | 2,861 | 100.00 |

Source: "Natural Gas", Shell Briefing Service, No.4, 1983

As shown in Table 1, one quarter of the total reserves are located in the Middle East, mainly in Iran (485 tcf), Saudi Arabia (110 tcf), Qatar (60 tcf), Kuwait (30 tcf), and Iraq (27 tcf). Over 40% of the world reserves are found in the Communist countries. Though their figures are less certain

than those in other areas, they probably are in excess of 1,100 tcf, most of which are in the USSR with the world's largest reserves of about 920 tcf. In Africa, Algeria, Nigeria and Libya possess the major gas reserves of 131 tcf, 41 tcf, and 24 tcf respectively. For the Western industrialized countries, large gas reserves are found in the United States (191 tcf), Canada (87 tcf), Netherlands (62 tcf), Norway (43 tcf), Australia (30 tcf), and the United Kingdom (25 tcf). Developing countries with substantial gas reserves (between 20 and 45 tcf) are Venezuela, China, Indonesia, and Argentina.

At the present rate of consumption, the total proven reserves of natural gas will last for around 50 years or more, whereas the proven reserves of conventional crude oil are estimated to be about 30 years' present consumption. Theoretically, it is possible that natural gas could overtake oil as an energy source. However, this possibility depends largely on the technological factors which affect the development and transportation of natural gas. It is more likely that full utilization of gas still cannot be acheived within the next few decades.

## 2.3 World Production and Consumption

The world's natural gas consumption has been growing at about 6.5% per annum over the past 20 years. The growth is attributed to major discoveries and development of large gas reserves and the attractive price of natural gas

compared with that of oil. Natural gas is now the third largest source of energy after crude oil and coal. In 1982, it accounted for about 20% of the world total energy consumption. Its consumption was about 54 tcf which was equivalent to 26 million barrels of oil per day, compared with the oil consumption of 58 million barrels per day. (See Table 2.)

Table 2. World Primary Energy Consumption, 1982

| | Million barrel per day oil equivalent | % of total |
|---|---|---|
| Crude oil | 58 | 43.6 |
| Coal | 35 | 26.3 |
| Natural gas | 26 | 19.6 |
| Hydro | 10 | 7.5 |
| Nuclear | 4 | 3.0 |
| Total | 133 | 100.0 |

Source: "Natural Gas", Shell Briefing Service, No.4, 1983

The rate of growth of natural gas consumption has slowed down since 1979 such that in 1982 the world gas consumption was at the same level as in 1981. The declining demand has been due to stagnation in some world major markets, particularly Europe and America.

Tables 3 and 4 respectively show natural gas consumption and production of the world's major consuming and producing countries in 1980. The United States was clearly the largest natural gas consumer and producer with its consumption and output accounting for 39% and 35% of the world total. This is followed by the USSR which produced and consumed 26% of the world total. Other industrialized countries with more than 1% share of world production are Netherlands, Canada, the United Kingdom, and West Germany. These four countries were also among the world's major gas consumers, although their consumption was much smaller than that of the United States or the USSR. Developing countries with substantial gas production include China, Mexico, Indonesia, Bolivia, Pakistan, Venezuela, and Algeria. None of them, except for China, can be regarded as a large consumer of natural gas.

It is obvious from the data above that both the production and consumption of natural gas were concentrated in industrialized countries. The United States, the USSR, Western Europe, and Japan consumed and produced over 80% of the world total. Among them, only the USSR had a surplus in natural gas, while the other three areas had to import.

Since the 1940's natural gas consumption in the United States has increased rapidly. Th development of pipeline technology reduced the cost of natural gas transportation and encouraged import from neighboring countries, notably Mexico and Canada. In 1970 the United States produced about 88% of its

Table 3. World Natural Gas Consumption, 1980

| | Tcf | % of world total consumption |
|---|---|---|
| United States | 20.5 | 39.0 |
| USSR | 13.7 | 26.0 |
| Canada | 2.0 | 3.8 |
| West Germany | 1.7 | 3.2 |
| United Kingdom | 1.7 | 3.2 |
| Netherlands | 1.3 | 2.5 |
| France | 1.0 | 1.9 |
| Italy | 0.9 | 1.7 |
| Japan | 0.5 | 1.0 |
| China | 0.5 | 1.0 |
| Others | 8.8 | 16.7 |
| Total | 52.6 | 100.0 |

Source: Sevinc Carlson, "Southeast Asian Energy as a Dimension of the Pacific Basin Community", in The Invisible Nexus: Energy and ASEAN's Security, edited by Kusuma Snitwongse and Sukhumbhand Paribatra, 1984.

Table 4.Natural Gas Production in Major Producing Countries, 1980

| | Tcf | % of world total production |
|---|---|---|
| United States | 20.3 | 34.6 |
| USSR | 15.4 | 26.2 |
| China | 3.5 | 5.9 |
| Netherlands | 2.8 | 4.8 |
| Canada | 2.7 | 4.6 |
| United Kingdom | 1.5 | 2.6 |
| Mexico | 1.2 | 2.0 |
| Romania | 1.2 | 2.0 |
| Indonesia | 1.0 | 1.8 |
| West Germany | 0.7 | 1.3 |
| Norway | 0.7 | 1.2 |
| Bolivia | 0.6 | 1.1 |
| Pakistan | 0.6 | 1.0 |
| Italy | 0.5 | 0.9 |
| Venezuela | 0.5 | 0.9 |
| Algeria | 0.5 | 0.9 |
| Others | 4.9 | 8.4 |
| Total | 58.6 | 100.0 |

Source: Sevinc Carlson,"Southeast Asian Energy as a Dimension of the Pacific Basin Community", in The Invisible Nexus: Energy and ASEAN's Security, edited by Kusuma Snitwongse and Sukhumbhand Paribatra, 1984.

domestic consumption and import the remaining 12% from Canada and Mexico through sophisticated pipeline systems. Total gas consumption in the United States rose to about 22.8 tcf in 1973 and has since declined to 18.8 tcf in 1982. Of this consumption amount, 43% was used in the residential and commercial sectors, 37% went to the industrial sector, and the remaining 20% was burned in power stations. In spite of the recent downturn in consumption, natural gas is still the second most important primary energy behind oil, and contributes to about 27% of total primary energy consumption in the United States.

The USSR has developed its natural gas industry since the 1950's. With very high growth in production and consumption, the USSR overtook the United States to become the world's largest producer of 18.3 tcf of natural gas in 1982.(2) It can supply all the gas used in the country and export about 2 tcf a year to Eastern and Western Europe.

The large-scale production and utilization of natural gas in Western Europe began after the important discovery of the Groningen Field in Netherlands in the early 1960's, and the exploitation of various offshore gas fields in the North Sea in the later period. Natural gas consumption in Western Europe as a whole has grown at the impressive rate of 16% per year since 1960, and is currently about 17% of Europe's total primary energy consumption. More than 85% of its total gas consumption was produced in the area in 1982, with the rest being imported from

the USSR through pipeline, and from North Africa in the form of LNG.(3)

Among the four major consuming areas, Japan is the only country with no significant indigenous gas reserves. However, due to its effort to reduce the serious atmospheric pollution and oil import dependence, natural gas---a low sulphur fuel, has become an attractive alternative energy source. Japan has to import most of its consumed gas, mainly in the form of LNG. About 70% of its LNG imports are used as fuel in power stations. At present, natural gas constitutes about 7% of Japan's total primary energy consumption. Japan is currently the world's largest LNG importer, receiving most of its LNG from Alaska, Brunei, Indonesia, and Abu Dhabi.

Natural gas reserves exist in several developing countries, including those which have to import oil. Based on the existing reserves, there is a good potential in developing countries for much higher production and consumption of natural gas than the current levels. The most important barrier to exploiting natural gas as an alternative source of energy in developing countries is the high cost of transporting it. Natural gas transportation for domestic use or for international trade requires high capital costs and high technology, which are serious constraints in developing countries. Consequently, natural gas has been underutilized in these countries. In most oil-producing developing countries, the associated gas is usually burned away

or flared. It has been estimated that about 12.5% of the world gas production is flared as it comes out of the ground, and the wastage rate is much higher in developing countries. Because of long lead times between discovery and gas utilization and lumpy investment in gas development, some non-associated gas fields in several developing countries have not been developed.

For developing countries as a group, natural gas constituted about 10% of their total commercial energy consumption in 1980. About 20% of their total gas production was exported as LNG or by pipeline in that year. Of their total domestic gas consumption, about 60% was used in power generation and industry, 30% as feedstock in fertilizer and petrochemicals and 10% in the residential and commercial sectors.

Due to limited domestic demand for natural gas, its exports from developing countries have become increasingly important and grew rapidly from 5.5 million tonnes of oil in 1970 to about 40 million tonnes of oil in 1982. Most of the increases during the period can be attributed to the very high growth of LNG exports, notably from Algeria and Indonesia, which together accounted for most of the world's LNG exports in the past five years. As shown in Table 5, the world LNG trade is clearly a North-South transaction in which most exporting countries are developing countries and all importing countries are industrialized countries. The dominant LNG suppliers are Algeria and Indonesia, while Japan is the largest importer accounting for

two-thirds of the world total trade in 1982.

Table 5. World LNG Trade by Country

Unit: mmcfd

| | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|
| Exporting countries: | | | | | |
| Abu Dhabi | 170 | 168 | 252 | 249 | 288 |
| Algeria | 617 | 1,106 | 639 | 710 | 1,062 |
| Brunei | 712 | 732 | 725 | 687 | 673 |
| Indonesia | 503 | 833 | 1,111 | 1,122 | 1,204 |
| Libya | 389 | 348 | 198 | 71 | 77 |
| US | 126 | 133 | 112 | 140 | 125 |
| World total | 2,516 | 3,320 | 3,027 | 2,979 | 3,429 |
| Importing countries: | | | | | |
| France | 278 | 306 | 202 | 400 | 667 |
| Italy | 231 | 231 | 131 | - | - |
| Japan | 1,510 | 1,866 | 2,199 | 2,198 | 2,290 |
| Spain | 193 | 163 | 178 | 210 | 217 |
| UK | 72 | 61 | 81 | 40 | 2 |
| US | 231 | 692 | 235 | 131 | 223 |
| World total | 2,516 | 3,320 | 3,027 | 2,979 | 3,429 |

Source: Petroleum Economist, December 1983, p.454.

## 2.4 Future Prospects

According to the World Bank forecast, natural gas will increase its share in the world's commercial primary energy above the present level of 20% in the next decade. This is still lower than the shares of oil and coal, but oil is expected to decline in its relative importance to below 40%. Most natural gas will be produced and consumed by industrial countries, but the shares of developing countries will grow significantly. More associated gas and local large reserves are to be utilized in developing countries. The supply of natural gas in Asian countries, in particular, will grow at a higher rate than the world total supply. In its study on world gas supply and demand for 1980-2000, the International Gas Union (IGU) projected the Asian supply to increase at 25% per annum in 1980-1990 and at 14% in 1990-2000, while the corresponding growth rates of world supply are 15% and 11%, assuming a moderate rate of increase of oil price.(4)

In the next two decades, most natural gas produced in the world will still be locally consumed, but its percentage in total production is likely to decrease from 88% in 1982 to 81%-84% in 2000. International pipeline gas trade is forecast to grow from 10% of total gas production in 1982 to 12%-14% in 2000. International LNG trade will also expand at a very high rate from 2% of total gas production in 1982 to 4%-5% in 2000.(5) As for LNG, which is exported mainly by some developing countries, the

biggest market for LNG export in the future will still be Japan, followed by Western Europe, and the United States. Consequently, the size of LNG world trade volume depends largely on Japan's LNG consumption. The estimate of LNG world market for 1990 ranges from 2.3 tcf to 3.2 tcf. However, beyond 1990, the growth of LNG demand is likely to be more moderate than in the 1970's because of the possible increasing competition from nuclear energy in power generation. In Asia, the new markets for LNG are expected to be South Korea, Taiwan, and possibly Singapore.

In the future, natural gas will still be consumed as a fuel for stationary uses, particularly in power generation and industry. However, recent technological progress enables a few countries to use natural gas as compressed natural gas (CNG), LPG, or methanol for transport. Although we cannot expect these unconventional uses of natural gas to form a large proportion of total gas consumption, they can be particularly important to some countries which possess large gas reserves.

The future of natural gas as an energy depends on the factors that determine the cost of gas transportation and development, the inflexibility of gas supply systems, and the security of supply. These will eventually affect the competitiveness of natural gas vis-a-vis crude oil, coal, and nuclear. With an abundance of gas resource, and with its characteristic of being a clean burning fuel, natural gas is likely to play a greater role as an energy source in the long run.

## 3.Natural Gas in ASEAN

### 3.1 ASEAN

Table 6 shows the energy picture of ASEAN in the context of the low- and middle-income developing countries in 1980. In terms of commercial primary energy production and consumption, the figures for ASEAN in 1980 accounted for 6% to 7% of the total of developing countries. With abundant petroleum resources and the largest population in ASEAN, Indonesia dominated the rest of ASEAN in both energy production and consumption. Among all commercial primary energy sources, natural gas ranked second in ASEAN's energy consumption and production--far behind liquid fuels, which consist mainly of crude oil. ASEAN accounted for 13% and 6% of all natural gas produced and consumed in developing countries respectively. While no natural gas was imported by ASEAN, 45% of the natural gas export from developing countries originated in Indonesia, which was the largest natural gas exporter in the developing world.

Estimated in 1981, the proven reserves of oil and natural gas in ASEAN was about 2% of the world total. (See Table 7.) Thus, the ASEAN figures seem rather small compared with the world estimate. However, the area has been known to have promising hydrocarbon potentials. And while it has not been as much explored as in many parts of the world, the above figures may have been underestimated. As we will see in the next sections

Table 6. Production, Consumption, and Trade of Commercial Primary Energy in ASEAN, 1980

(million tonnes of oil equivalent)

| | I | M | P | S | T | ASEAN |
|---|---|---|---|---|---|---|
| Production | 93.6 | 15.2 | 2.1 | - | 0.7 | 111.7 (7.27) |
| Liquid fuels | 78.7 | 13.9 | 0.5 | - | 0.01 | 93.1(10.25) |
| Solid fuels | 0.2 | - | 0.1 | - | 0.2 | 0.5 (0.14) |
| Natural gas | 14.0 | 1.0 | - | - | - | 15.0(13.43) |
| Primary electricity | 0.7 | 0.2 | 1.5 | 0.003 | 0.5 | 3.0 (2.61) |
| Consumption | 26.7 | 8.4 | 12.6 | 14.2 | 11.9 | 73.9 (6.36) |
| Liquid fuels | 21.2 | 7.1 | 11.0 | 14.2 | 11.1 | 64.6 (5.33) |
| Solid fuels | 0.2 | 0.04 | 0.1 | 0.001 | 0.3 | 0.7 (0.17) |
| Natural gas | 4.6 | 1.0 | - | - | - | 5.6 (6.05) |
| Primary electricity | 0.7 | 0.2 | 1.5 | - | 0.5 | 3.0 (2.61) |
| Imports | | | | | | |
| Liquid fuels | 2.7 | 3.7 | 10.6 | 32.3 | 11.1 | 60.3(21.84) |
| Solid fuels | 0.02 | 0.04 | - | 0.006 | 0.1 | 0.2 (1.19) |
| Natural gas | - | - | - | - | - | - |

Table 6 (continued)

Exports

| | | | | | | |
|---|---|---|---|---|---|---|
| Liquid fuels | 60.2 | 10.5 | 0.1 | 18.1 | 0.02 | 88.9(13.84) |
| Solid fuels | 0.02 | - | - | 0.005 | - | 0.03 (0.44) |
| Natural gas | 9.4 | - | - | - | - | 9.4(44.65) |

Note: 1) I, M, P, S, and T stand for Indonesia, Malaysia, Philippines, Singapore and Thailand respectively.

2) Figures in parentheses are percentages of ASEAN totals in developing countries' totals.

3) Liquid fuels include crude oil and petroleum products, while solid fuels refer to coal, lignite and peat.

Source: The Energy Transition in Developing Countries, the World Bank, 1983.

on individual ASEAN countries, the proven reserve estimates for Indonesia and Malaysia in the later period are higher than those in Table 7. Moreover, a relatively large number of natural gas development projects have been planned and under construction in Indonesia, Malaysia, and Thailand. (See Table 8.) In terms of production and consumption, natural gas will be the fastest-growing energy in ASEAN, and its production is expected to increase from the level of 1,200 billion cubic feet in the early 1980's to over 3,500 billion cubic feet in 1990.

Table 7. Estimated Proven Reserves of Oil and Natural Gas in ASEAN, 1981

| | Oil (million barrels) | Natural gas (trillion cubic feet) |
|---|---|---|
| Indonesia | 9,600 | 23.5 |
| Malaysia | 3,000 | 15.0 |
| Philippines | 20 | 0.01 |
| Thailand | - | 0.0 |
| ASEAN total | 12,620 | 46.51 |
| World total | 648,524 | 2,638.5 |

Source: International Petroleum Encyclopedia, 1981

Table 8. Number of Natural Gas Development Projects in ASEAN

| | Operating | Planned | Under construction |
|---|---|---|---|
| Indonesia | 184 | 24 | 17 |
| Malaysia | 40 | 18 | 11 |
| Philippines | 2 | - | - |
| Thailand | 11 | 14 | - |

Source: Petroleum News, March 1983.

3.2 Indonesia

Among the ASEAN countries, Indonesia is most abundant with oil and natural gas. Its proven reserves of oil are estimated to be about 9.6 billion barrels with the probable reserves of 10-50 billion barrels. The wide range of probable reserves is due to the fact that out of 40 basins with petroleum potential, only 12 are producing oil and gas, while the rest are scarcely explored. In 1982, its natural gas reserves were estimated to be about 34.4 trillion cubic feet.(6) This figure excludes natural gas reserves in the East Natuna which is expected to have the largest quantity in the South China Sea. If the probable reserves are included, Indonesia's natural gas reserves are estimated by the Association of Indonesian Geologists to be 264.4 tcf, as shown in Table 9.

Table 9. Gas Reserves in Indonesia

| | Trillion cubic feet | % of total |
|---|---|---|
| Onshore | 89.4 | 33.8 |
| Shallow offshore | 75.3 | 28.5 |
| Deep offshore | 99.7 | 37.7 |
| Total | 264.4 | 100.0 |

Source: Petroleum News, July 1982.

Before 1960, most produced natural gas was flared at the producing oilfields. Since then, natural gas development in Indonesia has grown very rapidly. The discovery of relatively large gas reserves in the Raja field in 1950 opened a new era for the gas industry in Indonesia. An 80 kilometre pipeline was built from the gasfield. This was followed by the establishment of fertilizer plants, steel and cement industries to exploit both associated and non-associated gas. After two huge reserves of non-associated gas were discovered in Arun, North Sumatra in 1971, and in Badak, East Kalimantan in 1972, LNG trains and terminals were built. By the end of 1977, the first shipments of LNG were on the way. Three years later, gas utilization in Indonesia was improved in the sense that 78% were economically utilized compared with only 34% in 1975.(7)

Production

Natural gas production in Indonesia has increased from about 110 billion cubic feet (bcf) per year during the late 1960's to 202 bcf in 1974 and just over 1,000 bcf in 1980, as shown in Table 10. The increases were particularly high between 1976 and 1978 when natural gas was piped to various industries in West Java in 1976. Before that, most utilized gas was channelled to be used as fuel and raw material in a fertilizer plant in Palembang. In 1977, the production increased to 540 bcf in 1977 and to 800 bcf in 1978 due to the beginning of LNG exports from Arun and Badak. In 1982, natural gas production in Indonesia was

about 1,200 bcf per year, over half of which was destined for LNG exports.

Table 10. Natural Gas Production in Indonesia, 1975-1981

| | Billion cubic feet | % change |
|---|---|---|
| 1974 | 202.0 | |
| 1975 | 222.2 | 10.0 |
| 1976 | 312.4 | 40.6 |
| 1977 | 542.8 | 73.7 |
| 1978 | 820.1 | 51.1 |
| 1979 | 998.5 | 21.7 |
| 1980 | 1,045.7 | 4.7 |
| 1981 | 1,123.7 | 7.5 |

Source: Petroleum News, July 1982.

Utilization

Out of about 1,200 bcf of natural gas currently produced in Indonesia, 900 bcf are utilized in various activities. The percentage of flared gas was considerably reduced from 36% in 1972 to 20% in 1981. The pattern of gas utilization in Indonesia is shown in Table 11. During 1979 and 1981, about half of total gas utilization was processed into LNG, exclusively for export. Almost 30% was used in gas lift and pressure maintenance in oilfields, and nearly 10% was burned as fuel in refineries and

for its own production. The remaining 10%-15% was consumed by fertilizer plants, other large industries (e.g. cement and steel smelting industries), and some small industries.

Table 11. Natural Gas Utilization in Indonesia, 1978-1981

(billion cubic feet)

| | 1978 | 1979 | 1980 | 1981 |
|---|---|---|---|---|
| Production | 900.2 | 981.3 | 1,041.3 | 1,123.7 |
| Utilization | 510.0 | 771.8 | 810.7 | 901.1 |
| Fertilizer | 47.4 | 47.8 | 51.1 | 50.5 |
| LPG and carbon black | 2.2 | 30.1 | 23.2 | 23.5 |
| LNG | 224.9 | 383.3 | 472.3 | 482.8 |
| Other large industries | 11.1 | 32.1 | 40.2 | 56.7 |
| Small industries | 0.05 | 0.2 | 0.4 | 0.5 |
| Fuel in refineries | 6.5 | 9.2 | 10.6 | 10.6 |
| Gas lift | 42.0 | 42.7 | 42.1 | 41.3 |
| Pressure maintenance in oilfields | 131.7 | 172.0 | 114.7 | 181.0 |
| Fuel for own use | 44.1 | 47.4 | 48.1 | 54.2 |

Source: Hadi Soesastro and Budi Sudarsono, "Mineral and Energy Development in Indonesia", a paper in ASEAN-Australia Project on Trade in Minerals and Energy, 1983.

Since 1977 LNG has become an increasingly important export item of Indonesia. As indicated in Table 12, while

the volume of LNG export went up by sixfold during the 1977-1982 period, its value shot up tremendously from US$ 160 million or only 1.5% of total export earnings in fiscal year 1977/78 to over US$ 2,300 million or 10% of total export revenue in 1981/82. Currently all LNG is supplied by plants in Badak, East Kalimantan, and Arun, North Sumatra, in both of which huge gas-fields are located. In Badak, Indonesia's first LNG plant was completed in 1977 with two production units or "trains", and the combined capacity of 3.3 million tonnes of LNG per year, or about 530 million cubic feet a day of required natural gas. The Arun plant was established in 1978 with 3 production units with the combined capacity of 4.5 million tonnes of LNG per year, or about 840 mmcfd of natural gas.(8)

After the two plants were in operation, Indonesia's natural gas production for LNG was increased from 53 bcf in 1977 to over 480 bcf in 1981. The entire LNG production has been exported to Japan under a long term contract. To meet the growing Japanese demand for natural gas, both plants have been operated above design capacity. In 1983, two more trains were added at Badak bringing the four-train plant capacity to 8 million tonnes of LNG per year, or 1,400 mmcfd of natural gas. The capacity of the Arun plant will be expanded to 7.8 million tonnes of LNG per year when two more trains are completed in 1984. Another train is also scheduled to be built at Arun to supply LNG for South Korea, starting in 1986. It is expected that the current output of LNG will be doubled by the end of 1986.

Table 12. Indonesia's Exports of Crude Oil, LNG, and Others

| | 1977/78 | 1978/79 | 1979/80 | 1980/81 | 1981/82 |
|---|---|---|---|---|---|
| Export Value | | | | | |
| (million US$) | | | | | |
| Oil | 7,191 | 6,958 | 10,995 | 15,187 | 16,482 |
| LNG | 162 | 516 | 1,345 | 2,111 | 2,342 |
| Others | 3,507 | 3,979 | 6,171 | 5,587 | 4,170 |
| Total | 10,860 | 11,353 | 18,511 | 22,885 | 22,994 |
| Percent of Total Export Value | | | | | |
| Oil | 66.2 | 60.4 | 59.4 | 66.4 | 71.7 |
| LNG | 1.5 | 4.5 | 7.3 | 9.2 | 10.2 |
| Others | 32.3 | 35.1 | 33.3 | 24.4 | 18.1 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Export Volume | | | | | |
| Oil | | | | | |
| (million barrels) | 533 | 503 | 487 | 481 | 469 |
| LNG | | | | | |
| (trillion BTU) | 71 | 216 | 373 | 424 | 458 |

Note: 1.Export value is based on fob. value.

2.Oil exports include crude oil and oil products.

Source: Bank of Indonesia.

Demand and Supply Projections for 1985-2000

An attempt is made to project the demand and supply trends of natural gas in Indonesia in the next 15 years. Basically, there are two approaches used in our projection. The first is to base our projection on the past data, either in the form of past time trend or past growth rate. The second approach is to study future plans which affect the demand and supply of natural gas. A priori, we believe that the second approach tends to be more accurate than the first if the future plans we base our projection on are quite firm. However, in some cases, there is inadequate information on the future for us to take the second approach, and thus we have to base our judgment on the past experience which is most likely to foretell the future.

On the supply side, there is no doubt that, with the existing large reserves, Indonesia can potentially produce natural gas at a level much higher than the current one. There is no definite production plan for the period beyond 1986. Therefore, our projection on production has to be based on the past production trend. Using the average growth rate during the 1979-1981 period of 11.3% per year, we arrive at the projected natural gas production in the next 15 years for Indonesia, as shown in Table 13. The figures indicate that gas production will reach 3,000 bcf in 1990, 5,000 bcf in 1995, and over 8,000 bcf in 2000.

Table 13. Projections of Indonesia's Production and Utilization of Natural Gas, 1985-2000

(billion cubic feet)

| | 1981 | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|---|
| Production | 1,123.7 | 1,722.3 | 2,937.2 | 5,009.1 | 8,542.5 |
| Utilization | 901.1 | 1,379.1 | 2,444.9 | 4,388.0 | 7,983.4 |
| Fertilizer | 50.5 | 55.1 | 61.4 | 68.5 | 76.4 |
| LPG, carbon black | 23.5 | 29.7 | 39.7 | 53.1 | 71.0 |
| LNG | 402.8 | 746.6 | 1,325.6 | 2,353.6 | 4,178.8 |
| Other large industries | 56.7 | 108.6 | 244.6 | 550.9 | 1,241.0 |
| Small industries | 0.5 | 0.6 | 0.9 | 1.3 | 1.8 |
| Fuel in refineries | 10.6 | 11.9 | 13.6 | 15.6 | 18.0 |
| Gas lift, pressure maintenance | 222.3 | 359.9 | 657.2 | 1,200.2 | 2,191.8 |
| Fuel for own use | 54.2 | 71.7 | 101.9 | 144.8 | 205.6 |

Note: The figures for 1981 are from Budi Soesastro and Budi Sudarsono, "Mineral and Energy Development in Indonesia", a paper in ASEAN-Australia Project on Trade in Minerals and Energy, 1983.

In projecting the future demand for natural gas, we are aware of the fact that it depends largely on the price of gas relative to that of oil, and factors that may affect the transportation and development of natural gas. Limited information on these factors make any projection difficult.

As mentioned above, LNG accounts for half of the natural gas utilized in Indonesia. Therefore, changes in the demand for LNG will significantly affect the total demand for natural gas. Since all LNG is exported, and the only buyer so far is Japan, it is important to examine the Japanese demand for LNG import in order to make a projection for the demand for Indonesia's LNG. Japan is the world's biggest LNG importer, accounting for over 70% of all LNG shipment in 1981. The demand for LNG in Japan has increased quite rapidly in the past five years. However, according to the Institute of Energy Economics in Tokyo, their projections of Japan's economic growth and energy demand have consistently been lower than the Ministry of International Trade and Industry (MITI) projections. The Institute predicts that if the real GNP growth rate in 1990 is 3.1%, the demand for LNG will increase from 16.91 million tonnes in 1981 to 25.5 million tonnes in 1985 and 35 million tonnes in 1990. These figures are about 0.8 million tonnes lower than the revised long-range projection of MITI. With the 4% rate of economic growth, the demand for LNG would rise to 37 million tonnes in 1990. However, while the Institute of Energy Economics projections seem to be realistic, the gas industry and power companies in Japan project something higher than these figures due to the favorable effect of natural gas as a "clean" fuel, and increasing investment in LNG technology. Moreover, LNG can be supplied on a rather stable and secure basis because of long term purchase contracts.

As shown in Table 14, Indonesia is the largest supplier of LNG for Japan. The gas buying contract from the United States, specifically from Alaska, will expire in 1984, and it is still uncertain whether it will be renewed. In 1982, Japan imported 7.5 million tonnes of LNG from Indonesia under long term contracts, and 1.3 million tonnes under short term contracts. As indicated in Table 15, Indonesia is presently committed to supply Japan 8.8 million tonnes of LNG, which amounts to over 400 bcf. The contracted future import of 6.3 million tonnes a year will increase the demand for natural gas by over 300 bcf to about 750 bcf by 1986.

Table 14. LNG Import by Japan, 1980 and 1981

(million tonnes)

| Exporter | 1980 | 1981 |
|---|---|---|
| Indonesia | 8.5 | 8.7 |
| Brunei | 5.5 | 5.2 |
| Abu Dhabi | 1.9 | 2.0 |
| United States | 0.9 | 1.1 |

Source: Petroleum News, July 1982.

Table 15. Japan's LNG Import Commitments

(million tonnes per year)

| Supplier | Present Commitments | Contracted Future Imports | Under Discussion |
|---|---|---|---|
| Abu Dhabi | 2.06 | | |
| Malaysia | 1.7 | 4.3 | |
| Brunei | 5.14 | | |
| Indonesia | 8.8 | 6.5 | |
| Australia | | | 6.0 |
| Canada | | | 2.6 |
| Alaska | .96 | | |

Source: Petroleum News, May 1982.

In 1983, Indonesia concluded a deal with South Korea to supply its LNG at the rate of 2 million tonnes a year starting 1986. In the past years, Indonesia has been discussing LNG deals on and off with the United States and Taiwan. However, for the United States, the prospect of future LNG sale has to be considered unlikely due to the new large gas reserves found in Western Canada and Alaska. There was also discussion about exporting about 2 million tonnes of LNG from Indonesia to Singapore, although an overland pipeline from Malaysia may be a cheaper alternative.

All in all, it is very likely that LNG production in Indonesia will increase to about 950 bcf by 1986. Beyond that,

the prospect of increasing demand for LNG will depend on LNG prices, the development of gasfields in other producing countries, and economic growth in the Pacific region. However, if the Japanese projection of energy demand for LNG is correct, in 1990 Indonesian LNG export to Japan will increase to at least 13.2 million tonnes or 900 bcf of natural gas in 1990, assuming that the present market share is to be maintained. With other potential importing markets, Indonesia's LNG export in 1990 is expected to increase to 1,325 bcf of natural gas equivalent. The projected figures of LNG export in 1995 and 2000 are estimated from the average growth rate during the 1985-1990 period. (See Table 13.)

The demands for natural gas in fertilizer plants, LPG and carbon black production, other industries, gas lift and pressure maintenance in oilfields, including as a fuel in refineries are all estimated on the basic of their past growth rates which are judged to be the most reasonable estimates of future growth. The following growth rates are used in our projection of various future domestic uses of natural gas:

| | |
|---|---|
| Fertilizer | 2.2% p.a.(1979-1981) |
| LPG and carbon black | 6.0% p.a.(1970-1978) |
| Other large industries | 17.7% p.a.(1980-1981) |
| Small industries | 7.2% p.a.(1980-1981) |
| Fuel for refineries | 2.8% p.a.(1975-1978) |

| | |
|---|---|
| Gas lift and pressure maintenance | 12.8% p.a.(1979-1991) |
| Fuel for own use | 7.3% p.a.(1979-1991) |

The results of these projections are shown in Table 13. The projected total gas utilization more than doubles during the 1981-1990 period, and increases to about 4,390 bcf and almost 8,000 bcf in 1995 and 2000 respectively. Over half of the total use is expected to be converted into LNG for export throughout the projected period. The major domestic uses of natural gas are anticipated to be for gas lift and pressure maintenance in oilfields, and to be used as a fuel in large industries, including fertilizer, petrochemicals, cement, and steel.

## 3.3 Malaysia

In 1982, the major source of energy requirement in Malaysia was products from crude oil which represent over 90% of the country's total energy consumption. Hydroelectricity and traditional energy sources account for only less than 10% of total energy use.(9) In 1982, the proven reserves of oil were estimated to be 2.5-3 billion barrels, compared with 1.04 billion barrels given in 1979 and 0.9-1 billion barrels estimated some years before that. The country's crude oil production increased from 10,000 barrels per day in the early 1970's to about 300,000 barrels per day, as shown in Table 16.

Up to 1977, the two prominent oilfields were in Sarawak (operated by Sarawak Shell) and Sabah (operated by Shell and Esso) which produced about 61% and 39% of the total crude oil production respectively. In 1978, the third oilfield was discovered in Trengganu which began to add about 42,200 barrels per day, rising to about 100,000 barrels a day in 1979. The contribution of crude oil production at Trengganu offset the declining output from some older areas in Sarawak, as shown in Table 17.

Energy consumption in Malaysia increased at the rate of 9% per annum. The consumption of oil products rose from about 63,330 barrels per day in 1970 to over 160,000 barrels a day.(10) Electricity generation, the country's largest energy

Table 16. Crude Oil Production in Malaysia, 1960-1980

| Year | Barrel/day |
|---|---|
| 1960 | 1,189 |
| 1965 | 962 |
| 1970 | 17,969 |
| 1975 | 98,003 |
| 1976 | 165,429 |
| 1977 | 183,517 |
| 1978 | 216,907 |
| 1979 | 292,962 |
| 1980 | 300,000 (a) |

(a) Estimate

Source: Petroleum Economist, May 1980

consumer, consumed about 29% of total energy consumption, followed by transportation (20%), manufacturing industries (19%), and agriculture (6%).(11)

## Reserves and Production

Although Malaysia could easily increase its crude oil production to 500,000 barrels per day with the existing reserves, the emphasis has recently been shifted away from oil towards natural gas, thus slowing down the rate of oil exploitation. The government, through Petronas, is turning steadily

Table 17. Malaysian Crude Oil Production by Field, 1977-1979

(barrel/day)

| State | Operator | Field | 1977 | 1978 | 1979 |
|---|---|---|---|---|---|
| Sarawak | Sarawak Shell | Baronia | 50,821 | 41,095 | n.a. |
| | | Tukau | 23,098 | 26,031 | n.a. |
| | | W. Lutong | 12,016 | 10,557 | n.a. |
| | | Baram | 18,907 | 8,033 | n.a. |
| | | Betty | - | 2,706 | n.a. |
| | | Fairly-Baram | 4,576 | 2,436 | n.a. |
| | | Bakau | 2,792 | 2,197 | n.a. |
| | | Total | 112,210 | 93,105 | 110,400 |
| Sabah | Sabah Shell | | | | |
| | Petroleum | Samarang | 63,244 | 70,502 | 75,900 |
| | Esso Production | | | | |
| | Malaysia | Tembungo | 8,063 | 11,091 | 6,600 |
| | | Total | 71,307 | 81,593 | 82,500 |
| Trangganu | Esso Production | | | | |
| | Malaysia | Pulai/Tapis/ | | | |
| | | Bekok | - | 42,209 | 99,200 |

Source: Petroleum Economist, May 1980

towards natural gas as a major alternative energy source to oil. Since the early 1970's, when large non-associated gas reserves were found in the north of Sarawak, and especially when it was confirmed in 1979 that the natural gas reserves were as large as

27 trillion cubic feet, natural gas has become a priority in Malaysia. In 1978, Shell reported the figure of 6 trillion cubic feet of associated gas, bringing the total reserves to about 33 trillion cubic feet, which was four times greater than the oil reserves in terms of heat value. The discovered gas reserves are located in 45 offshore areas around the oil-producing fields.

Gas production in Malaysia started in 1973. (See Table 18.) Up to 1983, most gas produced was associated with oil. When the Trengganu oil fields began operation in 1978, the production of natural gas increased from 21.8 bcf in 1977 to 85.1 bcf in 1978. Of the total output of 85.3 bcf in 1981, Sarawak Shell was probably responsible for 60%, while 10%-15% was from Shell's Sabah fields and the rest was split between Esso at Trengganu and at Sabah.

Consumption

In the 1970's, only a small proportion of produced gas was utilized, while most was flared at production sites. Throughout the 1970's, only 8-9 mmcfd was used from the Sarawak fields which were located close to the shore. The largest were a Brunei LNG plant, which consumed about 4 mmcfd from the Fairly-Baram Field, and the Sarawak Electricity Council power station at Miri. In 1980, about 5% of gas production or about 16 mmcfd was used on the platforms for power generation, and about 9.5 mmcfd were utilized for other commercial purposes. Therefore, with the

Table 18. Natural gas Production in Malaysia, 1973-1981

| Year | Billion cubic feet |
|---|---|
| 1973 | 3.2 |
| 1974 | 2.9 |
| 1975 | 5.9 |
| 1976 | 4.3 |
| 1977 | 21.8 |
| 1978 | 85.1 |
| 1979 | 105.6 |
| 1980 | 94.5 |
| 1981 | 85.8 |

Source: Department of Mines, Malaysia

amount of 327 mmcfd of gas produced, the total of 300 mmcfd was flared. Gas utilization was limited to the area close to the shore due to the lack of liquefaction and transportation systems. In fact between 1973 and 1980, the rate of gas flaring once declined in 1975 when a Brunei LNG plant was completed and took about 4 mmcfd from the Fairly-Baram field through a gas collection pipeline grid. Again in 1978, gas flaring increased after Esso's Trengganu fields began to supply their oil. The Malaysian authority then became more concerned with the very high rate of flaring and proposed a gas conservation plan to reduce flaring even at the cost of declining oil production in some oil fields. This policy is in accordance with the National Oil Depletion

Policy which aims at prolonging the duration of the country's oil production. Each contractor was asked to reduce the rate of flaring. The gas-oil ratio varies from well to well with the minimum associated gas of 388 cubic feet per barrel of produced oil. The maximum allowable rate of flaring was introduced and reinjection measures were proposed. At the same time, Petronas began to emphasize on long term gas development. The concrete plans towards gas development started in 1979 after Petronas Carigali took over Conocco, the former operator at the very-high-gas-potential, 19,166 square kilometre tract off Trengganu under a production sharing contract with Petronas. After taking over from Conocco in July 1978, Petronas constructed a gas-gathering pipeline which tied in both associated and non-associated gas from the Esso area with Petronas Carigali's Duyong and Sotong Fields in the south. The conservative estimate of the reserves at Duyong and Sotong, and at the nearby Fenri and Anding Fields was 2 trillion cubic feet. The gas reserves of Esso's fields were estimated at around 3 trillion cubic feet.

In 1983, Malaysia started exporting LNG from its Bintulu plant in Sarawak. According to the 20-year contract with Japanese importers, Malaysia will supply LNG at the initial volume of 250 mmcfd of natural gas, rising to 900 mmcfd of natural gas or 6 million tonnes a year of LNG.(12)

In the long run, the associated gas from oilfields throughout the country is planned to be used in the following

activities:

—Petrochemical industries

—A 450-MW power station

—1,500-2,000 tonnes per day of methanol manufacture

—LPG production

—A steel industry

—LNG (if the Trengganu gas is sufficiently abundant)

Demand and Supply Projections

Although the existing gas reserves in Malaysia are considerably abundant, difficulties in reaching both the domestic and export markets have kept the level of gas production at a very low rate. However, future growth in natural gas utilization will be very high, with most of the produced gas being processed into LNG for export. By 1985, the capacity of the LNG plant at Bintulu was expanded to almost 200 bcf per year. And in 1984/85, natural gas was supplied to a 450-MW power station at Trengganu which consumes about 40 bcf per year. Therefore, the total demand for gas increased to 235 bcf in 1985. (See Table 19.)

It has been suggested that Malaysia can set up a viable petrochemical industry by 1990.(13) According to Malaysia's master plan on natural gas, an ethylene complex with a few polymer plants downstream in the initial phase at a cost of M$ 1

billion will be built by 1990. Acethylene black and vinyl chloride are suggested for a follow-up phase. The petrochemical plan is expected to be feasible, because the domestic market alone will be large enough to support an ethylene plant by 1990, assuming that the local demand for petrochemicals will increase steadily. If this expectation is correct, Malaysia will be able to utilize 485.5 bcf a year of natural gas in 1990 in order to satisfy the need for LNG export, a power station, and a petrochemical industry.

Table 19. Estimated Long Term Demand for Malaysia's Natural Gas

(billion cubic feet)

| Year | Volume |
|---|---|
| 1980 | 9.5 |
| 1985 | 235.0 |
| 1990 | 485.5 (a) |

(a) Estimated by V. V. Desai in "Energy Resource Balance and Supply Developments in the Asia-Pacific Region", a paper presented at the 13th Pacific Trade and Development Conference, Manila, 1983

## 3.4 Thailand

Unlike Malaysia and Indonesia, Thailand is an oil-importing country. In the 1960s and 1970s, oil was the country's main energy source, providing at least half of the total energy requirement. Of the commercial energy consumption of 300,000 barrels of oil equivalent per day in 1981, over 70% came from oil.(14) Most of the oil consumed had to be imported, since there is virtually no significant production of indigenous oil.

The oil crises in the 1970's and the early 1980's brought about adverse effects on the Thai economy by creating large trade and balance of payments deficits, high inflation, and growing foreign debts. After the dramatic rises in oil prices in 1979/80, Thailand's import value of crude oil and oil products in 1981 accounted for over 40% of its total export earnings and about 30% of its total import bill. In its efforts to reduce these serious impacts of oil price increases on the economy, the government has set an energy policy which aims at diversifying the country's energy sources and lessening the dependence on imported energy, particularly oil. In order to rely more on local energy, petroleum exploration in the country has been vigorously promoted.

Petroleum exploration in Thailand started in 1950. Before 1971, the rights to explore hydrocarbon potential were reserved exclusively for the government. The geological surveys

and exploration were done on a limited scale. In 1971, the Petroleum Act was promulgated in order to standardize the terms and conditions for foreign investment in petroleum exploration. The Act was proved successful in encouraging foreign oil companies to explore, produce and sell petroleum under a concession system. Spurred also by high oil prices, exploration activities in the country increased sharply after 1971. In 1985, 15 oil companies were holding 32 concession blocks: 15 blocks onshore, 16 blocks in the Gulf of Thailand, and one block in the Andaman Sea.

Between 1971 and 1985, more than 120 exploration wells were drilled both onshore and offshore, and about 40 wells were found to contain commercially viable deposits of petroleum. So far, the reserves of the discovered natural gas have been much larger than those of the oil found. These discoveries opened a new era of the development of indigenous oil and gas for Thailand, which will enable the country to be more self-reliant in energy.

Reserves

Thus far, commercially viable natural gas deposits have been discovered in the concession blocks operated by Union Oil and Texas Pacific in the southern part of the Gulf of Thailand, and by ESSO in the Northeast of Thailand. As of early 1985, the proven reserves in these areas were estimated to be

around 3.72 trillion cubic feet, with the possible reserves of 9.20 trillion cubic feet. (See Table 20.) However, these figures, even those of the proven reserves, should be considered to be uncertain. The proven reserves in the Erawan Field, the first producing field in Thailand, were revised downward to one-third of the original estimate, because, as claimed by the producer (Union Oil), after more drillings the geological structure in the area was found to be more complicated than it was first thought to be.

Table 20. Natural Gas Reserves in Thailand

(trillion cubic feet)

| Operator | Proven | Possible | Total |
|---|---|---|---|
| Union Oil | 1.517 | 2.317 | 3.834 |
| Texas Pacific | 1.923 | 5.665 | 7.588 |
| ESSO | 0.280 | 1.220 | 1.500 |
| Total | 3.720 | 9.202 | 12.922 |

Source: Estimated by the Supply Working Group of the Energy Planning Project for the Sixth National Economic and Social Development Plan.

Production and Utilization

In October 1981, Union Oil, an American oil company which started exploring in Thailand in 1972, began to produce natural gas from its Erawan Field in the Gulf of Thailand. In 1982, the Erawan gas output ranged from 120 to 150 mmcfd, which was below the original target level of 200-250 mmcfd. (See Table 21.) The shortfall was due to the downward revision of the gas reserves in the field from 1.58 tcf to 0.628 tcf. However, the company was able to supply additional natural gas from its nearby gasfields (Kapong, Platong, Pladang, Satun, Baanpot) from early 1985 onwards.

Texas Pacific, another American oil company, also succeeded in finding natural gas in its 4 concession areas in the Gulf. Although its production plan is not definite pending an agreement with the Petroleum Authority of Thailand (PTT) on the price of its gas, it is expected that production will start in 1991 at the rate of 100 mmcfd, increasing to 250 mcfd by 1995. In 1985, the rate of Union Oil's gas flow at about 310 mmcfd yielded about 10,000 barrels a day of condensate. In addition, about 18 mmcfd of associated gas was produced by Shell at its Sirikit Oilfield in the northern part of Thailand. The actual and expected total natural gas production in Thailand is shown in Table 22. PTT expects that the total gas supply will increase to 700 mmcfd in 1991 and to over 950 mmcdf in 1997.

Table 21. Monthly Production of Natural Gas in Thailand, 1981/82

(million cubic feet per day)

| | | |
|---|---|---|
| 1981 | | |
| | October | 80 |
| | November | 87 |
| | December | 94 |
| 1982 | | |
| | January | 124 |
| | February | 117 |
| | March | 122 |
| | April | 150 |
| | May | 140 |
| | June | 125 |
| | July | 117 |
| | August | 124 |
| | September | 153 |

Source: Department of Mineral Resources.

The natural gas from the Gulf has all been purchased by PTT which in turn delivered most of it to the Electricity Generating Authority of Thailand (EGAT) for two of its power plants situated near Bangkok. The gas is transported from the gasfields through the PTT's pipeline which is 590 kilometres long and has about 425 kilometres under water. In 1985, PTT also supplied about 30 mmcfd of its natural gas to a cement plant which is 120 kilometres north of Bangkok.

There is a plan for other uses of the offshore natural gas in the future after a gas separation plant was completed in 1985. As shown in Table 22, the main use of natural gas as a feedstock is in an ethylene cracking plant which is planned to produce 300,000 tonnes a year of ethylene. The product is to be used as an important raw material in downstream petrochemical industries (producing HDPE, LDPE, VCM, and PP) to be set up in later stages. Some of the future gas production is earmarked for the use as a fuel and a feedstock in such large-scale industries as cement and fertilizer. In the next two decades, the EGAT's power plants will still be the largest consumer of natural gas , burning over half of the total output.

A plan to export LNG from Texas Pacific's gas reserves to Japan at the rate of about 440 mmcfd or over 3 million tonnes per year is being discussed. If it materializes, the export will be handled by a joint venture between some Japanese trading companies (notably, Mitsui and Mitsubishi) and Thai

Table 22. Natural Gas Production and Utilization (by Activity) in Thailand

(million cubic feet per day)

| | 1982 | 1986 | 1991 |
|---|---|---|---|
| Production | 120/150 | 867 | 1,167 |
| Utilization | | | |
| LPG | - | 80 | 120 |
| Petrochemicals | - | - | 40 |
| Cement | - | 30 | 40 |
| Fertilizer (Ammonia,Urea) | - | - | 30 |
| Other industries | - | - | 30 |
| Electricity (EGAT) | 120/150 | 221 | 440 |

Source: Policy Planning Section, Petroleum Authority of Thailand.

LNG Co., which is a wholly Thai-owned company with major shareholders being the Finance Ministry, the PTT, a few large Thai commercial banks, and some other Thai companies. It is expected that the LNG export will not start until after 1990.

The use of natural gas as an energy source represents Thailand's important step towards relying more on an indigenous energy. In 1982, which is the second year of gas production in Thailand, natural gas constituted 6% of the country's total primary energy consumption---a percentage which was still much smaller than 38% in the case of oil. (See Table 23.) However, in the next two decades, natural gas is expected to be an increasingly important energy in Thailand, growing from 5% of total primary energy consumption in 1982 to 17%-22% in the 1990's. (See Table 24.) Crude oil, while still the most important commercial energy source, is likely to reduce its share further in the future.

Table 23. Primary Energy Sources in Thailand, 1982

| | Million litre (Crude oil equivalent) | % of total |
|---|---|---|
| Oil | 8,716 | 38 |
| Natural gas | 1,301 | 6 |
| Hydro | 1,157 | 5 |
| Lignite and coal | 907 | 4 |
| Charcoal and wood | 9,366 | 41 |
| Others | 1,386 | 6 |
| Total | 22,733 | 100 |

Source: Macroeconomic Situation and Prospects for Energy Demand in Thailand, 1985-2001, National Economic and Social Development Board, October 1985, p. 250.

Table 24. The Share of Natural Gas in Total Primary Energy Demand in Thailand, 1982-2000

| Year | Million litre (crude oil equivalent) | % of total primary energy demand |
|---|---|---|
| 1982 | 1,301 | 5.72 |
| 1986 | 4,320 | 15.09 |
| 1991 | 5,910 | 17.44 |
| 1996 | 8,149 | 21.95 |
| 2001 | 7,362 | 18.09 |

Source: Macroeconomic Situation and Prospects for Energy Demand in Thailand, 1985-2001, National Economic and Social Development Board, October 1985, p. 250.

## 3.5 Philippines(15)

Philippines is one of the ASEAN countries which have to rely heavily on imported oil for its energy requirement. The demand for energy in Phillipines increased from 62.7 million barrels of oil equivalent in 1972 to 84.8 in 1981. About 85% of the total demand in 1981 was accounted for by oil, most of which was imported. As in other oil-importing developing countries, the two oil shocks caused massive trade deficits and serious energy supply disruption in Philippines. The oil import value, which constituted 13% of total export earnings in 1972, dramatically increased to 43% in 1981. The government has attempted to manage the energy sector through these difficult times by diversifying the source of petroleum imports, and more importantly, by developing indigenous energy resources. It sought to promote and regulate the exploration, development, exploitation, and utilization of such alternative sources of energy as hydropower, geothermal, coal, and biomass (bagasse, alcohol, coconut oil, etc.)

Compared to these alternative energy sources, natural gas seems unlikely to be an attractive alternative to oil. The proven reserves of natural gas is estimated to be as low as 0.01 trillion cubic feet, which is very small relative to those of coal and oil. The proven and potential coal reserves are estimated to be around 200 and 1,750 million tonnes respectively in 1981, while the proven reserves of oil were 6 million tonnes.

As for geothermal, there were already 446 megawatts of installed capacity derived from geothermal energy. The proven geothermal power capacity was estimated to be 1,700 megawatts in 1981.

As far as long-term energy planning is concerned, Philippines aims at reducing imported energy and become more self-reliant through development of domestic energy resources. It is planned that the dependence of imported energy, particularly oil, will reduce from 95% in 1970 to 50% in 1987. However, natural gas is not one of the major alternatives as long as significant amounts of natural gas have not been found in the country. At present, no plan has been made for natural gas development or even the prospect of importing natural gas from other ASEAN countries, since Philippines seems to put more emphasis on exploiting indigenous energy resources, especially hydroelectric, coal, and geothermal. Of the 4,666 megawatts of power capacity in 1981, hydroelectric energy contributed about 940 megawatts or 20%, geothermal energy accounted for 440 megawatts or 10%, 2% was produced from coal, and the remaining 68% was from oil. It is expected that coal, geothermal, and hydro will replace a substantial part of petroleum products as energy sources in generating electricity in the future.

3.6 Singapore(16)

Singapore is the only ASEAN country which can be regarded as a resource-poor country. Its development and prosperity has been due to its location at the crossroad of international sea routes. It has became a major port and trade center of Southeast Asia. Before 1960, Singapore was mainly a trade center and a port for oil bunkering. In 1961, its oil industry began to change its structure by moving into petroleum refining and becoming a regional center for oil refining and oil exploration services. Since then, its major export item has been petroleum products refined from imported crude oil.

However, in recent years the ASEAN share of Singapore's petroleum export market has decreased from 50% in 1960 to 23% in 1981. This has been due to the fact that Indonesia, Malaysia and Thailand have expanded their domestic oil refining capacity with the purpose of increasing their oil supply security. Moreover, all other ASEAN countries have placed more reliance on their indigenous energy resources to reduce the impacts of future oil price increases. At present, substantial excess capacity exists in the oil refining industry in Singapore.

In 1983, Singapore started to move into new petroleum-related industries. A petrochemical complex, with the investment by the Petrochemical Corporation of Singapore and a Japanese consortium led by Sumitomo, was completed and is

expected to produce 300,000 tonnes per year of ethylene and 160,000 tonnes per year of propylene from a central naptha cracking complex. At present, the complex may enjoy the benefit of being the only plant in ASEAN, but with worldwide excess capacities in the petrochemical industry, some revision on production plan is being discussed by the investors.

There have been talks, but no definite plan, about importing natural gas from Indonesia to Singapore. The import figure suggested is about 2 million tonnes per year. However, this has to compete with natural gas from Malaysia via an overland pipeline, which could be a cheaper alternative. In any case, for many years to come Singapore will have to rely heavily on oil for its energy requirements, as it has always done in the past two decades.

## 4. Cooperation in ASEAN on Natural Gas

The preceding section clearly shows that three of the five ASEAN countries are substantially endowed with natural gas, and there is a good potential in exporting as well as consuming this energy resource by these countries. A number of large projects in the region have been undertaken and planned in order to better utilize natural gas, which in the past was either flared away or left unused in the ground due to low energy prices. The prospect of discovering more natural gas reserves in this part of the world is also rather promising. In the next decade when it is expected that ASEAN's natural gas production will more than double, this resource will become one of the region's most important energy sources which enable the producing countries to earn or save large sums of foreign exchange. It is important, therefore, that ASEAN should explore possibilities of cooperation among member countries in matters related natural gas in order to identify and realize the mutual benefit which may exist. An attempt is made in this paper to suggest and briefly discuss some seemingly possible cooperative measures by ASEAN in this area. It must be emphasized that the measures discussed in this paper are only tentatively suggested and not exhaustive, and further detailed studies are definitely needed to assess the feasibility of the following measures.

1) As pointed out by Siddayao (17), it is possible that the development of petroleum resources in the ASEAN region can lead to property rights problems. With the ASEAN countries sharing either land or offshore borders, conflicts may arise from overlapping claims to resource ownership due to a) conflicting historical ownership claims, b) extended economic boundary limits, and c) boundaries straddling petroleum reservoirs. Although these property rights problems are pertinent to all mineral resources found along the borders, they are particularly relevant to natural gas because most of the gas discovered and produced in this region is located in offshore areas where in general boundaries are not well defined and conflicting claims are more possible than in onshore areas.

To avoid these problems, efforts should be made by the ASEAN countries to device methods and procedures by which their shared boundaries are clearly defined. However, as Siddayao observes, the possible existence of petroleum deposits in boundary areas tends to harden the countries' positions in negotiations over conflicting claims. In cases where it is impossible to delineate common boundaries and overlapping is thus unavoidable, a compromise should be reached whereby the resources found in these areas are shared among countries involved. A good example can be seen in the 1979 agreement between Thailand and Malaysia, under which both countries agreed to jointly develop their offshore boundary area straddled by a natural gas reserve. The agreement involved a sharing of expenses and revenue from

exploration and production of oil and gas in the 2,100 square mile area, where a reserve of 6 trillion cubic feet of gas reportedly exists. So far, the delay in implementing this Thai-Malaysian joint development project has been due to differences in their laws and regulations concerning petroleum exploration, production and sale. Once the project gets underway, it should serve as a good example for future development in other disputed areas of the region.

2) The plans on natural gas utilization in Indonesia, Malaysia and Thailand indicate that some of the gas found will be used in such gas-related industries as petrochemicals, fertilizers and iron-steel products, either as a feedstock or a fuel. For each of these industries, which require large investment and long term commitment, it is imperative that its economic and financial feasibility be carefully assessed. The assessment should be based not only on the availability of natural gas but also on the prices of other important inputs (which in most cases have to be imported) and the market situation. There is a tendency for a government to conclude that these industries are economically viable and foreign-exchange saving simply because its country happens to discover substantial amounts of natural gas. In some cases this tendency is reinforced by the fact that a high degree of tariff and nontariff protection, and a potentially large size of the local market make the projects financially feasible. However, it is possible that these large industries will in the long run be inefficient behind

the tariff wall and create financial difficulties. While each country in the region tries to protect its own industries, all countries will forego the opportunity and the benefit of increasing trade among themselves and with the rest of the world based on the principle of comparative advantage. Even if these industries are not to be protected, the dynamic situation in energy and petroleum-related industries can make their feasibility uncertain. This is demonstrated by the newly-built petrochemical industry in Singapore which was expected at the planning stage to be promising because of its large oil-refining facilities and abundant supply of petrochemical feedstocks. However, the present oil glut and the world's excess capacity in the petrochemical industry have reduced the profitability of the project, and changes are planned to be made in order to improve its performance. It is therefore suggested that detailed studies be made which lead to recommendations on the optimum location of these gas-related industries in the region in order to maximize economic efficiency, and avoid excess capacity, scale diseconomies, and wasteful protection.

3) It can be seen from the above review that while Indonesia, Malaysia and Thailand possess natural gas, Phillipines and Singapore have found none so far. It is tempting to suggest that, to reduce the region's dependence on oil import from sources outside the ASEAN, its indigenous energy resources including natural gas should be traded and consumed within the region. In the case of natural gas, the relevant question is

whether it is feasible to build a network of gas pipelines linking some or all ASEAN countries (e.g. Indonesia, Malaysia, Thailand and Singapore) or to trade LNG among these countries. It can be imagined that Indonesia and Malaysia, with their abundant reserves of natural gas, can supply their natural gas to other energy-deficit ASEAN countries on a regular and long term basis. As noted above, there have been discussions about the possibility of Singapore importing natural gas either from Indonesia or Malaysia.

4) With some experience gained by most ASEAN countries in the natural gas industry, we can expect some mutual benefit in the sharing of knowledge and information among them. For example, we can envisage Indonesia, Malaysia and Thailand exchanging knowledge and information on their laws concerning foreign investment in oil and gas exploration, the negotiations and contracts on the international sale of natural gas, and some technical and economic aspects of the utilization and transportation of natural gas. Joint efforts can also be made by these gas-producing countries, e.g. mutual consultation and collective bargaining in selling LNG to non-ASEAN buyers, joint ventures in exploration and production of natural gas in the region, and joint studies on some proposals of ASEAN cooperation in natural gas as suggested in this paper.

Footnotes

(1) This section is based on the information extracted from "Natural Gas", Shell Briefing Service, No. 4, 1983.

(2) "Natural Gas", Shell Briefing Service, No. 4, 1983.

(3) Ibid.

(4) Petroleum News, July 1982.

(5) Petroleum News, June 1983.

(6) Petroleum News, July 1982.

(7) Bank of Indonesia, 1982.

(8) Ibid.

(9) Asian Development Bank, Asian Energy Problems, 1983.

(10) Suhadhavan Nayudamma, "Energy and Adjustment: Indonesia and Malaysia", a paper presented at the 13th Pacific Trade and Development Conference, Manila, 1983.

(11) Ministry of Energy, The Energy Sector in Malaysia, 1982.

(12) Petroleum Economist, December 1983.

(13) A study prepared by C. Itoh of Japan contends that the rising demand for petrochemicals within ASEAN and Malaysia's substantial gas reserves mean the development of a petrochemical industry makes good economic sense.

(14) National Energy Administration, Energy Situation in Thailand, 1982, 1983.

(15) This section relies extensively on information from Teodoro Santos, "Philippines Mineral Industry, Development and Trade", a paper in the ASEAN-Australia Project on Trade in Minerals and Energy, 1983.

(16) This section draws some information from John Wong and Linsk Lim, "The Changing Role of Singapore in Trading and Processing Natural Resources", a paper in the ASEAN-Australia Project on Trade in Minerals and Energy, 1983.

(17) See Carmen M. Pedrajas, "ASEAN and Offshore Energy: Problems and Prospects", in Kusuma Snitwongse and Sukhumbhand Paribatra (ed.) The Invisible Nexus : Energy and ASEAN's Security, 1984, pp. 48-96.

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