

Energy Development Plan  
During The Period.  
Of  
The Sixth National Economic and Social Development Plan.  
( 1987 - 1991 )

---

Office of The  
National Economic and Social Development Board  
Office of The Prime Minister



## TABLE OF CONTENTS

	Page
1. INTRODUCTION.....	223
2. ENERGY SITUATION.....	224
2.1 WORLD ENERGY SITUATION.....	224
2.2 THAILAND'S ENERGY SITUATION.....	227
3. THE COUNTRY'S ENERGY DEMAND SUPPLY BALANCE.....	232
3.1 ENERGY DEMAND IS LIKELY TO INCREASE SUBSTANTIALLY..	232
3.2 COMMERCIAL ENERGY CONSUMPTION IN RURAL AREAS WILL INCREASE RAPIDLY.....	233
3.3 FUEL CONSUMPTION IN THE TRANSPORTATION SECTOR WILL CONTINUE TO BE INEFFICIENT.....	233
3.4 NATURAL GAS MARKET IS LIMITED.....	234
3.5 THE DEPENDENCE ON IMPORTED ENERGY WILL DECLINE.....	236
3.6 SUMMARY OF ISSUES IN ENERGY DEMAND DURING THE SIXTH PLAN.....	237
4. KEY ISSUES IN ENERGY DEVELOPMENT DURING THE SIXTH PLAN PERIOD.....	238
4.1 ENERGY SUPPLY MANAGEMENT FOR DOMESTIC ENERGY REQUIREMENT.....	238
4.2 ENERGY CONSUMPTION, ENERGY PRICES AND ENERGY CONSERVATION.....	242
4.3 ROLES OF THE PUBLIC SECTOR IN ENERGY MANAGEMENT AND ROLES OF THE PRIVATE SECTOR IN THE ENERGY SECTOR.....	244
5. ENERGY DEVELOPMENT STRATEGIES DURING THE SIXTH PLAN.....	248
6. ENERGY DEVELOPMENT TARGETS DURING THE SIXTH PLAN.....	250
7. POLICY MEASURES.....	252
7.1 ACCELERATE THE EXPLORATION AND DEVELOPMENT OF VARIOUS INDIGENOUS ENERGY RESOURCES.....	252

	Page
7.2 ENERGY PRICING MEASURES .....	254
7.3 ENERGY CONSERVATION MEASURES.....	257
7.4 EXPANSION OF REFINING CAPACITY AND THE IMPORT OF PETROLEUM PRODUCTS.....	258
7.5 PROMOTION OF RESEARCH, DEVELOPMENT, PRODUCTION AND USE OF RENEWABLE ENERGY.....	259
7.6 PROMOTION OF APPROPRIATE PRODUCTION/CONSUMPTION OF ENERGY IN RURAL AREAS.....	259
7.7 ENERGY MANAGEMENT, ROLES OF GOVERNMENT AND PRIVATE SECTORS IN ENERGY DEVELOPMENT.....	260
7.8 INVESTMENT MEASURES.....	260
8. FRAMEWORK FOR ENERGY INVESTMENT.....	263

LIST OF TABLES

	Page
TABLE 1 : World Consumption of Oil, Natural Gas and Coal during 1979-1985.....	264
TABLE 2 : World Production of Oil, Natural Gas and Coal during 1979-1985.....	265
TABLE 3 : World Refinery Capacity and Production during 1979-1985.....	266

## ABBREVIATIONS AND ACRONYMS

DED	Defense Energy Department
DMR	Department of Mineral Resources
EGAT	Electricity Generating Authority of Thailand
LPG	Liquefied Petroleum Gas
MEA	Metropolitan Electricity Authority
NEA	National Energy Administration
NEPO	National Energy Policy Office
NESDB	National Economic and Social Development Board
PEA	Provincial Electricity Authority
PTT	Petroleum Authority of Thailand
RTG	Royal Thai Government

## 1. INTRODUCTION

As the energy sector is a fundamental component of the economic system and could exert a significant influence on the development of other economic sectors, it is necessary for the government to formulate a comprehensive and appropriate Energy Policy and Energy Development Plan. This Energy Development Plan must also be supportive of the following strategies of the Sixth National Economic and Social Development Plan :

- Maintenance of the country's economic and financial stability by reducing external financial deficits and foreign debts.
- Improve the country's international competitiveness by reducing production costs and encouraging the acceleration of exports of goods and services.
- Rationalize the role of the public sector and encourage greater private sector participation.

## 2. ENERGY SITUATION

### 2.1 WORLD ENERGY SITUATION

After the second oil crisis in 1979/80, the Thai economy was affected by the following changes in the world energy situation.

#### (1) Decline in the World Energy Consumption

Since the second oil crisis in 1979/80, the world commercial energy consumption has shown successive declines. In particular, the world oil consumption declined from 64 million barrels per day in 1979 to 59 million barrels per day in 1985 (Table 1). This decline was due to the increase in oil and other energy prices in 1979/80 which in turn has resulted in the following developments:

- The reduction in the world economic growth and energy demand.
- The successful implementation of energy conservation measures by a number of countries.
- The rapid increase in the exploration and development of indigenous energy resources in many oil importing countries in order to substitute for imported oil.

#### (2) Decline in the International Oil Price

The increases in oil production and oil export from the non-OPEC countries have reduced the influence of OPEC countries in the international oil market. The market share of OPEC oil production declined from about 50 percent in 1979 to about 30 percent in 1985 (Table 2). The decline in OPEC's influence on the international oil market has resulted in the following developments:

- The decline in the world price of oil from 1983 onwards to levels below US \$ 20 per barrel by early 1986.
- The world price of oil is expected to remain low during the next 4-5 years.



- During the 1990s there is a possibility of higher oil prices as a result of higher energy demand and declines in the productions of oil and other types of energy.

### (3) Oil Price and Exchange Rates Volatility

Energy prices are highly volatile. This is due to the following factors:

- Both the political situation in the Middle East and the oil production policy of OPEC countries are highly unstable, and could directly influence the international oil price. Although the world oil price is likely to decline during the next 4-5 years, changes in the political situation and production policies of OPEC countries could cause rapid fluctuations in the international oil price.
- Under the current international monetary system of floating exchange rates, exchange rate volatility (especially the US dollar) could cause even larger fluctuations in oil prices (in local currencies) for both oil importing and exporting countries.

### (4) The Surplus in World Oil Refining Capacity

The reduction in oil consumption during 1979-1983 had resulted in a surplus in world oil refining capacity. Although many countries have reduced their refining capacities, the actual refining capacity utilization in 1984 was still below 75 percent (Table 3). Refineries currently in operations are likely to be those which are highly efficient and have high operational flexibility.

### (5) The Role of Oil in the Energy Sector

In the long term, it is expected that oil would continue to be the most important source of energy for the world, accounting for about half of the world commercial energy consumption. Oil prices, therefore, should continue to have a significant influence on the world energy situation.

(6) Summary of Issues on the Impact of World Energy Situation on the Thai Energy Policy and Energy Development Plan

The world energy situation and its trend, as already described, are likely to have the following impacts on the Thai Energy Policy and Energy Development Plan.

- The decline in international oil prices is expected to reduce Thailand's external financial deficits.
- The decline in oil import prices will facilitate the improvement in the distorted retail price structure of petroleum products.
- Without changes in laws and regulations on petroleum exploration, the establishment of natural gas pricing policy and natural gas pipeline tariff, and the development and expansion of natural gas markets, the present level of oil price does not provide sufficient incentives for continued investments in domestic petroleum exploration and development activities. This will result in a decline in oil and natural gas production after the Sixth Plan period.
- Volatilities of oil prices and exchange rates make national energy planning more difficult. The appropriate energy development strategy is, therefore, to streamline the energy demand and supply management in order to create flexibility and the ability to adapt to any future situation.
- Under the situation of surplus world oil refining capacity, any expansion or improvement in domestic oil refineries must be carefully assessed, especially in regards to the rate of return and comparison to the alternative option of importing refined petroleum products.
- Evaluations of investments for improving refinery efficiency or refining flexibility should take into account market conditions, crude oil supplies and the economic feasibility.

## 2.2 THAILAND'S ENERGY SITUATION

### (1) Thai Energy Consumption

Since the beginning of the first National Economic and Social Development Plan in 1961, the Thai economy and society have experienced the following changes:

- a rapid economic growth;
- a significant expansion of the industrial sector;
- an increase in the number of population and urbanization;
- development and expansion of the transportation system; and
- the diversification of electricity use throughout the country.

These changes have resulted in a rapid increase in commercial energy demand as evident from:

- The country's energy intensity (as measured by commercial energy consumed per one million baht of output) rose from 18,400 litres of crude oil equivalent in 1961 to 35,380 litres of crude oil equivalent in 1985, i.e. total energy intensity has doubled during the past 20 years.
- Total energy consumption rose from 1,359 million litres of crude oil equivalent in 1961 to 13,400 million litres of crude oil equivalent in 1985, or at an annual rate of about 10 percent.

### (2) Impacts from Oil Crises

Since most of the country's commercial energy requirement is imported from abroad, both oil crises (in 1973/74 and 1979/80) had substantially affected the Thai economy in the following ways.

- The levels of trade and balance of payments deficit increased considerably. The value of oil import also rose significantly relative to the exports of goods and services.

- Price inflation became a very serious problem especially during the oil crises.
- Both public and private external debts showed a substantial increase.
- All these events eventually led to a slow down of the country's economic growth from 1982 onwards.

(3) Results of the Energy Sector Restructuring Programme During the Fifth Plan

One of the Fifth Plan's objective is to reduce the reliance on imported petroleum through the following strategies:

- acceleration of the development of various types of indigenous energy resources in order to substitute for imported oil;
- adjustment of the domestic energy price structure to more appropriately reflect the international energy prices; and
- encouragement of energy conservation effort and more efficient uses of energy.

Results of the energy sector development programme during the Fifth Plan period could be summarized as follows:

a) The Development of Domestic Energy Resources to Substitute Imported Energy

During the Fifth Plan period, Thailand was able to greatly diversify the production of indigenous energy resources. The actual amounts of energy production from hydro-power, lignite and natural gas were close to the Plan's targets. Besides, crude oil production from an on-shore field had also been developed. Though the amount of crude oil production was not high, it marked the beginning of an important step in Thailand's indigenous energy development programme. The development of these indigenous energy resources had resulted in :

- the reduction of the country's dependence on imported energy from about 90 percent of commercial energy requirement in 1981 to about 58 percent in 1985; and
- the reduction in the value of imported energy from 63 billion baht in 1981 to 53 billion baht in 1985.

However, a trend is emerging that the level of Thailand's domestic petroleum development activities is not as high as it should be because of the following factors:

- The complex geological conditions have increased the risk in natural gas and crude oil exploration and production, as well as their production costs.
- The government's laws and regulations are not conducive to petroleum exploration and development, particularly the development of small petroleum deposits as those existed in Thailand.
- The long delay in the natural gas well-head price negotiation.
- The demand for natural gas is too low and the natural gas market is not sufficiently diversified.

b) The Adjustment of Energy Price Structure

During the Fifth Plan period, the domestic energy price structure still does not appropriately reflect international prices, partly due to political constraints.

- The policy of uniform electricity tariff throughout the country to promote development in rural areas has affected the financial position of the Provincial Electricity Authority.
- The differentials between the retail prices of various types of petroleum products are too large, resulting in inefficient interfuel substitutions. Retail prices of petroleum products were also slow to keep pace with changes in international prices.

The distorted energy price structure had resulted in inefficient energy uses and investments, and is a crucial issue which remains to be tackled during the Sixth Plan.

c) The Increase in Energy Utilization Efficiency

During the Fifth Plan period, the government has started to implement various measures to increase energy efficiency in a number of economic sectors. In particular, energy efficiency improvement in the industrial sector had been encouraged through the dissemination of information, promotion campaign, and tax reductions for some energy saving equipments. However, in the transportation, household, and commercial

sectors, there has been no strong effort in promoting energy conservation. The decline in energy prices has also discouraged energy conservation efforts to a certain extent. It is, therefore, necessary for the government to formulate more effective energy conservation strategies in order to maintain its momentum.

#### (4) Rural Energy Consumption

The main sources of rural energy consumption are fuelwood and charcoal (more than 70 percent of total energy consumption in rural areas). It is estimated that the consumption of traditional energy (fuelwood, charcoal, and bagasse) in rural areas accounts for about 96 percent of total traditional energy consumption in the Whole Kingdom. It is also estimated that commercial energy consumption (petroleum products, coal and electricity) in rural areas accounts for about 23 percent of total commercial energy consumption of the country.

#### Rural Energy Consumption in 1983

	% of total energy consumption in rural areas	% of total energy consumption in the country
Traditional energy	73.56	95.91
Commercial energy	26.44	23.03

However, commercial energy has been substituting traditional energy in rural areas due to the following factors:

- The forest, which is the source of fuelwood and charcoal, is diminishing, thereby increasing the cost of traditional energy.
- The increase in electrification of rural areas together with the expansion of road networks have facilitated the use of commercial energy.

The issues of rural energy demand and supply are closely related to the issues of environment and natural resources protection (forest, land, and water resources), which in turn affect the well-being of the rural population. Therefore, the development of appropriate types of energy for the rural economy is a crucial issue which has to be tackled in conjunction with the effort to alleviate poverty in rural areas during the Sixth Plan period.

(5) Summary of Issues on Domestic Energy Situation

- The expansion and the change in domestic economic structure will increase the commercial energy consumption in all economic sectors, both in urban and rural areas.
- Since most of the commercial energy requirement still has to be imported, the world energy situation (especially oil prices) will continue to have an important influence on the economy and the domestic energy situation.
- Results of energy development efforts during the Fifth Plan period have indicated that there are still many weaknesses in the following strategies: the diversification of domestic energy resources, adjustment of energy price structure, and increasing energy efficiency. It is, therefore, important to continue the improvement of energy utilization during the Sixth Plan period so that there would be enough flexibility in adapting to rapid changes in the world energy situation.
- Although rural commercial energy consumption will increase, traditional energy (especially fuelwood and charcoal) will still be the main sources of rural energy requirement. The development of traditional energy and other types of energy will help to alleviate the rural energy problems as well as reducing the level of poverty.

### 3. THE COUNTRY'S ENERGY DEMAND SUPPLY BALANCE

#### 3.1 ENERGY DEMAND IS LIKELY TO INCREASE SUBSTANTIALLY

(1) The domestic energy demand is expected to increase by approximately 4.2 percent per year during the Sixth Plan period and 3.1 percent per year during the 7th -8th Plan period from 31,500 million litres of crude oil equivalent in 1986 to 38,700 and 52,500 million litres of crude oil equivalent in 1991 and 2001 respectively.

(2) Although total energy demand is expected to increase at a rather low rate, the commercial energy demand is expected to increase by about 6 percent per year during the Sixth Plan period. The country's energy demand in 2001 will double from the present level.

#### Energy Demand Growth Rate

Unit : % per year.

	<u>5th plan</u>	<u>7th-8th plan</u>
Commercial energy	5.9	4.1
Traditional energy	0.3	0.1
Total	4.2	3.1

(3) At the same time traditional energy consumption such as fuelwood and charcoal is expected to remain stagnant during the next 15 years. This will sharply push up the reliance on commercial energy, and is an important energy development issue as most of the commercial energy requirement will have to be imported.

#### Energy Consumption Pattern

Unit : million litres of crude oil equivalent

	<u>1986</u>	<u>3</u>	<u>2001</u>	<u>3</u>
Commercial energy	20,506	65	40,904	70
Traditional energy	11,022	35	11,582	22
Total	<u>31,527</u>	<u>100</u>	<u>52,486</u>	<u>100</u>

(4) The rapid growth in commercial energy demand during the next 15 years is the results of a number of crucial changes in the country's economic structure, for instance:



- the high urban population growth and rapid expansion of urban economic activities;
- the rural electrification programmes; and
- the shortage of fuelwood in rural areas which is expected to become more acute especially in the Northeast.

### 3.2 COMMERCIAL ENERGY CONSUMPTION IN RURAL AREAS WILL INCREASE RAPIDLY

During the next 15 years, commercial energy consumption in rural areas is expected to increase rapidly with the following significant changes:

- Residential electricity consumption in rural areas will double.
- By 2001, 98 percent of the villages will be electrified.
- The liquified petroleum gas (LPG) consumption in rural households is expected to increase 6 times.
- Fifteen percent of rural households will use LPG for cooking compared to 4 percent at present.
- The low income households in rural areas will be using more charcoal for cooking and the consumption of fuelwood is expected to decline.

### 3.3 FUEL CONSUMPTION IN THE TRANSPORTATION SECTOR WILL CONTINUE TO BE INEFFICIENT

(1) The transportation sector will continue to rely mainly on diesel oil. Approximately one third of LPG use is consumed in the transportation sector.

(2) If the retail price structure of gasoline, diesel oil, and LPG are still distorted then the imbalance between oil demand and refining capacity will become even more serious.

(3) The demand for gasoline will increase at a rather low rate, while the demand for diesel oil and LPG will show rapid increases.

### The Demand for Gasoline, Diesel Oil and LPG

	1986	Unit : million litres	
		<u>6th plan</u>	<u>7th-8th plan</u>
Gasoline	2,140	2.0	2.6
Diesel	6,090	5.2	3.4
LPG	1,210	7.8	6.8

(4) This imbalance growth pattern will result in the following :

- The import of diesel oil will continue to increase despite the installation of conversion units to convert fuel oil to diesel.
- The import of LPG will increase rapidly thereby necessitating large investments in the expansion or construction of new gas separation plants.
- Thailand will have to increase the export of condensate because there is no domestic market.

### 3.4 NATURAL GAS MARKET IS LIMITED

Fuel oil, lignite, imported coal, and natural gas are commercial energy which are substitutable in certain types of industries and electricity generation. It is expected that the demand for fuel oil, lignite, imported coal and natural gas will show a considerable increase due to the following reasons:

- The electricity demand will continue to increase at a relatively high annual rate of about 6.0 percent during the Sixth Plan period and 5.1 percent during the 7th-8th Plan period.
- The industrial sector is expected to grow rapidly.

Domestic energy prices are important factors which determine the substitution between these 4 types of energy.

#### (1) Consumption of Fuel Oil

- During the past 3 - 4 years, fuel oil had become the most expensive fuel. This had resulted in a decline in fuel oil consumption as it was substituted by lignite, imported coal and natural gas in the industrial sector and power generation.

- This trend is expected to continue in the next 2-3 years, before the substitution process slowing down. The consumption of fuel oil would then start to increase again if the present structure of energy prices, especially the price of natural gas, still persists. This is because the substitution of fuel oil by other types of energy in large industries (such as cements) and power generation will be approaching its saturation point.
- However, if the oil price should remain at the level of US\$ 10-15 per barrel for a sufficiently long period, the demand for fuel oil would increase more rapidly than expected as it would be cheaper than natural gas.
- The result is that there would be a surplus of fuel oil for export in the next 3 years if EGAT fully utilizes natural gas for power generation. However after the installation of the hydrocracker for converting fuel oil to diesel, the import of fuel oil is expected to increase substantially.

(2) Consumption of Lignite and Imported Coal

- Lignite consumption in the industrial sector and power generation is expected to show a high rate of increase due to its low cost and the existence of large amounts of reserves.
- Lignite consumption will increase from about 5 million tons per year in 1985 to about 10 million tons per year in 1991.
- The consumption of imported coal will also show a rapid rise especially in the industrial sector. During 1997-2001, with the capacity constraint on natural gas supply, EGAT may have to use imported coal for power generation which could rise to 5 million tons per year by 2001.

(3) Consumption of Natural Gas

- The consumption of natural gas is expected to increase from 368 million cubic feet per day in 1985 to 680 million cubic feet per day in 1991. The main use is still expected to be for power generation.

- The consumption of natural gas will be lower than its production capability during the next 10 years because of the relatively high natural gas price. Moreover, market diversification has been partly slowed down by the lack of clear and transparent regulations for establishing retail natural gas prices.

### 3.5 THE DEPENDENCE ON IMPORTED ENERGY WILL DECLINE

(1) The types of energy which would become more important during the Sixth Plan period are lignite and natural gas. It is expected that the consumption of lignite (including coal) and natural gas will increase from 29 percent of total commercial energy consumption in 1986 to 37 percent in 1991.

#### Demand for Commercial Energy

Unit : million litres of crude oil equivalent

	<u>1986</u>	<u>%</u>	<u>1991</u>	<u>%</u>	<u>Growth rate</u> (% per year)
Petroleum Products	13,226	64	15,573	57	3.3
Lignite and Coal	1,894	9	3,227	12	11.2
Natural gas	4,037	20	6,884	25	11.2
Hydro-power	1,349	7	1,580	6	3.2
Total	20,506	100	27,264	100	5.9

(2) Although the quantity of imported energy is expected to increase during the Sixth Plan period it will not cause any serious problem for the balance of payments. The proportion of imported commercial energy will decline from 58 percent in 1986 to 52 percent in 1991.

#### Dependence on Imported Commercial Energy

Unit : million litres of crude oil equivalent

	<u>1982</u>	<u>1986</u>	<u>1991</u>	<u>2001</u>
Consumption	14,593	20,506	27,264	40,904
Production	3,348	8,704	13,112	15,885
Import	11,246	11,802	14,152	25,019
Import/consumption (%)	77.1	57.6	51.9	61.2

(3) The natural gas surplus, the decline in oil prices together with the disincentives in the petroleum exploration laws and taxation regimes will slow down exploration activities for natural gas and crude oil during the Sixth Plan period. This will result in the following developments:

- The production of crude oil will begin to decline during the Sixth Plan period, while the production of natural gas will start to decline during the Eighth Plan period.
- Lignite production is expected to remain stagnant during the 7th-8th Plan. This will cause an increase in the import of petroleum and coal towards the end of the Sixth Plan period.
- The dependence on imported commercial energy during the 7th-8th Plan will increase and reach 61 percent by 2001.

### 3.6 SUMMARY OF ISSUES IN ENERGY DEMAND DURING THE SIXTH PLAN

(1) The country's energy demand will show a substantial increase during the next 15 years, especially commercial energy requirement which is still mainly imported. Therefore, strategies of improving energy efficiency will need to continue in order to reduce the reliance on imported energy.

(2) The distorted domestic petroleum price structure, which is out of line with international prices, will lead to a rapid increase in the demand of diesel oil, fuel oil, and LPG. At the same time there will be a surplus of gasoline, and condensate will need to be exported.

(3) There is no transparent retail natural gas pricing policy. This will cause the natural gas consumption to be lower than its production capability, thereby discouraging petroleum exploration in the country. Eventually, this will result in a shortage of natural gas and makes it necessary to import coal during the Eighth Plan period.

(4) The scarcity of fuelwood will be more critical in rural areas, especially in the Northeast. This will result in more forest destruction and switching to commercial energy, which will mainly have to be imported from abroad.

#### 4. KEY ISSUES IN ENERGY DEVELOPMENT DURING

##### THE SIXTH PLAN PERIOD

#### 4.1 ENERGY SUPPLY MANAGEMENT FOR DOMESTIC ENERGY REQUIREMENT

##### (1) The Level of Energy Import Will Remain High

- The level of energy import will remain high, particularly commercial energy whose demand is expected to increase by about 6 percent per year during the Sixth Plan period to attain a much higher level by 2001.
- If the level of petroleum exploration activity does not increase during the next 5 years, natural gas and crude oil productions will decline during the Seventh and Eighth Plan period. Energy imports in the forms of petroleum and coal will begin to rise after the Sixth Plan period.

##### (2) The Country's Energy Resources are Quite Diversified but Under-Utilized.

This is due to the following reasons :

- Additional exploration work is needed to discover new deposits and confirm the levels of reserves, especially for natural gas, crude oil, lignite, and geothermal energy.
- The market for natural gas is still not sufficiently diversified and natural gas is under-utilized except for use in the power sector. This is partly due to the inappropriate and unclear pricing policy.
- There may be opportunities to develop renewable energy resources, such as solar energy, biomass, and wind energy. However, at present they remain at the research and development stage of developing appropriate technologies for production and utilization.

There is clearly a need to continue the acceleration of exploration and development activities for indigenous energy resources. This would eventually produce sufficient information to allow an efficient formulation of energy production policy and production plan.

(3) Petroleum Exploration and Development Activities Must be Continuously Maintained

This will help to maintain the levels of indigenous energy production and to partly satisfy the growth in energy demand. In particular, there are rooms for increasing the utilization of already discovered natural gas deposits which at present are not in production due to the following major obstacles :

- Government's laws and regulations, and taxation regimes for petroleum exploration are inappropriate. In particular, during the period of weak oil prices such as at present, these regulations and taxation regimes do not provide sufficient incentives for petroleum exploration and development.
- There is no clear and transparent set of rules accepted by both producers and users in price negotiations, especially for natural gas. This has resulted in delays in price negotiations and slowed down the development and production from new natural gas deposits.
- At present, the natural gas market is still very narrow with only 2-3 major consumers. The government should expand the natural gas market by using the pricing policy as the major instrument to stimulate market diversification.

(4) Issues on Refining Capacity Expansion and Petroleum Import

In order to ensure the balance between the supply of petroleum products and domestic demand, and at the same time minimizing the acquisition cost, the following issues on refining capacity expansion and import of petroleum products need to be considered :

- The level of domestic refining capacity is insufficient to meet the domestic demand. However there is a surplus of world refining capacity and the international oil prices are weak. It may be more economical to import refined petroleum products to satisfy domestic needs rather than to expand the domestic refinery capacity.
- The domestic price structure of petroleum products is distorting the consumption pattern. The high level of diesel oil consumption, for example, has resulted in the imbalance between its demand and domestic refinery production. Some products have to be imported while there are surpluses of some other products. This has necessitated large investments to improve and expand domestic refineries, thereby incurring unnecessary economic losses.
- While both domestic and world refineries do not have sufficient cracking/conversion capacities, any installation of conversion units to convert fuel oil to diesel oil in domestic refineries should be undertaken only when it is economically viable.
- Since oil prices are expected to increase again in the future, the improvement of refining efficiency to save energy and reduce losses should be encouraged.
- At present, the public sector is facing a number of financial and budgetary constraints. Since any expansion or improvement of refineries normally require high investment cost, the government should, therefore, encourage private sector investment in oil refining activities and reduce the role of the public sector.
- At present, the government imposes a number of controls on the imports of petroleum products which cause the domestic oil market to be less competitive than otherwise, especially for diesel oil and LPG. Moreover, small independent importers have been acting rather irresponsibly and



have tended to disregard government's rules and regulations. This has led to uneven flows of petroleum imports and has created undue burdens on PTT and domestic refineries.

(5) Over-Investment in the Energy Sector could Cause Unnecessary Economic Losses Especially in the Power Sector

In the past, over-investment in the energy sector has caused unnecessary economic losses and increased financial burdens for the country, especially in the power sector. In addition during the Sixth Plan period, it is expected that the level of public sector investment in the energy sector will be very high and approximately 60 percent of the financial requirement will be met by foreign borrowing. So the following issues must be carefully considered:

- Most of the energy sector investment is in the power sector. At present, the reserves capacity in power generation is as high as 60 percent. Therefore, under the present financial constraints the investment for power generation should be minimized whenever possible by improvement in load forecasting and the maintenance of reserves capacity at an appropriate level.
- The energy price structures both for petroleum products and electricity do not truly reflect the economic values and have led to over-investment in energy by the public sector. This has resulted in negative repercussions on financial positions of MEA and PEA.

(6) Energy Supply Strategies for Rural Areas Must be Coordinated with the Rural Development Policy

- Changes and growth of economic and social structures in rural areas are expected to result in increasing commercial energy consumption which in turn would be exerting pressures on the country's external financial position. Moreover, the price of certain types of commercial energy (for example electricity) in rural areas do not truly reflect their economic values. An important issue which has to be

considered is how to satisfy the rural energy requirement while at the same time minimizing both the country's and public sector's financial burdens.

- Forest destruction is likely to deteriorate, especially in the Northeast, because of the necessity of using fuelwood and charcoal as fuels. In the Sixth Plan period, the government would need to develop energy resources in rural areas, especially biomass such as fuelwood and charcoal, in order to preserve the balance of rural environment.

#### 4.2 ENERGY CONSUMPTION, ENERGY PRICES AND ENERGY CONSERVATION

##### (1) Inefficient and Imbalance Use of Petroleum Products

The differential tax rates on various types of petroleum products have resulted in large differences in the retail prices of different types of petroleum products. This has caused the following problems:

- It is unfair to consumers whose vehicles use gasoline as fuel. These consumers have to bear an unproportionate share of the tax burden compared to diesel and LPG users.
- An inefficient interfuel substitution in the transportation sector is a serious problem. In particular, the distorted retail prices have resulted in the substitution of gasoline by diesel oil in light trucks and the substitution of gasoline by LPG in certain types of vehicles.
- Moreover, it has also created illegal blending of petroleum products, in particular the dilution of gasoline with diesel oil has increased significantly. This has caused large losses in government's tax revenues as well as damages to vehicle engines.
- The excessive consumption and import of diesel oil and LPG have led to an increase in the country's dependence on imported petroleum.

- The gasoline market has remained stagnant, resulting in the need to export condensate at a relatively low price.
- Any investment for expansion or improvement of domestic refineries or gas separation plants in order to correct the present imbalance between domestic demand and supply would cause unnecessary economic losses for the country.
- Oil Fund subsidy for certain types of petroleum products has kept their retail prices at levels lower than their economic costs. This has resulted in inefficient energy uses, and has also caused negative impacts on the government's financial position.
- The existing two-tier pricing of LPG is causing illegal decanting of cylindered LPG. This has resulted in losses of tax revenues as well as being extremely hazardous.

(2) The Mechanism for Retail Oil Price Adjustment Lacks Flexibility

The Oil Fund has been used to stabilize the retail prices of oil for too long. A consequence of this is that the domestic oil prices do not reflect the changing international oil prices and the variation in exchange rates. The Oil Fund has also made the domestic oil market to be less competitive than otherwise.

(3) Natural Gas Price Bears Little Relation to the Prices of Substitutable Fuels

The mechanism for the retail natural gas price determination lacks flexibility and the price bears little relation to the price of substitutable fuels such as imported coal, thereby making it uncompetitive with other types of energy. This, in turn, discourages the expansion of the natural gas market as well as hinders exploration, production and development activities of new domestic petroleum deposits.

is Rather Limited

(4) Progress in Energy Conservation Effort

This is due to the following reasons :

- There is no governmental organization with enough flexibility to efficiently and continuously promote energy conservation effort in both the public and private sectors.
- Reduction of energy prices and inappropriate energy pricing policy have discouraged energy conservation efforts.
- Energy conservation in large-scale industries have increased because of the perceived long run benefit. However, medium and small-scale industries still lack understanding in benefits of energy conservation efforts, and do not have personnel or funding to undertake energy conservation work by improving their production processes.
- Expansion of the telecommunication system would help to save energy. However, the present telecommunication system remains well below the level of requirement.
- Traffic congestion in the Bangkok Metropolitan Areas are wasting a considerable amount of energy.

4.3 ROLES OF THE PUBLIC SECTOR IN ENERGY MANAGEMENT AND ROLES OF THE PRIVATE SECTOR IN THE ENERGY SECTOR

At present, roles of the public sector in energy sector management are not sufficiently clear, and have resulted in an inefficient management of the country's energy sector.

(1) Management of Energy Sector Lacks Unity

The Fifth National Economic and Social Development Plan recommended the improvement of the country's energy sector management structure by reorganizing the functions of various energy related governmental organizations to create a more systematic management structure and a unified line of command. However, not much progress has been made, in particular the following:

- The reorganization of various energy related organizations to come under a single line of command has not made sufficient progress.
- The present energy management structure of the government in the areas of planning, supply management and development of various energy resources, and the formulation of the energy pricing policy are scattered among various governmental agencies / committees / subcommittees / working groups. This makes it difficult to efficiently coordinate and regulate their activities.

(2) Roles of the Public Sector and Private Sector in Energy Development Lack Clarity

- In the past the government has played a leading role in energy development efforts in order to stimulate and accelerate the development of indigenous energy resources and increase their utilization as required by the energy situation at the time.
- However, the present situation is quite different for the following reasons:
  - . the world energy situation has changed significantly; and
  - . the government still has a responsibility to invest and develop the country in other directions whereas its financial position has come under a severe constraint.

It is, therefore, necessary to encourage private sector's investments in energy development, especially the exploration and development of natural gas, oil and lignite in order to alleviate public sector's investment requirements.

- But the policy to encourage the private sector investment on energy development remains unclear. Co-ordinations between the public and private sectors in energy matters also lack permanent mechanisms to create close cooperation.

### (3) What Should be the Role of the Public Sector in Petroleum Activities?

During the past 5 years, the public sector has substantially increased its role in petroleum activities which now ranges from production, refining, transportation, import to retail distribution. The issue, which needs to be considered, is whether the government should reassess its roles in petroleum activities and allow the private sector to increase its participation as the present energy situation is substantially different from the past.

- Certain stages of petroleum activities require high levels of investment, technologies and expertises. Public sector's involvement in these activities should take into consideration the readiness of governmental organizations which are to participate in these activities and the country's financial constraints.
- The world energy situation has changed from the situation of an oil shortage to the present situation of excessive oil production. Therefore, the government may be able to allow the private sector to take part in certain petroleum activities without undermining the country's security of energy supplies.
- With the rapid changes in the energy situation, activities such as refinery operations need highly efficient and flexible management structure. Whether the government should continue to play a leading role in this sector is a crucial issue as the public sector management lacks the ability to timely and consistently adapt to changes in external situations.
- For certain activities, such as retail distribution, which the private sector can operate efficiently, is it necessary for the public sector to compete in such activities?
- The public sector through PTT has the monopoly to sell petroleum products to state enterprises and governmental organizations, causing prices for certain

users to be unnecessarily high. In order to increase efficiency and competition as well as to lower production costs of state enterprises, particularly for air transportation, it may be appropriate to reconsider this policy.

- Furthermore, the public sector through PTT has a monopoly in the purchase, transportation, and sales of domestically produced natural gas and crude oil, resulting in relatively high user prices. The monopoly position of PTT also discourages the private sector to increase exploration, development and marketing activities, and reduces the private sector's confidence as to the scopes of public and private sector's roles in petroleum production activities.

## 5. ENERGY DEVELOPMENT STRATEGIES DURING THE SIXTH PLAN

Key issues, used to establish the framework for energy development strategies during the Sixth Plan period, could be summarized as follows:

- Energy demand is expected to show a significant increase.
- It is becoming increasingly necessary to accelerate efforts in the exploration and development of domestic energy resources.
- The use of energy is not adequately efficient because the present energy price structure still does not truly reflect the economic values.
- The country's financial constraints need to be fully taken into consideration in assessing investments in energy production and distribution.
- In the short term the international oil price will remain weak and volatile but it is expected to increase again in the long term.

In order to establish targets, policy measures, and energy development projects of the country, the following energy development strategies have been formulated:

(1) Reduce the dependence on imported energy and diversify both sources and types of energy by accelerating the exploration and development of indigenous energy resources, such as natural gas, crude oil, lignite, hydro-power and various types of renewable energy sources.

(2) Improve both the petroleum and electricity price structures in order to encourage efficient uses of energy and create a more balanced demand supply pattern. The prices of natural gas, lignite, imported coal and fuel oil should also be consistently determined.

(3) Encourage efficient energy uses by promoting energy conservation efforts in the transportation sector, manufacturing industry, commercial buildings, and cooking by fuelwood and charcoal.



(4) Encourage private investments in the energy sector in order to reduce the public sector financial burden as follows:

- Specify types of activities where private sector investment should be promoted.
- Clearly define roles of the public sector in the energy sector by clearly specifying activities where the public sector would be the promoter/leader/co-investor or operator.
- Improve and streamline the management and coordination between energy related government agencies in order to create a more unified line of command.

(5) Promote and encourage the acquisition of appropriate types of energy to satisfy rural energy needs by formulating rural energy strategies in conjunction with poverty alleviation strategies.

## 6. ENERGY DEVELOPMENT TARGETS DURING THE SIXTH PLAN

(1) Maintain the overall domestic energy consumption growth to 3.7 percent per year during the Sixth Plan period.

(2) Reduce the dependence on imported energy from 58 percent of commercial energy consumption in 1985 to 49 percent in 1991.

(3) Targets for domestic natural gas production are set as follows:

Unit : million cubic feet per day

<u>A. Gulf of Thailand</u>	<u>1985</u>	<u>1991</u>
- Erawan field	180	500
- 2nd Union's contract	147	
- 3rd Union's contract	-	
- "B" Structure		100
Total	<u>327</u>	<u>600</u>
<u>B. On-Shore</u>		
- Sirikit field	27	20
- Nam-pong field	-	100
Total	<u>27</u>	<u>120</u>

(4) Targets for condensate production in the Gulf of Thailand are set as follows:

	<u>1985</u>	<u>1991</u>
- Erawan field	7,100	
- 2nd Union's contract	7,150	17,500
- 3rd Union's contract	-	
- "B" Structure		1,000
Total	<u>14,250</u>	<u>18,500</u>

(5) Targets for on-shore crude oil production are set as follows:

Unit : barrels per day

	<u>1985</u>	<u>1991</u>
- Sirikit field	20,800	10,600
- Other fields	-	18,000
Total	<u>20,800</u>	<u>28,600</u>

(6) The use of natural gas for power generation is to rise from about 250 million cubic feet per day in 1985 to at least 500 million cubic feet per day in 1991.

(7) The use of lignite for power generation is to increase from about 5 million tons per year in 1985 to 9 million tons per year in 1991. This should result in an increase in electricity generation from lignite from 735 MW in 1985 to 1,485 MW in 1991.

(8) The reserve capacity for power generation should be in the range of 15-20 percent of the peak demand in 1991.

(9) The use of lignite in the industrial sector is to rise from 500,000 tons per year in 1985 to about 1 million tons per year in 1991.

(10) The use of imported coal in the industrial sector is to rise from about 200,000 tons per year in 1985 to about 500,000 tons per year in 1991.

(11) The rural electrification programme should be extended to another 10,700 villages during the Sixth Plan period.

(12) Energy conservation through the improvement of energy efficiency in the transportation sector, industry and households is to reduce annual energy consumption by 390 million litres of crude oil equivalent during the Sixth Plan period.

## 7. POLICY MEASURES

In order to attain the energy development goals in accordance with the above strategies, the following policy measures would be implemented.

### 7.1 ACCELERATE THE EXPLORATION AND DEVELOPMENT OF VARIOUS INDIGENOUS ENERGY RESOURCES

#### (1) Petroleum Exploration and Development

(1.1) Improve petroleum related laws and regulations to provide more incentive for exploration and development of domestic petroleum resources as follows:

- The annual benefit and annual bonus should be collected at levels which would provide enough incentive for exploration and long term development. The government's share should reflect the real economic values of resources and should directly relate to profits from petroleum exploration and development.
- Reduce both the exploration and production periods to appropriate levels in order to stimulate and speed up petroleum development.
- Information on petroleum exploration and production should be kept confidential for at most 2 years before being released to the general public to stimulate interests from investors. For existing concessions, confidentiality of information would follow existing contracts.
- Encourage direct negotiations in natural gas pricing and sales between producers and consumers.

(1.2) Encourage the diversification and expansion of natural gas markets in line with future production potentials. This would help to stimulate more petroleum exploration and development activities.

(1.3) Speed up the cooperation with the Malaysian government and oil companies for petroleum development in the Joint Development Area in the Gulf of Thailand so that its development could begin during the Sixth Plan period.

(2) The Diversification of Oil Supply

Diversify sources of oil supplies from abroad in order to avoid too much reliance on any one source. Conditions and timing of purchase contracts should also be negotiated in such a way as to maximize national benefits and reduce risks from price volatility and supply disruption.

(3) Lignite Exploration and Development

(3.1) Encourage the Department of Mineral Resources to undertake exploration and drilling activities of domestic lignite deposits to be used in the industrial sector and power generation.

(3.2) Encourage EGAT to carry out detailed exploration activities of lignite deposits at Mae Moh, Krabi and other areas in order to obtain lignite deposits economically suitable for power generation.

(3.3) Promote research and development work in order to increase lignite consumption in industry and rural households.

(3.4) Encourage EGAT and other relevant organizations to prevent and alleviate environmental effects resulting from the development of lignite deposits. The National Environment Board should closely monitor these activities.

(4) Exploration and Development of Water Resources for Power Generation

(4.1) Encourage EGAT to explore and develop water resources which are economically and ecologically suitable for power generation.

(4.2) Encourage an appropriate form of cost sharing for multi-purpose hydroelectric projects in order to ensure efficient utilization of natural resources.

(4.3) Speed up the National Energy Administration's effort in the formulation of mini-hydroelectric development plan and project priorities. This would facilitate the process of economic evaluation and assessment of suitable locations so that capable and well-prepared agencies would be able to proceed with the projects.

## 7.2 ENERGY PRICING MEASURES

The basic principle of the energy pricing policy is the optimization of energy use efficiency and reduction of production costs in various economic sectors in order to increase the country's international competitiveness. The pricing policy should also help to maintain the nation's financial stability.

In order to reach the above objective, the energy pricing policy should create competition between various types of substitutable fuels such as natural gas, lignite, fuel oil and imported coal; or gasoline, diesel oil and LPG by imposing similar tax rates on these fuels. The government should not provide special incentives exclusively to any particular type of fuel.

### (1) Adjustment of Petroleum Products Pricing Structure

(1.1) Reduce the differences in retail prices of gasoline and diesel oil, and between gasoline and LPG by imposing similar tax rates on these three fuels.

(1.2) Price subsidization by the Oil Fund should be discontinued for all types of products.

(1.3) In addition to the adjustment of petroleum price structure, the government may use other supplementary measures in order to reduce the use of diesel oil and LPG in the transportation sector, such as an increase in the vehicle licence for small diesel or LPG fuelled vehicles and/or an increase in the business tax for small new vehicles which have diesel engines. However, these measures should only be considered as supplementary measures. The government should still use excise tax and the adjustment of retail prices as the main instrument in reducing the differences between the prices of gasoline, diesel oil and LPG.

(1.4) The government should consider the abrogation of the two tier pricing system for LPG. This could be carried out in steps. Initially the price of small cylindered LPG could be allowed to remain at a level lower than other types of LPG, but eventually the prices of LPG for all types of uses should be the same.

(1.5) Some tax should be collected on fuel oil in order to provide consistency with other substitutable fuels such as coal and natural gas.

(1.6) Deregulate retail prices and refinery prices of petroleum products during the initial part of the Sixth Plan period. This could be done by allowing the prices to float in line with international prices. The deregulation could either cover the whole system or only in parts, but it must be carried out with other strategies to encourage more competition in production, import and domestic retail marketing of petroleum products. To implement this policy, a detailed implementation plan needs to be carefully drawn up before deregulation actually takes place at an opportune moment.

(1.7) Any effort to create a uniform pricing of petroleum products throughout the country should be based on the principle of market mechanisms and avoid strategies involving government interference and controls.

## (2) Natural Gas Pricing

(2.1) Encourage the use of basing point pricing for establishing the price of natural gas. The basing point price of natural gas has to be related to the prices of other substitutable fuels and ensure the competitiveness of natural gas with these substitutable fuels. The basic mechanisms for establishing the basing point price of natural gas are as follows:

- The basing point price must be related to prices of other substitutable fuels such as fuel oil and coal.
- The basing point price is the price set at an important wholesale marketing location, such as the end of the pipeline at Rayong or the end of the pipeline at Bangpakong power plant.
- The basing point price will be used as a reference price for calculating gas prices at various levels, for example gas price at the production well head would be equal to the basing point price less the pipeline tariff from the production well head to the wholesale marketing location, and the retail price would equal the basing point price plus the pipeline tariff from the wholesale marketing location to the user.
- The basing point price should be flexible and reflect market conditions.

(2.2) The government should establish transparent regulations for determining the price structure and pipeline tariff. The pipeline tariff should enable the pipeline carrier to earn a "reasonable" rate of return.

(2.3) The above pricing mechanism could be applied to productions and sales of natural gas in new contracts, or it could be used to replace existing contracts with mutual consent by both parties of the agreement.

(2.4) Encourage direct negotiations between producers and consumers by clearly establishing the role of the pipeline carrier so that all producers and consumers would have the right to use the gas pipeline system by paying the pipeline tariff according to the government's regulations.

### (3) Crude Oil Price

(3.1) The crude oil price should be established in a similar way as the natural gas price. A crude oil basing point price could be set by using the price of imported crude oil as a reference.

(3.2) For both crude oil and natural gas, the government should impose government benefits in the forms of royalty, profit sharing or petroleum income tax which are only collected at the production stage. The government should not collect special benefits as disguised in the form of super normal profits resulting from market monopoly, for instance as a part of the pipeline tariff, transportation cost, or marketing margin.

### (4) Imported Coal Price Policy

(4.1) In order to allow competition between various types of fuels which are used as raw materials in industries, and in order to let the domestic industries optimize the use of fuels, the government should continue to allow coal to be imported freely in the same way as for other types of energy.

(4.2) The present tax rate on imported coal and the tax ceiling (25%) are already at appropriate levels when compared with taxes on natural gas. In order to provide assurance for the private sector, the government should maintain the present tax ceiling throughout the Sixth Plan period.

### (5) Adjustment of Electricity Tariff Structure

(5.1) Adjust the electricity tariff structure to a level that would ensure a reasonable return on investment as well as to cover future expansion plans.



(5.2) Adjust the electricity tariff structure to encourage the efficient use of electricity.

(5.3) Encourage the reclassification of electricity consumers according to their consumption characteristics and end uses.

### 7.3 ENERGY CONSERVATION MEASURES

#### (1) Transportation Sector

(1.1) Encourage the establishment of a central body responsible for the coordination of traffic management and transportation systems planning in the Bangkok Metropolitan Areas in order to increase efficiency and prevent overlapping of responsibilities.

(1.2) Encourage the improvement of the traffic system in the Bangkok Metropolitan Areas. This could be done by providing adequate services of the mass transit system and improving their services, particularly in regards to cleanliness and passengers' safety. Moreover, adequate parking spaces should be provided in various populated areas and the traffic law should be strictly enforced. There should also be additional constructions of connecting roads, main roads, ring roads and expressways, as well as more bus-lanes on some major roads.

(1.3) Campaign and provide training programmes for bus drivers, vehicle drivers and the general public in the observance of the traffic law.

(1.4) Improve the vehicle taxation system by introducing a progressive tax rate based on fuel consumption in order to increase fuel efficiency and energy savings.

(1.5) Improve the air and water transportation systems for freight and passenger traffics. Improve the land transportation system to satisfy the requirement and provide fast and convenient services.

#### (2) Industry, Commercial Buildings and Households

(2.1) Establish the Energy Conservation Center of Thailand as soon as possible in order to encourage the public and private sectors effort in energy conservation work in industry and other sectors. The center will provide advisory services training programmes, energy audit and information services as well as conduct research and development work on energy conservation technologies.

(2.2) The Industrial Finance Corporation of Thailand and other financial institutes should encourage industrial plants to increase the efficiency of fuel consumption by providing low-interest loans in adequate amounts.

(2.3) Amend the approval process for tax reduction on machineries and equipments used for improving energy efficiency.

(2.4) Implement a campaign to create energy conservation know-how and awareness for the general public. This could be done by using educational institutes to provide this know-how to students, and publicize energy conservation know-how to the general public.

(2.5) Consider the enactment of laws to encourage energy conservation in industrial plants and buildings. Improve building codes and regulations in order to increase energy savings in new buildings or those seeking modifications.

(2.6) Government agencies should monitor and study energy conservation policies and their implementation in other countries, and adapt them for uses in Thailand.

(2.7) Promote the transfer of energy conservation know-how and technology. Encourage close co-operation between the related governmental organizations and the private sector.

(2.8) Encourage and promote the use of high efficiency cooking stoves and charcoal kilns in rural areas.

#### 7.4 EXPANSION OF REFINING CAPACITY AND THE IMPORT OF PETROLEUM PRODUCTS

(1) In order to bring efficiencies of domestic refineries up to international standards and to minimize the cost of oil acquisition for the country, the government should consider the deregulation of retail prices and ex-refinery prices of all petroleum products. Moreover, the government should encourage a more liberal system for the import of petroleum products.

(2) In the short term, if oil prices are still set by the government then the ex-refinery price of each product (including gas separation plant) should be at a level similar to the import price, which in turn should reflect international prices. In particular the pricing of products based on production costs should be avoided.

(3) In the long term, the government should reduce the controls on petroleum product imports to create a more competitive trading environment. However, the government should impose certain controls to ensure regular flows of imports, such as investment requirement in oil reserve tank. In addition, the National Petroleum Policy Committee should be given the responsibility of formulating the oil import policy in order to provide a clear policy framework and eliminate operational problems.

(4) Encourage private investments in oil refineries, in order to increase the efficiency and operational flexibility, and reduce the government's financial burden.

(5) Explore the possibility of increasing the refining of condensate and using condensate as fuel in oil refineries.

#### 7.5 PROMOTION OF RESEARCH, DEVELOPMENT, PRODUCTION AND USE OF RENEWABLE ENERGY

(1) Encourage energy related government agencies, academic institutes and the private sector to undertake research and development of renewable energy sources such as solar energy, biogas energy and geothermal energy. There should be co-ordination among these activities to prevent the overlapping of works.

(2) Promote the production and consumption of renewable energy sources which are economically feasible. This should be undertaken by providing tax incentives for materials and equipments used in the production process in order to encourage investment by producers and consumers, and an increase in the use of renewable energy resources.

#### 7.6 PROMOTION OF APPROPRIATE PRODUCTION/CONSUMPTION OF ENERGY IN RURAL AREAS

(1) Promote the planting of economic forests and wood energy for households and local uses. This could consist of tree plantings in farm-edges, in the vicinity of dwellings and community tree planting in public lands. The government would support these activities by providing seeds and seedlings.

(2) Encourage the private sector to grow trees for commercial purposes from 50 rais upward, by offering low interest loan and income tax incentive.

(3) Disseminate the technologies and materials used for energy conservation which are already available in rural areas, such as high efficiency cooking stoves and charcoal kilns.

(4) Encourage research, development and experimentation of the production of biogas energy, for instance the increasing of growth rate and yield of plants by specie improvement, and the planting of oil producing plants to substitute for petroleum.

(5) Promote the uses of LPG and electricity in rural areas. This should be based on the principle of market mechanisms and avoids any price subsidization.

#### 7.7 ENERGY MANAGEMENT. ROLES OF PUBLIC AND PRIVATE SECTORS IN ENERGY DEVELOPMENT

(1) Under the present energy management structure, energy planning and policy formulation work which are scattered among the various agencies / committees/ subcommittees/ and working groups should be better coordinated. This will create a more unified system which would result in better co-operation and consistency, higher efficiency and more flexibility to adapt to changing situations as well as eliminating overlapping work. An Energy Board will be established to implement this strategy. In the long term, the government should consider the unification of various governmental agencies related to energy to come under a single line of command.

(2) Improve the efficiency of the Department of Mineral Resources in the management of petroleum and mineral fuel resources.

#### 7.8 INVESTMENT MEASURES

##### (1) Electricity

(1.1) Regularly revise the load forecast in order to keep the power investment and distribution plans up to date and consistent with the changing situations. This will ensure that power investment projects are of appropriate sizes and timing.

(1.2) Encourage the use of the Least Cost Analysis as a criteria for selecting projects and for preparation of the national power development plan.

(1.3) Encourage the reduction of power generation reserve capacity to an appropriate level in order to avoid over-investment and reduce investment burden of the public sector.

(1.4) Encourage appropriate cost sharing for medium scale and large scale multi-purpose hydroelectric projects between electric utilities and irrigation system development in order to optimize the use of natural resources.

(1.5) Encourage the National Energy Administration to accelerate the formulation of the master plan for small scale hydroelectric development. The master plan will be used for setting priorities of the locations and economic benefits in order to prevent the implementation of recurrent projects.

(1.6) Encourage the implementation of the rural electrification programme in accordance to the target and financial capabilities of the Provincial Electricity Authority.

(1.7) Encourage the electric utilities to increase the uses of internal financial resources to finance their investment programmes. This would help to reduce the debt burden, especially foreign debt. At the same time, the electric utilities should increase their equity, and the government should consider the possibility of private sector participation.

(1.8) Encourage the private sector to explore and produce lignite in the areas outside of EGAT's responsibility. This could either be in the form of private investment and/or joint venture between the public and private sectors. Moreover, the government should give more opportunity for the private sector to participate in lignite marketing by formulating clear production targets.

## (2.) Petroleum

(2.1) Encourage private investment, both from domestic and foreign investors, in petroleum exploration and development. The government may enter into joint ventures with the private sector in order to gain technological know-how and experiences, but investment risk should be minimized.

(2.2) For petroleum supply management, the government should encourage oil refineries to operate independently fully covering all aspects of their operations. The government should be responsible for monitoring and setting guidelines for supply management consistently with domestic demand rather than getting involved with the operations.

(2.3) Encourage private investment in both existing refineries and in any future expansion plan.

(2.4) For natural gas development and related industries, the government would encourage the private sector to increase their participation and investments.

(2.5) For transportation and marketing, the government would limit its role in competing with the private sector to the minimum.

## 8. FRAMEWORK FOR ENERGY INVESTMENT

According to the estimates by various government agencies, total investment in energy projects during the Sixth Plan period in accordance with the development framework of the Sixth Plan would amount to 96,000 million baht of which 54,839 million baht would be in foreign currencies and 41,161 million baht would be domestic currency. The details are shown below.

unit : million baht

<u>Agencies</u>	<u>Foreign currencies</u>	<u>Domestic currency</u>	<u>Total for the Sixth Plan</u>	<u>Total for the Fifth Plan</u>
EGAT	33,872	28,889	62,761	53,092
PEA	7,852	5,546	13,398	12,000
MEA	2,075	3,747	5,822	4,608
PTT	<u>11,040</u>	<u>2,979</u>	<u>14,019</u>	<u>17,924</u>
Total	<u>54,839</u>	<u>41,161</u>	<u>96,000</u>	<u>87,624</u>

However, the energy investment target would need to be regularly revised in order to provide consistency with the financial positions of the country and the implementing agencies. In the case of the National Energy Administration which uses the government budget, its budgetary needs have to be assessed on an annual basis in accordance with the country's fiscal and financial positions.

Table 1

World Consumption of Oil, Natural Gas and Coal during 1979-1985

	<u>Quantity</u>						
	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
<u>Oil (million barrels per day)</u>							
- World	64.1	61.6	59.9	58.4	58.0	58.9	58.7
- Free World	51.2	48.6	46.7	45.2	44.8	45.7	43.4
- Centrally Planned Economy	12.9	13.0	13.2	13.2	13.2	13.2	13.3
<u>Natural Gas (million tons of crude oil equivalent)</u>							
- World	1,273	1,297	1,321	1,315	1,325	1,410	1,470
- Free World	892	893	887	856	835	883	905
- Centrally Planned Economy	381	404	433	460	490	527	565
<u>Coal (million tons of crude oil equivalent)</u>							
- World	1,976	2,006	2,003	2,047	2,101	2,180	2,223
- Free World	909	956	977	983	1,003	1,042	n.a.
- Centrally Planned Economy	1,067	1,055	1,025	1,064	1,098	1,138	n.a.
<u>Commercial Energy (million tons of crude oil equivalent)</u>							
- World	6,940	6,896	6,857	6,858	6,943	7,202	n.a.
- Free World	4,769	4,696	4,646	4,574	4,586	4,763	n.a.
- Centrally Planned Economy	2,171	2,200	2,211	2,284	2,357	2,439	n.a.



Table 2

World Production of Oil, Natural Gas and Coal during 1979-1985

<u>Oil (million barrels per day)</u>	<u>Quantity</u>						
	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
- World	65.8	62.7	59.4	57.0	56.7	57.8	57.2
- OPEC	31.5	27.4	23.4	19.9	18.5	18.3	17.2
- Free world (Except OPEC)	19.9	20.6	21.2	22.2	23.2	24.3	24.8
- Centrally Planned Economy	14.4	14.7	14.8	14.9	15.1	15.1	15.2

Natural Gas (million tons of crude oil equivalent)

- World	1,340	1,344	1,374	1,371	1,355	1,444	n.a.
- Free world	928	906	095	864	816	861	n.a.
- Centrally Planned Economy	412	438	470	508	538	583	n.a.

Coal (million tons of crude oil equivalent)

- World	n.a.	n.a.	2,021	2,082	2,107	2,167	n.a.
- Free world	n.a.	n.a.	991	1,004	989	1,018	n.a.
- Centrally Planned Economy	n.a.	n.a.	1,031	1,078	1,118	1,150	n.a.

Table 3

World Refinery Capacity and Production during 1979-1985

	<u>Capacity and Production</u>						
	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
Refining capacity (million barrels per day)	80.1	81.1	81.7	79.0	76.4	74.7	73.1
Refinery production (million barrels per day)	61.9	59.9	55.7	55.2	56.2	56.2	n.a.
Capacity utilization (% of refining capacity)	77.28	73.23	70.50	70.42	72.25	75.23	n.a.

**THAILAND : ENERGY SECTOR REVIEW**

**BY**

**PIYASVASTI AMRANAND**

**NATIONAL ENERGY POLICY OFFICE**

**JUNE 1988**



## THAILAND : ENERGY SECTOR REVIEW

Over the past two years a number of important changes have taken place in Thailand's energy sector, ranging from the development of domestic energy resources, changes in energy demand structure to the implementation of a number of key policy decisions. On the energy demand/supply balance there has been a rapid increase in both the country's economic growth and energy demand, thereby creating a remarkable shift of sentiment in the investment climate in the energy sector. On the policy side, the Sixth Five Year National Economic and Social Development Plan was launched in 1987, and a number of key policy decisions in the energy sector have been made or are in the process of being implemented.

This paper is divided into two parts. The first part will present the change in the country's energy demand/supply balance and will try to assess its impact on energy investment and policy issues facing the country. Then, in the second part important changes in the government's energy policy over the past two years will be presented.

### I. Recent Changes in Thailand's Energy Situation

In the early 1980's most of Thailand's commercial energy requirement was imported from abroad. This is indicated by the fact that the share of energy import in total commercial energy demand of the country was over 90 percent. This consisted mainly of petroleum. The major source of indigenous commercial energy was hydropower which accounted for one quarter of energy input for electricity generation. There was a small amount of crude oil and lignite production, but the amounts were negligible. Not only did Thailand rely on imported petroleum for most of its commercial energy requirement, most of the country's oil import was from Saudi Arabia which made Thailand extremely vulnerable to any supply disruption.

As a result, Thailand was hard hit by the second oil crisis of 1979/80. The problem was accentuated by a severe drought which greatly reduced the generation of electricity from hydropower. However, at the end of 1981 natural gas from the

Gulf of Thailand came on shore. Production and consumption of natural gas rose steadily from about 100 million cubic feet per day to over 500 million cubic feet per day at present. This is equivalent to crude oil production of about 100,000 barrels/day. Approximately 15 percent of natural gas is separated into liquefied petroleum gas (LPG) used for cooking and automotive fuel. a small amount is used in the industrial sector, and the rest is used for power generation. Natural gas from the Gulf of Thailand is wet gas which also yields about 20,000 barrels/day of condensate and natural gas liquid. The natural gas operation in the Gulf of Thailand represents Unocal's biggest investment anywhere in the world including the USA.

Running in parallel to the development of natural gas from the Gulf of Thailand, was the massive lignite development programme undertaken by the Electricity Generating Authority of Thailand (EGAT). Over the past seven years the Electricity Generating Authority of Thailand has successfully reduced oil consumption in power generation by substituting it with lignite. Lignite consumption in the power sector rose from 1 million tons in 1980 to 6 million tons per year at present. This is equivalent to crude oil production of about 40,000 barrels/day.

It is evident that the power sector's reliance on imported energy has dropped sharply. In the early 1980s only one quarter of Thailand's electricity was generated from domestically produced energy which made the country very vulnerable to power shortages during the oil crisis. But now one half of the country's electricity supply is generated from domestically produced natural gas and one quarter is produced from domestically mined lignite. Only 7 percent is produced from oil and even this is also domestically produced. Apart from natural gas and lignite, crude oil was also discovered in the North of Thailand, and production from the Sirikit field came on stream in 1983. Production from this field is around 20,000 barrels/day, and earlier this year Thailand's first off-shore field, the Nang Nuan field, also came on stream. At the moment it is too early to accurately estimate the amount of reserves and production potential as production from this field seems to have run into technical problems.

The development of indigenous energy resources during the past seven years has greatly reduced the country's reliance on imported energy. The share of energy import in commercial energy requirement fell from 90 percent in 1980 to 55 percent at present. The sources of Thailand's imported energy have also become more diversified with less reliance on the Middle East.

The success of past development effort has made Thailand's present energy situation substantially different from the early 1980s. The country's energy mix is quite diversified. Commercial energy demand now amounts to about 400,000 barrels/day of crude oil equivalent. Natural gas accounts for about one third of this while lignite and hydropower satisfy about 10% and 5% of total energy consumption respectively. The rest, approximately 60% is petroleum products. To complete the picture, it should be mentioned that traditional energy like charcoal and fuelwood still play a very important role in rural areas. Traditional energy consumption amounts to about 200,000 barrels/day of crude oil. Due to shortages of fuelwood and the rural electrification programme the use of charcoal and fuelwood should remain stagnant over the next decade and possibly showing sharp drops in certain areas as they are being substituted by electricity and liquefied petroleum gas.

During the first half of the 1980s both the country's economic expansion and energy demand growth were relatively low. This has resulted in the underutilization of Thailand's energy investment. For instance, natural gas production was at a level far below its production capability for a number of years, and was a big cause for concern for Unocal. At the same time, the reserve capacity in power generation was as high as 60 percent as a result of over optimistic investment programme. However, from the second half of 1986 onwards the Thai economy has begun to show a rapid expansion. In 1987 Thailand's GDP growth rate was recorded at over 7 percent. This trend is likely to persist for the time being - at least the level of economic growth this year should reach 8 percent. This was accompanied by an even more dramatic rise in the country's commercial energy demand which has been growing at an annual rate of 13-15 percent, and is not showing any sign of slowing down. The rapid expansion seems to have occurred for nearly all types of energy and in nearly all economic sectors, particularly electricity, natural gas, lignite, gasoline, diesel, jet fuel and industrial fuel oil. Another important reason for the rapid expansion in commercial energy demand is the structural change which is taking place in the Thai economy. Thai industry in general is becoming more energy intensive and this has been accelerated by the relocation of industries from Japan and some other Newly Industrialized Countries. In spite of the lower population growth, urbanization is increasing rapidly with a very rapid rise in the size of the more affluent middle class. All these changes are leading to major shifts in the ways both industry, business and the general population use energy. For example we can expect more energy intensive industry to occur in Thailand, and the use of air-conditioners in businesses and households will rise substantially over the next decade.

To provide some magnitudes, the National Energy Policy Office's projection indicates that the demand for commercial energy would rise from 400,000 barrels per day of crude oil equivalent at present to 900,000 barrels per day of crude oil equivalent by the year 2001. The rapid economic growth and energy demand has completely changed the country's energy demand-supply picture and has boosted confidence and optimism in energy sector investment. Natural gas, which was at one time in surplus, is now in short supply. Unocal has stepped up its exploration and development programme in the Gulf of Thailand. But even this together with the development of new gas fields like the Esso's Namphong concession in the Northeast and Texas Pacific concession in the Gulf of Thailand will not be sufficient to satisfy the growing demand during the next few years. The generation of electricity will likely need to rely more heavily on fuel oil during the medium term.

The type of energy which has shown the most rapid increase over the past two years is electricity. Its growth rate during the first five months of this year is approaching an annual rate of 15 percent. The reserve capacity, which only two years ago was excessive, is now rapidly declining. Investment programmes of the electric utilities, for both generation and distribution, have been recently revised substantially upward and represent the biggest investment programme of the energy sector over the next 5 years. According to the latest investment programme, total investment of the electric utilities will amount to over US\$ 4 billion during the period 1987-1991 and this amount could already be too conservative.

The rapid increase in petroleum demand has also substantially increased Thailand's imports of refined petroleum products to 70,000 barrels/day at present. Although there is already ongoing investment programmes to expand refinery capacity in two refineries, this is not going to be sufficient. As a result, the government has given approval for the expansions of the Thai Oil and Bangchak refineries for the early 1990s, and approvals for further expansions are expected shortly for additional capacities to come on stream in the mid 1990s.

The rapid economic recovery and transformation of the Thai economy has completely changed the country's energy demand/supply balance. The situation of over investment and underutilized resources, which existed a few years ago, has now turned into one where production capacities for many types of energy have been reached, and a substantial amount of investment will now be required over the next 5 years in order to satisfy the growing demand.



## II. Recent Changes in Thailand's Energy Policy

In 1987 the government launched its Sixth Five Year National Economic and Social Development Plan which covers the period 1987-1991. The Plan has 5 strategies for energy development which could be briefly summarized as follows.

1. Reduction of the country's dependence on imported energy and diversification of both the sources and types of Thailand's energy supplies by speeding up exploration activities and development of indigenous energy resources, namely natural gas, crude oil, lignite, hydropower and other types of renewable energy.

2. Adjustment of energy prices to reflect their true economic values in order to encourage efficient use of energy particularly petroleum products and electricity. The prices of industrial fuels which are substitutable, namely natural gas, lignite, imported coal and fuel oil, should also be adjusted to reflect their true economic values, and their tax rates should be neutral-that is not being biased towards any product.

3. Increase efficiency in energy use by encouraging energy conservation effort in the transportation sector, in industry and commercial buildings. Efficiency in the utilization of charcoal and fuelwood should also be raised.

4. Allow the private sector to play a bigger role in energy sector's investment programme in order to alleviate the government's financial burden. The government would set a clear set of guidelines for the roles of the public and private sector as well as directions for private sector investment in the energy sector. The management and coordination of the government's energy policy would need to be rationalized.

5. Encourage the development of appropriate types of energy to be used in the rural areas. This could be undertaken in conjunction with the rural development programme.

Although this is only the second year of the Plan a number of major policy changes have already taken place or are being implemented. These include the following :

## 1. The Establishment of the National Energy Policy

### Committee

In an effort to streamline the management of the country's energy policy, the government established the National Energy Policy Committee (NEPC) which is chaired by the Prime Minister. The Committee's main task is to make decisions on all energy policy related matters on behalf of the Cabinet. The National Energy Policy Office has been established to serve as its secretariat. The establishment of the NEPC was the first major energy policy decision to be made during the Sixth Plan period.

2. Development of the Indigenous Energy Resources Since the establishment of NEPC a number of key decisions and policy changes in regards to the development of indigenous energy resources have been made.

2.1 Natural Gas Price Negotiation with Esso to develop its on-shore concession of Namphong in the Northeast of Thailand has nearly been finalized. The long term price agreement has been reached, but the short term price agreement is still to be concluded. The concession is expected to come on stream in 1990 and will produce 250 million cubic feet per day of natural gas by the mid 1990s.

2.2 Development of the Texas Pacific Concession The government has agreed to buy back the Texas Pacific concession in the Gulf of Thailand at US \$83.25 million. The development will be carried out in a joint venture between the state owned Petroleum Authority of Thailand (PTT) and multinational oil companies. Possible partners are Unocal, BP and Statoil. The concession is expected to begin its production in early 1990s with production of natural gas rising to around 300 million cubic feet per day by the mid 1990s.

2.3 The Amendment of the Petroleum Act In an effort to boost petroleum exploration and development in the country, the government has been working on an amendment to the Petroleum Act in order to provide more incentives for petroleum exploration and development. The change has already been passed by the Lower House of Parliament, but unfortunately the Parliament was dissolved while the bill was being debated in the Senate. However, it is expected that the new government will try to push this bill through the new Parliament as quickly as possible after

the July election. The amendment will provide the much needed incentives for petroleum exploration and is expected to greatly increase exploration activities in Thailand. The amendment seeks to shorten the exploration and production periods thereby speeding up exploration activities and at the same time provide more fiscal incentives. The petroleum royalty system is being restructured from one single flat rate to progressive rates which would help the development of marginal fields. The annual bonus and annual benefit in the current fiscal term, which are equivalent to progressive taxes with a very high marginal rate, would be abolished. To replace this, a fairer special benefit would be introduced. This "special benefit" is a tax which would only be collected once all investment costs have been written off. The new term is expected to make petroleum exploration worthwhile at \$15 oil price while the present fiscal term hardly provides any incentive at \$25/barrel.

2.4 The Revamping of the Lignite Exploration and Development Regulations Geological data indicate that the country still has a vast amount of unexplored lignite resources. Mae Moh is the biggest known reserves with proven reserves of 850 million tons and total geological reserves of 1,300 million tons. Production from this mine is entirely used for power generation. However, Thailand's current level of lignite exploration activity remains low and should be expanded during the Sixth Plan period. Preliminary exploration work in a number of basins have shown encouraging results while many more remain unexplored. Past development effort has been hindered by institutional problems and the weakness in the lignite concession system. All these problems have been resolved and it is believed that much progress would be made in the development of lignite in the near future. In the past, lignite concession was granted on the first come first serve basis. Government income in the form of royalty has been negligible and the mining operations are mainly carried out by family businesses with little experience in lignite mining and marketing. Lignite mining operations, with the exception of the Electricity Generating Authority of Thailand's mining operations, have been undertaken with insufficient consideration given to new technologies. This causes inefficiencies and unnecessary losses in the mining operations as well as environmental problems. In the new system, a system similar to oil exploration has been introduced. First the government would carry out preliminary exploration activities to obtain information on lignite reserves. With this information, appropriate areas would then be auctioned to the interested parties. Conditions are placed on those entering the bidding process to ensure that they would be capable to operating mining operations efficiently.

In order to implement this policy the Department of Mineral Resources has drawn up a five year programme to undertake preliminary exploration work in a number of basins which are showing promising signs of lignite deposits such as Saba Yoi, Wang Neua, Chae Hom - Muang Pan and Ngow. The programme has been approved by NEPC which has also approved the use of lignite deposits at Sin Pun in the South and Wiang Haeng in the North for power generation. NEPC has also agreed that the Kian Sa deposit in the South should be auctioned to the private sector to develop under the new concession term.

3. Energy Demand Management Most of the effort on energy demand management has concentrated on the energy pricing policy. During the past two years there has been two important changes: improvement of the oil price structure and the restructuring of the electricity tariff. Prior to 1986 the domestic oil price structure was highly distorted with large gaps between retail prices of gasoline and diesel on the one hand, and between gasoline and LPG on the other hand. The oil price decline in 1986 enabled the government to reduce these gaps. Although the present price structure remain far from perfect, it is believed to have largely eliminated inefficient interfuel substitutions in the transport sector. For instance conversions of gasoline engine in passenger vehicles and small trucks to diesel or LPG have ceased. The price of fuel oil has also been adjusted with an imposition of an excise tax for the first time, thereby encouraging the use of indigenous energy resources. The structure of the electricity tariff, which had been distorted for a long time, was adjusted last year whereby the demand charge was doubled to a level which closely reflects the capacity cost of power generation. However, the overall tariff structure remains far from desirable. With the rapid increase in power consumption more reliance is now being placed on the tariff as an instrument to regulate demand. Time of Day Pricing is being introduced-possibly at the end this year.

4. Deregulation of the Domestic Oil Market One of the key policy measures proposed in the Sixth Plan is the deregulation of domestic oil prices. No deregulation has taken place yet, but steps are being made to achieve this objective. Ex-refinery and import prices of petroleum products are now established weekly with a clear set of price formulae which make them more closely reflect oil prices in the Singapore market. Import controls on gasoline and kerosene have been lifted, thereby introducing more competition into the gasoline market. New conditions for obtaining an oil trader license have been approved, and when they are actually announced the government would start to issue new

licenses for those applicants who satisfy the requirements. The new set of conditions is tougher than in the past, but any respectable oil company should have no difficulty in complying. This would allow companies like Mobil to obtain an oil trader license, thereby making the domestic oil market more competitive.

5. Refinery Expansion As already mentioned, the rapid increase in petroleum demand is making it necessary to increase the country's refining capacity. Government's approval for Thai Oil Company (TOC) to expand its refinery capacity by another 100,000 barrels/day in early 1990s has been given. The government has also agreed to allow the state owned Bangchak refinery to debottleneck its refinery capacity by about 20,000 barrels/day. But even with these investments it is likely that additional refining capacities would be needed by mid-1990s. The likely candidates include Esso and Shell, but the government would probably impose minimum requirement for Thai shareholding as a condition for the approval. Esso at present already has a 63,000 barrels/day refinery in Thailand while Shell owns no refinery. Not only have oil companies been showing strong interests in refinery investment, the marketing side has also attracted much attention from multinational oil companies which at present have little stake in the country, for instance BP and Mobil.

6. Investment in the Power Sector is likely to be very high during the medium term as already mentioned. In order to reduce the level of borrowing by the public sector, the government is considering the possibility of increasing the private sector's participation in power generation. The first option would be deregulation i.e. allow the sales of electricity from small private producers into the transmission line. This would greatly encourage cogeneration by industrial plants. The second option would be to allow the private sector to set up power plants in order to sell electricity into the grid system, for example by permitting the Build Own Operate Transfer Scheme (BOOT), or Build Own Operate Scheme (BOO) or Build Transfer Scheme (BT). A clear set of policy guidelines is expected shortly.

On the whole the entire energy programme is a success story, and none of the energy subsectors in Thailand are in serious trouble. This is a particularly exciting time for Thailand as the country is undergoing major structural changes in the economic system and energy requirement. With the present trend we would be able to achieve both a relatively high economic

growth and financial stability. Major targets of the Energy Plan could probably be achieved particularly those on the production of indigenous energy resources. The major task remained to be tackled is in raising the efficiency of energy use. Without this Thailand's dependence on imported energy could begin to rise again during the latter part of 1990s.

TABLE 1  
\*\*\*\*\*  
PRIMARY COMMERCIAL ENERGY

UNIT = 1,000 BBL/D (COE)

	PRODUCTION	NET IMPORT	CONSUMPTION	NET IMPORT/CONSUMPTION (%)
1976	20	172	192	89.6
1977	18	198	216	91.7
1978	13	210	223	94.2
1979	22	241	263	91.6
1980	14	253	267	94.8
1981	29	221	250	88.4
1982	58	191	249	76.7
1983	68	218	287	76.0
1984	95	209	305 *	68.5
1985	144	180	321 *	56.1
1986	152	183	337 *	54.3
1987	177	222	389 *	57.2
1988 (JAN-MAY)	198	215	429	47.8
Growth Rate (% p.a.)				
1977-1981	7.7	5.0	5.3	
1982-1986	39.3	-3.7	6.2	
1987	16.4	21.7	15.5	
1988 (JAN-MAY)	15.1	-3.2	12.5	

Note Consumption includes changes in stocks except for 1984-1987 when changes in stocks are included.

\* Excluding changes in stocks

TABLE 2  
\*\*\*\*\*  
PRIMARY COMMERCIAL ENERGY PRODUCTION

	LIGNITE (KTON)	CRUDE OIL (BBL/D)	CONDENSATE (BBL/D)	NATURAL GAS (MMCFD)	HYDRO (GWH)
1979	1,421	274	0	0	3,261
1980	1,499	274	0	0	1,271
1981	1,712	313	1,287	30	2,972
1982	2,113	301	5,551	129	3,826
1983	1,997	6,578	6,660	155	3,655
1984	2,362	14,758	8,241	234	4,065
1985	5,188	21,690	14,290	362	3,674
1986	5,476	21,200	14,265	351	5,532
1987	6,930	17,900	15,200	489	4,056
1988 (JAN-MAY)	2,918	20,638	17,635	565	1,842

Table 3

Primary Commercial Energy

Unit : KBD COE

Growth Rate (% p.a.)

	<u>1987</u>	<u>1988*</u>	<u>1986</u>	<u>1987</u>	<u>1988*</u>
<u>Production</u>	177.3	198.4	5.7	16.4	15.1
Natural Gas	87.9	101.6	-3.7	40.2	30.3
Condensate	13.8	16.1	-0.2	6.7	22.5
Crude Oil	17.9	20.6	-2.7	-15.3	10.3
Lignite	39.7	40.5	10.6	28.0	1.4
Hydro	18.0	19.6	50.1	-26.5	-13.1
<u>Import</u>	222.3	215.2	1.4	21.7	-3.2
Petroleum	217.5	211.1	2.2	21.8	-2.9
Coal	4.1	3.4	-33.0	48.2	-17.9
Electricity	0.7	0.7	4.6	-45.1	-0.3
<u>Consumption**</u>	389.4	428.6	5.1	15.5	12.5
Natural Gas	87.9	101.6	-1.0	40.1	31.1
Petroleum	240.1	262.1	4.8	11.3	9.1
Lignite	38.5	41.2	4.3	27.2	8.9
Coal	4.1	3.4	-33.0	48.2	61.3
Hydro/Electricity	18.8	20.3	53.4	-27.2	-12.0
<u>Import/Consumption (%)</u>	57.1	50.2			

\* 5 months

\*\* Excluding changes in stocks



Table 4  
Final Energy Demand

Unit : KRD COE  
Growth Rate (% p.a.)

	<u>1987</u>	<u>1988*</u>	<u>1986</u>	<u>1987</u>	<u>1988*</u>
1. Petroleum	225.6	255.3	6.3	12.4	11.8
- Premium Gasoline	16.6	18.9	9.5	19.3	17.3
- Regular Gasoline	22.2	24.7	8.0	11.0	9.6
- Kerosene	2.1	2.1	-7.1	-9.6	-2.6
- Diesel	111.0	129.7	4.0	12.1	12.5
- Fuel Oil	34.3	35.0	11.3	17.9	2.9
- JP	24.4	29.2	10.3	8.8	23.3
- LPG	15.1	15.7	4.7	6.7	7.3
2. Natural Gas	0.8	1.1	-53.1	-53.8	21.3
3. Electricity	42.4	46.4	7.7	15.1	14.4
4. Lignite & Coal	9.2	10.0	-10.3	40.7	50.2
 Total	 <u>278.0</u>	 <u>312.8</u>	 <u>5.1</u>	 <u>13.1</u>	 <u>13.1</u>

\* Jan-May

TABLE 5  
CONSUMPTION OF PETROLEUM PRODUCTS

(UNIT : M.LITRES)

YEAR	PREMIUM GASOLINE	REGULAR GASOLINE	DIESEL	KEROSENE	FUEL OIL	LPG	
						AUTO	OTHERS
1979	1,465	897	4,298	312	3,994	75	294
1980	1,243	1,006	4,110	290	4,721	33	322
1981	1,168	983	4,030	389	4,143	82	368
1982	692	1,323	3,931	388	2,997	205	396
1983	740	1,327	4,402	538	3,364	282	549
1984	840	1,278	5,259	290	3,125	366	596
1985	849	1,240	5,524	154	2,281	380	680
1986	933	1,336	5,736	143	2,410	308	810
1987	1,113	1,484	6,429	129	2,396	263	933

(GROWTH RATE : %)

YEAR	PREMIUM GASOLINE	REGULAR GASOLINE	DIESEL	KEROSENE	FUEL OIL	LPG	
						AUTO	OTHERS
1979	-	-	-	-	-	-	-
1980	-15.1	12.1	-4.4	-7.0	18.2	-56.6	9.5
1981	-10.9	-2.2	-1.9	33.9	-12.2	149.2	14.5
1982	-37.5	34.6	-2.5	-0.2	-27.7	151.5	7.4
1983	6.9	0.3	12.0	38.8	12.3	37.6	38.6
1984	13.5	-3.7	19.5	-46.1	-7.1	29.7	8.6
1985	-2.1	-2.9	5.0	-47.0	-27.0	3.7	14.2
1986	9.8	7.7	3.8	-6.9	5.7	-19.0	19.0
1987	19.3	11.0	12.1	-9.6	-0.6	-14.6	15.3

NOTE : OTHERS = COOKING + INDUSTRY

TABLE 6  
ENERGY CONSUMPTION FOR POWER GENERATION

YEAR	HYDRO (GWH)	FUEL OIL (M.LITRE)	DIESEL (M.LITRE)	NATURAL GAS (MMSCFD)	LIGNITE (KTON)	PURCHASED (GWH)
1977	3263	1920	68	0	367	177
1978	2108	2513	122	0	480	222
1979	3261	2241	161	0	1559	788
1980	1271	3000	158	0	1321	766
1981	2972	2456	85	25	1534	740
1982	3826	1524	17	130	1687	752
1983	3655	1823	32	149	1573	701
1984	4065	1612	19	206	1945	710
1985	3674	893	11	270	4597	723
1986	5532	866	8	257	4685	758
1987						
JAN	266	60	0.3	296	486	39
FEB	403	48	0.3	331	395	33
MAR	542	36	0.4	346	514	32
APR	485	52	0.2	351	525	35
MAY	409	64	0.3	388	520	30
JUN	341	34	0.3	454	442	32
JUL	385	40	0.4	421	536	18
AUG	380	42	0.9	410	518	25
SEP	252	49	0.2	461	420	8
OCT	230	37	0.4	450	515	48
NOV	241	53	0.5	452	427	51
DEC	124	59	0.4	394	430	65
TOTAL	4,058	574	4.5	4,754	5,727	416
1988						
JAN	220	42	0.2	444	472	43
FEB	340	37	0.3	466	433	44
MAR	550	64	0.4	455	458	30
APR	443	60	0.2	455	518	29
MAY	288	74	0.2	470	517	27
YTD	1,842	277	1.3	2,290	2,398	173

TABLE 7  
POWER GENERATION BY SOURCES OF FUEL

UNIT : GWH

DATE	HYDRO	FUEL OIL	DIESEL	NG	LIGNITE	PURCHASED	TOTAL
1977	3263	7368	148	0	274	177	11,230
1978	2108	9722	238	0	489	222	12,779
1979	3261	8500	328	0	1273	788	14,150
1980	1271	11353	317	0	1410	766	15,117
1981	2972	9301	190	1,142	1675	740	16,020
1982	3826	5910	38	4,955	1859	752	17,340
1983	3655	7096	93	6,167	1804	701	19,516
1984	4065	6334	17	8,256	2315	710	21,697
1985	3674	3384	7	10,666	5308	723	23,762
1986	5532	3336	10	10,252	5541	758	25,429
1987							
JAN	266	228	0.2	1,013	579	39	2,125
FEB	403	182	0.2	1,014	457	33	2,090
MAR	542	137	0.6	1,150	611	32	2,473
APR	485	197	0.2	1,134	598	35	2,449
MAY	409	245	0.2	1,268	576	30	2,529
JUN	341	136	0.2	1,445	512	32	2,466
JUL	385	153	0.2	1,405	586	18	2,547
AUG	380	157	0.2	1,376	607	25	2,545
SEP	252	186	0.1	1,511	491	8	2,448
OCT	230	142	0.3	1,503	630	48	2,554
NOV	241	195	0.1	1,467	516	51	2,470
DEC	124	231	0.0	1,336	534	65	2,289
TOTAL	4,058	2,188	2.5	15,622	6,697	416	28,984
1988							
JAN	220	167	0.1	1,506	536	43	2,472
FEB	340	139	0.2	1,469	478	44	2,471
MAR	550	239	0.3	1,530	546	30	2,896
APR	443	226	0.1	1,479	600	29	2,777
MAY	288	297	0.1	1,572	617	27	2,801
YTD	1,842	1,069	0.7	7,556	2,777	173	13,416







JICA