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Number 39

Energy Demand Management Policy in Thailand

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คณะเศรษฐศาสตร์

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FINANCIAL ASSISTANCE BY THE ASIAN DEVELOPMENT BANK IS GRATEFULLY ACKNOWLEDGED.

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Abbreviations

ASEAN	Association of Southeast Asian Nations
B.E.	Buddhist Era
BMTA	Bangkok Mass Transit Authority
c.i.f.	Cost, Insurance and Freight
CPI	Consumer Price Index
EDM	Energy Demand Management
EGAT	Electricity Generating Authority of Thailand
EPP	Energy Pricing Policy
f.o.b.	Free on Board
IFCT	Industrial Finance Corporation of Thailand
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MEA	Metropolitan Electricity Authority
NEA	National Energy Administration
NESDB	National Economic and Social Development Board
NPPC	National Petroleum Poligy Committee
OPEC	Organization of Petroleum Exporting Countries
PEA	Provincial Electricity Authority
PTT	Petroleum Authority of Thailand
TORC	Thailand Oil Refinery Company
WPI	Wholesale Price Index

Weights and Measures

cc	Cubic Centimetre
kcal	Kilocalorie
kg	Kilogram
km	Kilometre
kwh	Kilowatt-hour
MMSCFD	Million Standard Cubic Feet per Day
MW	Megawatt
TOE	Tonne of Oil Equivalent

Chapter 1

The Country and Its Economy

1.1 The Country

Thailand occupies an ares of 514,000 sq. km. and is situated roughly between the equator line and the 18 degree north latitude and between the 95-105 degree east longitude. Her border countries are Laos to the north, Malaysia to the south, Cambodia, Vietnam, and Laos to the east, and Burma to the west.

Climate

Thailand is a tropical country with 3 seasons during a year. The winter months are from December to February with the average temperature of about 23-26 degree centigrade. The summer months are from March to May with the average temperature between 28-30 degree centigrade. The remaining part of the year, i.e June to November, is subject to the rainy season. The highest temperature recorded in the last 30 years was 43.5 degree centigrade and the lowest is 5.5 degree centigrade.

The average rainfall is 1821.5 mm. for the whole country with the western part of the southern region having the heaviest rainfall (an average of 2889 mm.) and the central region of the country having the lightest among other regions (an average of 1265 mm.).

Population

The total population in 1982 is estimated to be 48.85 million with roughly 50.2% male and 49.8% female. The population density stands at about 95 persons per square kilometer. The age distribution of the population shown in Table 1.1, shows that children and youth (age under 20) constitute for slightly more than half of the population (51.1%).

The percentage of population living in the rural area is about 83% of which 19% live in the north, 33% live in the northeast, 20% live in the center, and 11% live in the south. The remaining 17% of the population live in the urban area the mejority of which live in Bangkok.

Land and Its Utilization

Land use in agriculture is about 37% of the total land area; this figure includes dwellings of farmers. The forest land covers about 30.8% and the remaining land cannot be classified.

Of the total agricultural land about 85% is used for food crops such as rice, maize, tapioca, sugar cane, sorghum, etc. Land use for planting rubber accounts for about 10% of the agricultural land. Rubber trees are planted mainly in the south and southeast where the climate is most suitable. The remaining 5% of agricultural land is used for fiber crops such as cotton and jute, oil seed crops such as mungbeans, peanuts, coconuts, sesame, and tobacco.

Rice, which is the main staple of the population, alone accounts for 59% of land use in agriculture. As a result, Thailand has been a rice surplus country and enjoyed considerable foreign exchange earnings from rice exports.

Degree of Urbanization

By international comparison, Thailand cannot be considered to be highly urbanized. Only 17.5% of its total population live in the urban areas while her neighbor countries like Malaysia and Philippines have about 35% of their population living in the urban areas. However, Thailand does have a very serious problem of having one city, i.e Bangkok, growing too fast and becoming too large.

Being the capital city and the center of everything, Bangkok is the biggest city and its population is well over 5 million. This population size is about 52 times larger than the second largest cities of the country (Songkla and Chiengmai) The average growth rate of Bangkok's population during 1970-1980 is 4.1% per year. About 2.4% is due to natural growth rate (birth-death rate). The other 1.7% is due to the increase of immigrants from other parts of the country. The majority of migration (43%) comes from the Northeast where land is relatively least productive and the concentration of the poor is high.

The 10 biggest cities and their population in 1981 are shown in Table 1.2. These ten cities account for about 12.5% of Thailand's population and 71.5% of the urban population. Bangkok alone accounts for about 11% of Thailand's population and 62.4% of the urban population.

The primate city problem of Bangkok is a mixed result of industrialization with little concern for distribution and lack of city planning. At present, although individuals can derive their private benefits from living in Bangkok, the social cost of their doing so is prevalent in terms of traffic jams, air pollution, noise pollution, inadequate supply of public utilities, slum sites, and the erosion of soil, etc.

1.2 Economic Growth and Development

Since the start of the National Economic and Social Development Plan which began in 1961, Thailand has experiened considerably high rates of growth in the past two decades. During the pre-oil shock period, 1965-1972, the everage growth rate of real gross domestic product was about 7.5% per year. The first oil shock which took place in October 1973 did not slow down the economy as the real economic growth registered at 9.0% in that year. However, the impact of the first oil shock seemed to take its full effect in 1974 when the economic growth considerably dropped to around 4.8%. The economy picked up again to its pre-oil shock growth path as the average growth rate during 1975 to 1978 rose to 8.8%.

The effect of the second oil price increases during 1979-80 coupled with the world economic recession slowed down substantially the economic progress of Thailand. The growth rate declined to around 4-5% (see Table 1.3) and even when the decline in oil prices took place during 1981-1982 the economy still seemed to be growing much more slowly than the previous decade.

In 1982, the real value of gross domestic product in 1975 price stood at 475,838 million baht or about 20,689 million U.S. dollars. The current per capita income was around 17,000 baht or 740 U.S. dollars. By international comparison, Thailand is considered to be a middle income developing country well on its path to modernization.

According to the World Bank study (1) in 1978, the vast majority of the country's population have participated in and benefited from recent growth. However, the degree and nature of participation have differed significantly among the four regions and among different pupulation groups. The proportion of the country's population living in absolute poverty has declined from about 52% in 1962/63 to about 25% in 1975/76. About 90% of these poverty households live in the rural areas, mainly in the rural North and Northeast with rainfed conditions. These findings imply that growth seems to have triggered down but there still exists some part of the population, a sizable proportion, that need to be lifted from absolute poverty. (2) Furthermore we need a new study on the incidence of poverty and the change in the pattern of income distribution between 1984 and 1975/76 to assess the distributional effect of growth in the last decade.

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(1) IBRD, Thailand: Toward a Development Strategy of Full Participation A Basic Economic Report, No. 2059-TH, September 1978.

(2) The definition of absulute poverty is based on the basic needs approach. For Thailand, this can be translated in monetary terms as 150 baht per month per person in rural areas and 200 baht per month per person in urban areas in 1975/76 prices.

Industrial Composition

As data in Table 1.3 indicate, the industrial structure of the economy has changed considerably in the past 15 years. The significance of the agricultural sector in gross domestic product has declined from about 36% in 1965 to 24% in 1982 although it still ranks first in employment. The increasing importance of the manufacturing sector can be clearly seen. Its contribution to gross domestic product has increased from about 14% in 1965 to 21% in 1982.

The mining sector is slowly declining in importance whereas the importance of the service sector and the other tertiory sector, namely construction, electricity, transportation, wholesale and retail trade, banking, insurance, and real estate, is slowly increasing.

Exports

In 1982, Thailand exports totalled 159,728 milion baht, an increase of about 12 times over the export value in 1965. The importance of exports in gross domestic product was 15% in 1965 and has increased to 18.9% in 1982. During the period 1970-1980, the nominal value of exports grew at an average annual rate of 25%, half of which was due to price increases. However, it slowed down in 1981 (14.9%) and went down further in 1982 (4.4%) partly as a result of world wide recession which slowed down the world demand for Thai commodity exports.

Thailand's exports are quite diversified among many agricultural products. Rice has been the item which ranks first in

its value although its share in total exports has dropped from 33% in 1965 to about 14% in 1982. The other important items are natural rubber, tapioca products, sugar, maize, tin, garments, shrimp and tobacco leaves. It is worth noting that jute and kenaf have lost their importance while sugar, molasses, garments, tobacco leaves and shrimp seem to be gaining in importance. (For more details about five principal export commodities see. Table 1.4.)

The concentration of commodity exports has improved somewhat over the period of study. In 1965 the first five major export items (rice, rubber, tin maize, jute, and kenaf) accounted for 74.2% of the total export value. In 1982, the share of the first five major export items (rice, tapioca products, sugar, rubber, maize) reduced to 45.7%. However, in terms of the export markets, the concentration is quite high. The first five major trade partners accounted for 52% of the total exports in 1982. These are Japan (13.7%), Netherlands (13.2%) , the United States (12.7%), Singapore (7.3%) and Hongkong (5.0%). The next fifteen major markets accounted for another 25%. Efforts have been made to further diversify Thailand's export markets.

Imports

Table 1.5 shows Thailand's imports by economic classification during the period 1965-1982. In the period before the 1973 oil shock, the total value of imports grew at an average annual rate of a little above 10%. However, in 1973 and 1974, the increases in the import value were 37% and 52% respectively due mainly to the quadruple increase in the world prices of oil.

If we look closely at the import items of fuel and lubricants it is clear that the 1973 increase in oil prices created a considerable burden in Thailand's foreign exchange. The value of fuel and lubricant imports increased by 169% in 1974 and its share in total value increased to 19.6%.

The second oil price increases in 1979 further aggravated the situation. The value of fuel and lubricant imports increased by about 80% in 1980 and its share in the total import bill increased from 22.3% in 1979 to 31.1% in 1980. In 1982, this proportion is around 31%, the biggest part of the total import value.

Trade Balance and Balance of Payments

It can be seen from Table 1.6 that Thailand has had a chronic trade deficit for almost two decades. Even though the net services have been positive but the trade deficits were much larger in magnitude and rendered a chronic deficit in the current account.

The 1973 rise in oil prices raised the import value in 1973 and 1974 considerably. However, during 1972-1974 there was a boom in primary commodity trade and the export values also increased. As a consequence, the trade balances in 1973 and 1974 were respectively -10,802 and -14,302 million baht while the balance of payments was positive in both years.

In 1975, due partly to the drop in export prices and partly to the slack in world demand, the trade balance ran a deficit much larger than that of 1974 and the balance of paymants began to run a deficit after three years of consecutive surplus.

The second oil price increase, in 1979-1980, also had a large negative effect in the trade balance because the value of imports increased substantially while the value of exports increased only moderately. In 1981, the trade deficit got worse (-65,782 million baht) and the government had to adjust the baht value downward against the U.S. dollar twice in May and July by 1.083 percent and 8.7 per cent respectively in order to promote exports and correct the structural trade and payments problem. (See Table 1.10 for rates of exchange) In 1982, the trade balance still ran a deficit with the size half of that in 1981. However, the baht value still stood at 23 per U.S. dollar which is the rate after the July 1981 adjustment.

It is worth noting that although the trade and the current account balances have been in chronic deficit, the balance of payments have been positive in some years. This is because of the positive contribution of the net capital flows. Before 1976, the inflows come mainly from private foreign borrowings and after 1976 the government has considerably increased its share of foreign borrowings. Table 1.7 provides some detailed information on foreign borrowings. The figures clearly show that the growth of external debt after the second oil crisis came largely from the public sector. However, debt service payments of the public sector started to exceed those of the private sector in 1982.

To some extent increases in earnings from oil supplying countries offset increases in the oil import bill of Thailand.

Table 1.8 shows the share of earnings from commodity exports to oil supplying countries in Thailand's total exports. The share has increased from 6.5 percent in 1973 to 10 percent thereafter. The proportion of earnings from the Middle East fluctuated around 4 to 7 percent. However, these figures do not include earnings from transfer income of Thai migrant workers in the Middle East. We can see from Table 1.9 that the receipts of "other services" have increased significantly and in 1982 accounted for 32 percent of total receipts from services. Since the large component of these other services was transfer income of migrant workers in the Middle East, we can say that these earnings have helped the Thai economy to finance the increased oil import bill. However, they were not enough to cure the balance of payments problem.

Inflation

Table 1.10 shows that during 1965-1972, the rate of price increase in Thailand was less than 5 per cent per year. In 1973 and 1974 because of the increase in oil prices, the inflation rate jumped to 15.4 per cent and 24.3 per cent (measured by the consumer price index). Nevertheless, the inflation rate seemed to be contained during 1975-1978 since the annual rate of price increase during this period was still less than two digit even though there seemed to be an increasing trend.

The second oil shock in 1979-1980 brought up the price level in the economy as the rate of price inrease was 9.9 per cent in 1979 and 19.7 in 1980 and slowed down to 12.7% in 1981. In 1982,

the rate of price increase further slowed down to around 5 per cent partly because of the restrictionary monetary and fiscal policies and partly because of the slack in aggregate demand. Furthermore, the increase in import prices had also slowed down.

It is evident that a small open economy like Thailand with the external sector (exports plus imports) accounting for about 40 per cent of its gross domestic product cannot escape from the international influence especially through the price linkage.

Overall Outlook

The economy of Thailand seemed to be doing well with a growth rate of 6.0 per cent in 1983 and an expected growth rate of about 6.2 per cent in 1984. The world economic condition was expected to get better and therefore the world demand for primary commodity would expand. This would have a positive effect for the exports of the country. However, the government has been more careful in monitoring the domestic demand, especially the demand for imports because lessons from the past two decades have shown that the economy has grown with the trade deficit problems.

TABLE 1.1 : Age Distribution of Population [a/]

Age	Percentage of Total Population
0 - 4	13.3
5 - 9	13.4
10 - 14	12.9
15 - 19	11.5
20 - 24	9.7
25 - 29	8.1
30 - 34	7.0
35 - 39	5.5
40 - 44	4.2
45 - 49	3.5
50 - 54	3.1
55 - 59	2.5
⩾ 60	5.3

a/ This is for the year 1982, using low fertility estimates. The 1982 population is estimated to be 48.84693 million after adjustment.

Source : Population Projection for Thailand Whole Kingdom and Regions, 1970 - 2010, by Working group on Population Projections, National Economic and Social Development Board, Institute of Population Studies, and National Statistical office.

TABLE 1.2 : Ten Biggest Cities and their Population (1981)

Region and city names	Population	Ratio of Bangkok's Population to the Population of other Big Cities
Center : Bangkok Metropolitan	5,331,402	
North : Chiengmai	101,394	52.6
Nakornsawan	91,138	58.5
Pitsanulok	73,836	72.2
Northeast : Khonkaen	100,210	53.2
Nakorn Rajsima	89,381	59.6
Udornthani	81,717	65.2
South : Hadyai	102,953	51.8
Songkla	75,553	70.6
Nakorn Srithammarat	67,961	78.4

Source : Chira Hongladarom, "Population and Bangkok's Expansion" a pap
presented at the symposium titled "Thailand is Bangkok".
organized by the Faculty of Economics, Thammasat University,
February, 1983.

TABLE 1.3: Gross Domestic Product and Structural Composition

	1965	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. GDP current (m. Baht)	84,303	216,543	269,695	298,816	337,635	393,030	477,341	556,240	684,930	786,166	846,136
2. GDP (1975 Constant prices m. Baht)	145,099	264,528	277,207	298,816	324,836	348,276	389,380	406,549	429,989	457,153	475,838
3. Real growth rate	8.1	9.0	4.8	7.8	8.7	7.2	11.8	4.4	5.7	6.3	4.1
4. GDP (1975 prices, m. US$) a/	7,009	12,841	13,588	14,648	15,922	17,072	19,181	19,929	20,974	20,970	20,689
5. GDP percapita (1975 prices, US$)	288	321	329	346	368	386	424	432	447	438	424
6. Population (million)	30.74	39.95	41.33	42.39	43.21	44.27	45.22	46.11	46.96	47.87	48.84
7. Sectoral Composition of GDP at constant prices (% share)											
7.1 Agriculture, fisheries, forestry	36.1	31.2	30.1	30.5	29.6	27.4	28.1	25.8	24.9	24.9	24.2
7.2 Mining	1.7	1.5	1.5	1.2	1.3	1.5	1.5	1.6	1.6	1.5	1.4
7.3 Manufacturing	14.3	17.5	17.7	18.1	19.1	20.1	19.8	20.9	20.7	20.7	20.8
7.4 Services	9.6	10.3	10.5	9.7	9.6	9.7	9.9	10.4	10.6	11.0	11.2
7.5 Other Tertiary Sector b/	38.3	39.5	40.2	40.5	40.4	41.3	40.7	41.3	42.2	41.9	42.4
8. Prices (1975 = 100)											
Wholesale Price Index	51.4	74.8	97.2	100.0	104.0	112.1	120.4	133.9	160.8	177.9	177.8
Retail Price Index	55.5	76.4	94.9	100.0	104.2	112.1	121.0	132.9	159.1	179.3	188.6
9. Foreign Exchange Rate (Simple average of official rate)	20.7	20.6	20.4	20.4	20.4	20.4	20.3	20.4	20.5	21.8	23.0

Note: a/ Use the average exchange rate in item 9 of this Table for conversion into U.S.$.
b/ Includes construction, electricity, and water supply transportation, wholesale and retail trade, baking, insurance and real estate, ownership of dwellings and public administration and defense.

Source: Bank of Thailand, Monthly Bulletin and Quarterly Bulletin, various issues.

TABLE 1.4 : Exports of Principal Comodities

(in Metric Ton and Million Baht)

	1965		1973		1974		1978		1979		1980		1981		1982	
	Baht	Metric Ton	Baht	Metric Ton	Baht	Metric Ton	Baht	Metric Ton	Baht	Metric Ton	Baht	Metric Ton	Baht	Metric Ton	Baht	Metric Ton
Rice	4,334	1,895,223	3,594	848,717	9,778	1,029,273	10,424	1,606,752	15,592	2,796,869	19,508	2,799,724	26,366	3,031,783	22,510	3,784,143
Tapioca Products	676	719,442	2,537	1,836,453	3,836	2,395,704	10,892	6,287,965	9,891	3,961,210	14,887	5,217,702	16,446	6,265,833	19,752	7,815,455
Sugar	82	54,858	1,264	407,501	1,161	275,405	3,970	1,040,049	4,797	1,189,818	2,975	451,696	9,572	1,118,639	12,932	2,206,240
Rubber	1,999	210,854	4,573	390,514	5,035	362,563	8,030	442,191	12,351	520,953	12,351	445,006	10,841	472,122	9,490	544,487
Maize	1,004	831,353	2,969	1,386,374	6,078	2,232,275	4,275	1,972,446	5,644	2,013,985	7,299	2,202,510	8,349	2,574,608	8,330	2,830,701

TABLE 1.5 : Imports by Economic Classification

(Value in million bath) a/

	1965	1973	1974	1978	1979	1980	1981	1982
1. Consumer Goods	4,113	6,311	7,995	12,942	15,933	19,286	22,985	22,783
	(26.6)	(14.9)	(12.5)	(11.9)	(10.9)	(10.6)	(10.6)	(11.6)
2. Intermediate and Products Materials	3,210	13,621	18,370	29,598	43,500	45,312	53,575	48,596
	(20.8)	(32.3)	(28.7)	(27.2)	(29.8)	(24.0)	(24.7)	(24.7)
3. Capital Goods	4,775	12,826	19,808	31,317	39,902	46,075	56,772	47,778
	(30.9)	(30.4)	(30.9)	(28.7)	(27.3)	(24.4)	(26.2)	(24.3)
4. Other Imports	3,335	9,426	17,871	35,042	46,826	78,013	83,414	77,459
	(21.6)	(22.3)	(27.9)	(32.2)	(32.0)	(41.3)	(38.5)	(39.4)
4.1 Fuel and lubricants b/	1,353	4,661	12,571	22,851	32,647	58,733	65,100	60,765
	(8.8)	(11.0)	(19.6)	(21.0)	(22.3)	(31.1)	(30.0)	(30.9)
4.2 Other	1,982	4,765	5,300	12,191	14,179	19,280	18,314	16,694
	(12.8)	(11.3)	(8.3)	(11.2)	(9.7)	(10.2)	(8.5)	(8.5)
5. Total Imports	15,433	42,184	64,044	108,899	146,161	188,686	216,746	196,616
	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

NOTE : a/ Figures in parentheses are percentage shares of total.
b/ Includes vehicles and parts, gold bullion, and miscellaneous items.

Source : Bank of Thailand, Statistical Bulletin, various issues.

TABLE 1.6: Balance of Payments

(Million Baht)

	1965	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Trade Balance	-2,556.3	-10,802.4	-14,302.2	-20,161.2	-11,084.9	-25,598.8	-28,540.0	-47,053.1	-57,984.8	-65,781.9	-36,136.7
2. Net Services	1,443.8	6,836.4	7,600.7	6,160.8	1,642.5	2,405.2	4,279.1	3,237.9	11,144.9	6,042.4	8,795.0
3. Current Account Balance	-1,112.5	-3,966.0	-6,701.5	-14,000.4	-9,442.5	-23,193.6	-24,260.9	-43,815.2	-46,839.9	-59,739.5	-27,341.7
4. Unrequited Transfers	794.4	2,968.8	4,916.9	1,632.1	464.5	801.9	816.0	1,224.0	4,430.5	3,690.2	4,203.5
5. Balance on goods, services and unrequited transfers	-316.1	-997.2	-1,784.6	-12,368.3	8,977.9	22,391.7	-23,444.9	-42,591.2	-42,409.4	-56,049.3	-23,138.2
6. Net Capital Movements	1,665.3	2,937.6	9,054.7	7,754.7	9,263.6	13,966.9	14,858.3	33,766.8	50,736.6	55,130.2	38,345.2
7. Allocation of SDR's	-	-	-	-	-	-	-	493.6	506.4	488.0	-
8. Net errors and ommissions	635.8	-1,076.2	741.9	1,755.6	-368.5	886.9	-4,711.4	405.8	-3,654.3	2,962.3	-11,892.7
9 Overall Balance	1,985.0	864.2	8,012.0	-2,858.0	-82.8	-7,537.9	-13,298.0	-7,925.0	5,179.3	2,531.2	3,314.3

Source: Bank of Thailand, Quarterly Bulletin, various issues.

TABLE 1.7 Debt Outstanding and Debt Services of Private & Public Sectors

(Million U.S.,$)

	1965	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Debt Outstanding Disbursed	405.0	920.3	1,176.3	1,359.5	1,615.5	2,031.1	2,719.0	3,956.0	5,751.6	7,213.9	8,317.7
1.1 Private	150.0	461.2	648.0	736.2	785.1	879.9	930.6	1,243.0	1,751.4	2,098.6	2,296.3
1.2 Public	255.0	459.1	528.3	623.3	830.4	1,151.2	1,788.4	2,713.2	4,000.2	5,115.3	6,021.4
2. Debt Service Payments	69.8	270.5	258.3	363.2	380.4	446.0	826.1	946.6	1,232.2	1,347.0	1,523.1
2.1 Private	37.4	213.4	195.0	258.3	291.2	320.3	624.1	648.0	789.8	704.0	709.6
2.2 Public	32.4	57.1	63.3	78.2	89.2	125.7	202.0	298.6	442.4	643.0	813.5
3. Debt Service Ratio a/	-	14.0	11.0	15.6	12.9	10.4	16.4	15.1	15.4	14.9	16.6

Note : a/ Ratio of total debt service payments over total export earnings of goods and nonfactor services. Obtained from BOT Annual Report.
Source : Bank of Thailand, Statistical Bulletin and Annual Economic Report, various issues.

TABLE 1.8 : Share of Export Earnings from oil Supplying Countries in Total Export Value*

	1973	1974	1978	1979	1980	1981	1982
1. Middle East	1.9	6.3	4.3	4.1	6.2	7.4	5.9
2. Indonesia	4.6	3.8	1.7	3.6	3.6	1.9	2.6
3. Nigeria	-	-	4.4	1.2	1.1	1.3	1.0
4. Share of oil Supplying countries	6.5	10.1	10.4	8.9	10.9	10.6	9.5

* Exports of goods.

Source : Calculated from UN, Yearbook of International Trade Statistics, Various issues.

TABLE 1.9: Receipts and Payments in Services

(Million of Baht)

	1965	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Receipts	3,249	12,723	15,634	16,552	13,993	14,772	22,124	29,164	43,529	51,399	59,269
1.1 Freight and Insurance on merchandise	392	926	1,454	1,229	1,604	1,730	2,144	2,594	3,870	4,791	5,047
1.2 Other transportation	154	514	1,200	1,269	1,131	1,469	1,385	2,200	2,410	2,122	3,294
1.3 Travel	359	3,394	3,805	4,482	3,990	4,607	8,895	11,232	17,765	21,456	23,879
1.4 Investment Income	526	1,448	2,920	3,887	3,146	3,036	3,367	4,219	5,316	5,779	5,642
1.5 Government,n.i.e.	1,492	5,034	4,238	3,520	2,053	1,081	1,336	1,707	2,529	2,298	2,300
Military Services	(922)	(4,210)	(3,393)	(2,644)	(763)	(5)	(6)	(43)	(17)	(29)	(52)
Other Governmental Services	(569)	(824)	(845)	(876)	(1,290)	(1,077)	(1,331)	(1,664)	(2,513)	(2,269)	(2,248)
1.6 Other services	327	1,408	2,017	2,164	2,069	2,849	4,998	7,212	11,639	14,954	19,108
2. Payments	-1,805	-5,887	-8,034	-10,391	-12,351	-12,367	-17,845	-25,926	-32,384	-45,357	-50,474
2.1 Freight and Insurance on merchandise	-118	-504	-1,005	-822	-1,094	-1,290	-1,721	-2,079	-2,619	-3,160	-3,496
2.2 Other transportation	-63	-387	-749	-644	-545	-690	-974	-1,636	-2,071	-2,183	-2,282
2.3 Travel	-509	-1,449	-1,634	-2,735	-3,881	-3,184	-3,579	-4,648	-4,989	-6,023	-6,151
2.4 Investment Income	-537	1,872	-2,934	-3,776	-3,993	-4,516	-8,178	-13,324	-17,002	-26,506	-30,624
2.5 Government,n.i.e.	-183	-445	-319	-304	-457	-448	-523	-564	-734	-1,609	-1,569
2.6 Other services	-396	-1,229	-1,393	-2,110	-2,381	-2,239	-2,869	-3,675	-4,970	-5,872	-6,352
3. Net Services	1,444	6,836	7,601	6,161	1,643	2,405	4,279	3,238	11,145	6,042	8,795

TABLE 1.10 : Price, Inflation, and Exchange Rates

	1965	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Consumer Price Index (% change)	53.3	73.3 (15.4)	91.1 (24.3)	96.0 (5.4)	100.0 (4.2)	107.6 (7.6)	116.1 (7.9)	127.6 (9.9)	152.7 (19.7)	172.1 (12.7)	181.1 (5.2)
2. Wholesale Price Index (% change)	49.4	72.0 (22.9)	92.8 (28.9)	96.2 (3.7)	100.0 (3.9)	107.8 (7.8)	115.8 (7.4)	128.8 (11.2)	154.7 (20.1)	169.5 (9.6)	171.0 (0.9)
3. G D P Deflator (% change)	55.9	78.7 (20.2)	93.6 (18.9)	96.2 (2.8)	100.0 (3.9)	108.6 (8.6)	117.9 (8.6)	131.6 (11.6)	153.2 (16.4)	165.4 (7.9)	171.1 (3.4)
4. Average exchange rates (Baht/U.S.$)	20.7	20.6	20.4	20.4	20.4	20.4	20.3	20.4	20.5	21.8	23.0
- Buying	20.62	20.49	20.25	20.26	20.30	20.30	20.24	20.33	20.38	21.72	22.90
- Selling	20.80	20.72	20.45	20.45	20.45	20.45	20.38	20.46	20.53	21.87	23.05

Source : Bank of Thailand, Quarterly Bulletin, various issues.

Chapter 2

Energy Resources, Supply and Demand

2.1. Domestic Energy Resources (1)

Thailand cannot be considered to be poor in energy resources. As Tables 2.1 and 2.2 show in 1982 about 40% of the country's energy supply in terms of heat content (ton of oil equivalent) came from indigenous sources. There are both renewable and nonrenewable energy sources, in Thailand. Although the resources at some deposits have not yet been available for use but the increases in oil prices have given a strong motivation for putting these resources into use. The major renewable energy resources are hydropower, fuelwood, charcoal, paddy husk, and bagasse. the major nonrenewable energy resources are coal (lignite), crude oil, natural gas, and oil shale.

2.1.1 Non-renewable Energy Resources.

Lignite

There are several coal deposits of lignite type in the country. At present, there are four known reserves which are

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(1) The reserve data given here are drawn mainly from the NEA reports on Energy Situation in Thailand, 1979, 1980, 1981, 1982.

already in production. They are two reserves in Lampoon Province, one reserve in Lampang and one in Krabi. The total proven reserves of these four sites are 420 million tons. There are additional proven reserves in other sites but not yet in production of about 67.23 million tons.

The total inferred reserve in Thailand is believed to be 1438.6 million tons since there are 14 more deposits still under exploration. Lignite deposits are mostly found in the Northern part of the country.

The production of lignite in million ton was 2.113 in 1982, and 1.916 in 1983.

Crude Oil

The first found crude oil reserve in Thailand is the Chaiprakarn deposit at Amphur Fang in Chiengmai Province. The proven reserve at this site was 200,000 barrels and has been depleted since 1974.

The other important deposits are the Maesoon Luang and Banpong Nok, both in Chiengmai, and the Sirikit deposits in Kampangpet Province. Maesoon Luang has a crude oil reserve of about 1.5 million barrels and about half of this has been used. The amount of crude oil at Banpong Nok deposit is still unknown.

The Sirikit deposit is probably the largest crude oil deposit in Thailand with a possible reserve of 190 million barrels but with a recoverable reserve of about 30 million barrels. It also has some natural gas.

The total production of crude oil in 1983 was only 2.2 million barrels which is about 4 - 5 percent of total supply of crude oil for Thailand. The rest of the supply of crude oil has to be imported.

Natural Gas

Natural gas and liquid natural gas are mainly found in the Gulf of Thailand. The proven reserve of natural gas at present stands at around 2 to 6.73 trillion cubic feet and that of liquid natural gas is about 63.14 million barrels.

Natural gas can be used to generate electricity in place of diesel and fuel oil. Since 1981, the Electricity Generating Authority of Thailand (EGAT) has used natural gas for generation of electricity and has reduced the use of fuel oil and diesel oil remarkably, almost by half of the levels in 1980 for fuel oil and by 85 percent for diesel oil. The domestic production of natural gas started at the end of 1981 at the rate of 25 MMSCFD. It rose to 130, 150, and 250 MMSCFD in 1982, 1983 and 1984 respectively. The current production is about 400 MMSCFD and the currently contracted gas is expected to rise to 528 MMSCFD in 1986 before

falling to 437 MMSCFD in 1991. However, more gas is expected to be found and the total production could reach the level of 800-900 MMSCFD in the 1990's.

Oil Shale

Crude oil can be extracted from oil shale which contains more than 12% of oil in weight. There are two reserves of oil shale found in Thailand. One is at Mae Sod in Tak Province which has a reserve of 1,172 million tons. Some of the oil shale found here contains as high as 20 percent of oil in weight. The other is at Amphur Lee in Lampoon Province which has a reserve of about 15 million tons. The oil shale found at this site contains only 1 -3% of oil.

Because of some technical difficulties in the extraction process, oil shale has not been used as a source of energy. However, the continual increase in oil prices may make it a viable source of energy in the future.

2.1.2 Renewable Energy Resources

Hydropower

Hydropower is an important potential source of energy for Thailand although at present only about 4 per cent of the domestic potential has been used. The country has about 160

hydropower sources within the country and 10 hydropower sources which are bordering other countries. It is estimated that if all the 160 domestic hydropower sources are put into use the potential electricity generating capacity will be 24,165 megawatts.

At present, there are 15 hydroelectric power plants in various parts of the country. These plants have a total installed capacity of 1,510.7145 megawatts. The annual generation of electricity in 1982 of these plants is 3,836.499 million kilowatt hour which represents about 6 percent of total energy consumption in terms of heat content or in terms of metric ton of oil equivalent.

Other Renewable Energy Resources

Apart from hydropower, the other important renewable energy resources in Thailand are fuelwood, charcoal, paddy husk, and bagasse.

Fuelwood and charcoal used to be a major source of energy in Thailand especially for household cooking but their importance has been declining as the people shift to other types of energy. However, in the rural areas they are still the main source of energy for household cooking.

The figures for consumption of fuelwood and charcoal shown in Table 2.2 for the years prior to 1979 are commercial data from the Department of Forestry and they represent on the average about less than 1 percent of total energy consumption. However, when the non-commercial data were added since 1979, the proportion of fuelwood and charcoal has increased to about 10% of total energy consumption, which is quite sizable. Almost all fuelwood and charcoal used are domestically produced.

Paddy husk is another source of renewable energy resources. It is a by-product in rice milling and mainly used at the place where production takes place as a convenient non-commercial source of energy. Its share in the total energy consumption is small, less than one percent.

Bagasse is also a by-product in the sugar factories and mainly used at the place of production since it cannot be conveniently transported. Its heat content is 1.91 million kilocalories per metric ton. However, in contrast to paddy husk, its share in the total energy consumption is quite substantial, around 4 to 8 per cent.

The other sources of renewable energy such as biomass, biogas, and solar energy have not been in much use in Thailand. Any attempt to use these resources to provide for energy in the country is still at an exploratory stage.

2.2 Changes in Energy Demand and Supply

Table 2.1 shows the energy consumption by type of energy in Thailand during 1965 to 1982 (1) and Table 2.3 shows the supply of energy from demestic and foreign sources by type of energy for the same period. There are several important observations to be made from these two tables.

Firstly, it can be seen that non-renewable energy (especially petroleum products) is the biggest part of energy consumption but its share seems to be on a slowly declining trend. (See Table 2.2). We use the word "slowly declining" even though the percentage share drops from 86.6% in 1971/72 to 72% in 1981/82 because we realize that before 1979 a large part of non - commercial use of renewable energy (i.e fuelwood and charcoal) was excluded and therefore created an upward bias in the share of non - renewable energy during 1971 - 1978. However, if we look only at petroleum products we can see clearly that its importance as a country's source of energy has dropped substantially from 74% in 1979/80 to only 64.1% in 1981/82. This is partly due to the discovery and use of domestic natural gas in 1981 and 1982.

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(1) The type of energy is divided into renewable and non-renewable types instead of commercial and non-commercial since part of the data in the non-commercial energy (namely fuelwood and charcoal) is commercialized and the commercial and non-commercial proportions cannot be identified.

Secondly, the growth rate of energy consumption has a clear trend of slowing down in the last decade. In 1971-72 the average rate of increase in total energy consumption was around 17.5 percent per year. During the first oil shock period, 1973-74, it slowed down to 7.4 percent. During 1975-1978 the average rate of increase was about 9.5 percent and in 1981-82 the average rate of increase was 4.7 percent.

From the above figures, it looks as though the second oil price increase in 1979 - 80 did not have much effect on the rate of energy consumption as compared to the first oil price increase in 1973 - 74. But we should bear in mind that the total energy consumption consists of several types of energy. If we only look at the consumption of petroleum products, the effect of oil price increases in both periods can be seen much more clearly. In 1971-72, the growth rate of petroleum products was 20.7 percent. During the first oil shock, this rate dropped to 5.3 percent. In the adjustment period, 1975-1978, the growth rate increased to around 8.9 percent. During the second oil price increase, it dropped to around 2.4 percent and during 1981-82 there was a decrease in the consumption of petroleum products as other types of energy, such as natural gas and lignite, were used as substitutes.

Thirdly, it can be clearly seen that in the early 1970's Thailand relied heavily on imported energy for her energy consumption. However, the importance of imported energy is on a

declining trend as its share in total consumption drops from over 90 percent in the early 1970's to about 68 percent in the early 1980's. This drop comes mainly from the decrease in imported crude oil which is mainly due to the increases in oil prices in 1973 and in 1979 - 80 and also to the discovery of crude oil and natural gas reserves in the country in the late 1970's and early 1980's.

The growth of imported energy also slowed down during 1973-74 and 1979-80 when there were considerable increases in oil prices. (Table 2.4) It is worth noting that in 1981-1982 there was a drop in imported energy, particularly in crude oil and petroleum products, as Thailand began to use her domestic resources of natural gas and increase the use of domestic hydropower.

Fourthly, the growth rates of domestic supply of energy were quite high during 1973-1974 when the economy faced the first oil shock and also quite remarkable since 1979 (an average of about 38 percent per year during 1979 to 1982). This seems to indicate the adjustment of the economy to the increase in oil prices which created a considerable burden on the import bill. Furthermore, this adjustment was possible becausee Thailand is luckily endowed with some energy reserves which can be tapped when the imported prices of energy increase.

Fifthly, we may summarize the effect of the first and second oil price increases on the changes in demand for and supply of energy in Thailand as follows. There is evidence that the increases in oil prices slowed down the growth of energy consumption and imported energy. Although petroleum products are still the biggest item of energy consumption, its importance has been declining as the country shifts toward her domestic energy reserves of natural gas, lignite, and other renewable energy sources.

2.3 Balance Sheet of Energy in 1982

The balance sheet of energy for 1982 is shown in Table 2.5 in thousand metric ton of oil equivalent. From this table we can see that at present Thailand can rely on indigenous resources for about 42.8 percent of her energy consumption. The rest has to be imported in terms of crude oil to be refined by domestic refineries or in terms of finished petroleum products. Petroleum products are the major sources of Thailand's imported energy. There are some imports of coal and hydroelectric power which account for only 1.8 percent of energy consumption.

From domestic resources the non-renewable energy, which consists of petroleum products, lignite and natural gas, accounts for 12.1 percent of total energy consumption while the renewable energy accounts for 30.7 percent of total energy consumption. Although this may look good, if we realize that about 14.4

percent come from fuelwood and charcoal we have to be careful in planning for reforestation in Thailand. The potential domestic source of energy may be hydropower since a large part of this renewable energy is still left untapped at present.

TABLE 2.1 Energy Consumption by Type[a/] (10^3 MTOE)

	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Total Commercial	2,455.7	5,040.1	6,245.4	7,180.2	7,968.1	8,004.7	8,516.8	9,563.9	10,357.2	10,864.1	11,931.2	11,313.9	11,858.9	12,268.51
1.1 Electricity (Hydroelectric)	267.1	488.2	560.0	524.4	568.5	726.6	990.6	1,057.1	959.1	648.9	988.9	497.8	906.6	1,120.6
1 2 Non-electric	2,188.6	4,551.9	5,685.4	6,555.8	7,399.6	7,278.1	7,526.2	8,506.8	9,398.1	10,215.2	10,942.3	10,816.1	10,952.3	11,147.91
1.2.1 Petroleum Products	2,146.2	4,414.4	5,529.8	6,425.7	7,271.1	7,075.8	7,323.0	8,268.6	9,185.0	9,939.1	10,531.5	10,412.2	10,299.7	9,367.11
-Gasoline	308.9	744.1	998.9	997.4	1,180.2	1,263.8	1,387.1	1,544.8	1,717.7	1,815.7	1,829.2	1,780.7	1,653.7	1,586.0
-Kerosene	57.7	111.7	165.7	233.3	181.4	209.3	179.4	256.1	247.9	231.1	281.3	261.5	340.2	337.1
-Diesel Oil	918.4	1,916.3	2,268.7	2,383.3	2,707.2	2,594.4	2,517.4	2,947.0	3,208.3	3,447.6	3,873.0	3,589.6	3,448.7	3,452.51
-Fuel Oil	367.1	1,283.2	1,653.1	2,088.8	2,403.4	2,345.7	2,449.1	2,697.4	3,249.2	3,645.7	3,638.1	3,668.9	3,761.4	2,759.8
-Jet Fuel	489.7	308.8	388.0	650.1	713.2	566.7	674.2	690.4	616.6	634.0	714.2	895.5	812.8	873.7
-L.P.G.	4.4	50.3	55.4	72.8	85.7	95.9	115.8	132.9	145.3	165.0	195.7	216.0	282.9	358.0
1.2.1 Coal	42.4	137.5	155.6	130.1	128.5	202.3	203.2	238.2	213.1	276.1	410.8	403.9	433.8	660.2
1.2.3 Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	218.8	1,120.6
2. Total Non-Commercial	310.4	390.4	392.8	412.0	505.1	613.8	640.2	879.5	872.1	1,066.2	2,121.1	2,922.6	3,206.6	3,343.8
2.1 Fuel Wood [b/]	53.5	45.6	57.6	51.3	44.2	38.6	36.3	36.5	40.2	31.6	378.3	527.0	572.5	556.8
2.2 Charcoal [b/]	73.9	57.1	55.0	41.5	33.8	20.1	12.1	23.0	17.8	16.9	1,089.4	1,393.4	1,640.9	1,666.0
2.4 Paddy Husk	58.2	34.8	36.9	30.3	36.4	33.7	40.9	35.5	36.1	39.4	43.9	42.8	91.9	122.7
2.5 Bagasse	124.8	252.9	243.3	288.9	390.7	521.4	550.9	784.5	778.0	978.3	609.5	959.4	901.3	998.3
3. Total Energy Demand	2,766.4	5,430.5	6,638.2	7,492.2	8,473.2	8,618.5	9,157.7	10,443.4	11,229.3	11,930.3	14,052.3	14,236.5	15,065.5	15,612.31
4. Electricity (in 10^6 kwl sold to final users)	n.a.	3,804.9	4,422.0	5,136.3	6,189.8	6,525.4	7,468.0	8,597.3	9,945.6	11,348.5	12,419.2	13,136.2	13,819.6	15,017.8

Note: a/ Data from NEA were in terms of heat content or in litres of crude oil equivalent and were converted into MTOE here.
b/ During 1965 - 1978 the figures for fuelwood and charcoal are commercial data from the Department of Forestry. Since 1979, these figures include non-commercial data from Pilot Rural Energy Survey conducted by NEA

Source: NEA, Thailand Energy Situation, Oil and Thailand, and Electric Power in Thailand, various issues.

TABLE 2.2 : Proportion and Average Growth of Energy Consumption

	1971-1972	1973-1974	1975-1978	1979-1980	1981-1982
I. Proportion (%)					
1. Commercial	94.4	93.5	92.2	82.3	78.8
1.1 Petroleum Products	84.5	83.9	81.0	74.0	64.1
1.2 Coal & Lignite	2.0	1.9	2.1	2.9	3.5
1.3 Natural Gas	0.0	0.0	0.0	0.0	4.3
1.4 Hydroelectric	7.7	7.6	8.7	5.2	6.6
2. Non-Commercial	5.6	6.5	7.8	17.7	21.2
2.1 Fuelwood	0.7	0.5	0.3	3.2	3.7
2.2 Charcoal	0.7	0.3	0.1	8.7	10.7
2.3 Paddy Husk	0.5	0.4	0.3	0.3	0.7
2.4 Bagasse	3.7	5.3	7.1	5.5	6.1
3. Total Energy	100.0	100.0	100.0	100.0	100.0
II. Growth					
1. Commercial	19.5	5.7	8.0	2.3	4.2
1.1 Petroleum Products	20.7	5.3	8.9	2.4	-5.0
1.2 Coal & Lignite	-1.6	28.1	9.2	25.2	29.8
1.3 Natural Gas	-	-	-	-	-
1.4 Hydroelectric	4.2	18.1	0.4	1.4	52.8
2. Non-Commercial	2.7	22.1	15.8	68.3 a/	7.0
2.1 Fuelwood	7.7	-13.2	-4.1	25.1	3.0
2.2 Charcoal	-14.0	-29.5	5.4	3,186.3	9.6
2.3 Paddy Husk	-5.9	6.3	4.8	4.4	73.9
2.4 Bagasse	7.5	34.3	18.2	9.9	2.4
3. Total Energy	17.5	7.4	8.5	9.5	4.7

Note : a/ The high growth in 1979 is due to the inclusion of non-commercial data from the Pilot survey of NEA.

TABLE 2.3 ENERGY SUPPLY (10^3 MTOE)

	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Domestic Source[a]	628.6	1,037.9	1,134.3	1,039.9	1,166.1	1,500.9	1,800.1	2,142.5	2,009.8	1,937.5	3,800.3	3,597.9	4,582.9	6,678.2
1.1 Crude Oil[b]	na.	na.	na.	na.	na.	na.	na.	na.	na.	na.	na.	na.	na.	na.
1.2 Petroleum Products[b]	1.7	10.6	13.4	8.4	5.7	4.1	11.8	10.5	14.7	15.0	9.5	11.6	14.7	190.5
1.3 Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	218.8	1,120.6
1.4 Coal	39.6	130.2	144.3	119.8	116.5	180.8	182.2	215.6	192.9	248.9	356.0	343.9	394.3	578.4
1.5 Hydro	267.1	498.9	571.7	482.2	524.7	682.7	948.8	1,015.4	911.3	588.8	796.6	310.7	726.0	936.6
1.6 Non-commercial[c]	320.2	398.2	404.9	429.5	519.2	633.3	657.3	901.0	890.9	1,084.8	2,138.2	2,931.7	3,229.1	3,852.1
2. Imports	na.	5,145.9	6,362.6	7,530.8	8,667.3	7,578.7	7,938.0	8,653.4	9,918.6	10,535.9	11,323.3	11,808.3	11,291.5	9,658.5
2.1 Crude Oil	na.	3,818.5	5,422.7	6,842.1	7,655.8	6,602.8	7,168.1	7,512.5	8,347.1	8,217.4	8,904.2	8,490.7	8,216.2	7,359.2
2.2 Petroleum Products	1,220.1	1,320.3	927.5	636.4	955.2	907.8	704.1	1,074.1	1,502.0	2,229.5	2,181.7	3,069.0	2,847.9	2,017.7
2.3 Natural Gas														
2.4 Coal	2.8	7.1	11.3	10.2	12.0	21.5	20.9	22.9	20.1	27.1	55.1	60.7	45.5	98.0
2.5 Electricity	0.0	0.0	1.1	42.1	44.2	46.2	44.2	43.7	49.4	61.8	192.3	187.0	180.6	183.6
2.6 Other[d]	0.0	0.009	0.0	0.03	0.1	0.4	0.7	0.2	0.009	0.1	0.0	0.9	1.3	0.01

NOTE: a) The total excludes petroleum products from foreign sources. (1.2 + 1.3 + 1.4 + 1.5 + 1.6)

b) Petroleum Products from domestic sources are extracted from domestic production of crude oil but the exact production figures of crude oil are not published.

c) During 1965 - 1978, the data for fuelwood and charcoal are commercial data from the Department of Forestry. Since 1979, these figures include non-commercial data from the Pilot Energy Survey conducted by NEA.

d) Includes only charcoal and fuelwood.

Source: NEA, Thailand Energy Situation and Oil and Thailand, various issues.

TABLE 2.4 : Importance and Growth of Imported Energy

	1971-79	1973-74	1975-78	1979-80	1981-82
Average					
1. Share in total energy consumption					
1.1 Crude Oil	86.5	83.5	73.4	61.5	50.8
1.2 Petroleum Products	11.3	10.9	12.5	18.6	15.9
1.3 Coal	0.1	0.2	0.2	0.4	0.5
1.4 Electricity a/	0.3	0.5	0.5	1.3	1.2
1.5 Other	-	-	-	-	-
1.6 Total imported energy	98.2	95.0	86.5	81.8	68.4
2. Average growth of imported energy					
2.1 Crude Oil	34.1	-1.0	5.7	1.9	-6.8
2.2 Petroleum products	-30.1	22.6	29.6	19.3	-18.2
2.3 Coal	24.4	48.2	7.4	56.6	45.2
2.4 Electricity	1,809.9	4.7	8.2	104.2	-0.9
2.5 Other	-	-	-	-	-
2.6 Total imported energy	21.0	1.3	8.6	5.9	-9.5

NOTE : a/ This item includes fuelwood and charcoal. The share of this it is very small, less than 0.00001 percent, therefore, the avera rates are not shown in the table.

Source : Computed from Tables 2.1 and 2.3

TABLE 2.5 : Thailand's Energy Balance Sheet for the year 1982

(10 MTOE)

Types of Energy	Supply					Exports	Total	Statistical
	Inland Production Sources		Sub Total	Imports	Total Supply	Re-exports	Consumption	Difference
	Indigenous	Foreign						
1. Petroleum Products	190.5	7,244.9	7,435.5	2,017.7	9,453.2	-	9,367.4	85.8
1.1 Gasoline	111.9	1,448.0	1,560.0	15.6	1,575.6	-	1,586.0	154.5
1.2 Kerosene	-	313.5	313.5	58.6	372.1	-	337.1	34.9
1.3 Diesel	31.4	2,467.1	2,498.6	1,023.1	3,521.8	-	3,452.5	69.3
1.4 Fuel Oil	16.6	2,164.7	2,181.4	581.9	2,763.3	-	2,759.8	3.5
1.5 Jet Fuel	23.4	743.0	766.4	84.8	851.2	-	873.7	22.4
1.6 L.P.G.	6.9	108.4	115.3	532.5	368.8	-	358.0	10.8
2. Coal and Lignite	578.4	-	578.4	98.0	676.5	0.7	660.2	15.6
3. Natural gas	1,120.6	-	1,120.6	-	1,120.6	-	1,120.6	-
4. Hydroelectric	936.6	-	936.6	183.6	1,120.3	-	1,120.3	-
5. Fuelwood	556.8	-	556.8	0.01	556.8	.004	556.8	-
6. Charcoal	1,688.9	-	1,688.9	-	1,688.9	22.9	1,666.0	-
7. Paddy Husk	536.8	-	536.8	-	536.8	-	122.7	414.1
8. Bagasse	1,069.6	-	1,069.6	-	1,069.6	-	998.3	71.3
9. Total	6,678.7	7,244.9	13,923.6	2,299.5	16,223.2	23.6	15,612.7	586.9

Source; NEA, Thailand Energy Situation 1982.

Chapter 3

Macroeconomic Energy Relationships

3.1 Economic Growth and Energy Demand

During the period 1971 - 1982, the average growth rate of gross domestic product is around 6.6 percent whereas the growth rate of total energy consumption is faster, around 9.3 percent. This indicates that the average income elasticity of energy demand during this period is about 1.4.

However, if we separate the period into the pre-oil embargo and the post-oil embargo we can see that the income elasticity has dropped significantly between these two periods. During 1971-1973 the income elasticity was 2.62 and dropped to Ø.63 during the first oil shock (1974-1975). In the intermediate period (1976-1979) it seems that the economy had adjusted to the embargo and the income elasticity rose to 1.41. The second oil shock which took full effect during 198Ø-1982 reduced the income elasticity to almost the same level as that during the first oil shock, Ø.66. And if we consider the years 1974-1982 as a whole, the average income elasticity stood at around 1.Ø6 which is less than half of that in 1971-1973.

We can see from Table 3.1 that during the first oil shock, the average growth rate of GDP was about the same as that during

1971-1973. However, the growth rate of energy demand dropped significantly due to the increase in oil prices, resulting in a smaller magnitude of income elasticity. In the intermediate period (1976-1979), the average economic growth rate rose to a higher level (8%) but the average growth rate of energy demand was even higher (11.3%) and this resulted in an increase in income elasticity. During the second oil shock (1980-1982), the economy slowed down (5.3%) but the demand slowed down even more (3.5%), resulting in an inelastic income response.

It should be noted that the above pattern of income elasticities of demand during 1971 - 1982 was dominated by the rate of change in the demand for petroleum products. The growth rate of the demand for petroleum products considerably slowed down from 18% in 1971-73 to 0.4% in 1974-75 and became negative, - 3.7%, during the second oil shock period. On the contrary, the growth rates of the demand for other types of energy, namely hydroelectricity, coal, and non-commercial energy moved in the opposite direction to that of petroleum products. The growth rates of non-petroleum energy demand increased during the first and second oil shocks indicating substitution away from petroleum products during the oil crises.

The substitution took place mostly because of the big increase in petroleum product prices in comparison to the increase in prices of other energies. As Table 3.1 shows, during 1974-1975, the average increase in petroleum product prices was

30.2 percent whereas that of electricity was 2.5 percent and coal prices decreased by 18.7 percent. During the second oil crisis, even though the prices of electricity and coal increased at higher rates than petroleum product prices there still was a reduction in the petroleum product consumption. This can be partly due to the result of the public effort to conserve energy in general and partly due to the discovery and use of domestic natural gas both of which had a combined decreasing effect on petroleum product consumption.

The computation of price elasticities by using the average changes in price and in energy demand as shown in Table 3.2 can be misleading as we end up with positive price responses for many types of energy in different periods. This is because energy demand increases even when prices increase as factors other than prices are concurrently influencing the demand. A straightforward calculation of price elasticities from the rate of change will not give a clear picture of the price effect alone. This reasoning also holds for income elasticities as we can observe from Table 3.2 that a few of the calculated income elasticities are negative. Other things being equal, the outcome of either positive or negative sign of both elasticities depends on whether the income effect or the substitution effect outweighs the other. The econometric estimates of price and income elasticities will be analysed later in Chapter 6.

3.2 Per capita Energy Consumption and Energy Intensity

Table 3.3 presents the data on per capita gross domestic product and per capita energy consumption. In 1970 the level of per capita gross domestic product at 1975 prices was 6,193.5 baht per person and it increased by 1.57 times to the level of 9,742.0 baht in 1982. The average annual growth rate is about 3.8%. In the meantime the per capita energy consumption in 1970 was 0.1527 ton of oil equivalent per person and increased by 2.1 times to the level of 0.3196 ton of oil equivalent in 1982. The average annual growth rate of per capita energy consumption is about 6.5% which is faster than the growth rate of per capita income. It is evident that as the level of economic development is higher, people will use more energy in making their life more comfortable and Thailand appears to be no exception. This level of per capita energy consumption is higher than some ASEAN countries, namely the Philippines and Indonesia, but it is considered low compared to the world average of about 1.24 tons of oil equivalent in 1979. (1) The average per capita income elasticity of energy consumption was about 1.7 before the oil embargo and it reduced to about 1.1 during 1974-1982.

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(1) United Nations, Statistical Yearbook 1979/80

Energy intensity in Thailand as measured by the proportion of total energy consumption per real value of GDP in 1965 was 19.1 tons of oil equivalent (TOE) per million baht. It increased to an average level of 29 TOE during 1970 - 1973, and an average of 31.9 TOE during 1974-1979. It should be noted that although during 1980-1982 the average level of energy intensity increased to 32.9, this increasing average trend may be misleading since tne non-commercial energy was first included in the total energy consumption in 1979 and thereafter. This, of course, results in a big jump in 1979. If we consider only the trend during 1979-1982 we will observe that energy intensity is slowly declining. This is also true for the intensity of the commercial energy. For international comparison, the total energy intensity of Thailand in 1982 in 0.75 TOE per 1,000 U.S dollars, the commercial energy intensity is 0.59 TOE/1,000 U.S. dollars, and the electricity intensiy is 725 kwh per 1,000 U.S. dollars. All these levels are not high compared to the following figures of Korea : total energy 1.81 TOE / 1,000 U.S. dollars, commercial energy 1.70 TOE / 1,000 U.S. dollars, and electricty 1,733 kwh / 1,000 U.S. dollars.

The declining trend of energy intensity after the second oil price increase in 1979/80 can be attributable to the fact that the second oil shock had a more pronounced effect on the economic growth rate than the first one. Consequently, there was more public effort to conserve energy when faced with increasing energy prices in general, and increasing oil prices in

particular. Whether this declining trend will continue depends on the general response to the discovery and use of domestic natural gas since 1981, combined with the price and income responses.

3.3 Effect of Changes in GDP Composition on Energy Demand and Energy Composition.

As the data in Table 3.4 shows, the importance of the agricultural sector has been declining. In 1965, agriculture accounted for 36.1 percent of the gross domestic product but in 1982 it was only 24.2 percent whereas the share of the manufacturing sector increased from 14.3 percent in 1965 to 20.7 percent in 1982. The share of the transportation sector, which is a major energy consuming sector, seems to be relatively stable, fluctuating around 6 to 6.7 percent.

When we look at the growth rates of these economic sectors, it is evident that both the manufacturing and the transportation sectors grew at higher rates than the agricultural sector. Since the agricultural sector consumes a smaller portion of total energy (see Chapter 4) while the manufacturing and the transportation sectors consume a large part, these higher growth rates in the latter two sectors explain the increase in energy intensity of the economy during this period.

Based on 1982 data in Table 3.6, the transportation sector is the largest user of many petroleum products. It takes 34.1 percent of LPG, 88.8 percent of gasoline, 52.7 percent of diesel and 100 percent of jet fuel. The second biggest user appears to be the industrial sector which consumes 12.1 percent of LPG, 12.7 percent of kerosene, 44.7 percent of fuel oil, and 63.1 percent of electricity.

Another major consumer of energy is the household sector which takes 49.2 percent of LPG, 48 percent of kerosene, and 24.2 percent of electricity. We must also note the importance of the electricity and water supply sector as a major consumer of fuel oil (50.9 percent) and of lignite (92.3 percent).

It is obvious that as the sectors which are major consumers of these various energy types expand, the demand for them will increase. The extent of the increase, of course, depends on both income and price responses. However, the speed of adjustment depends on the technological constraints of each sector which may or may not allow immediate response. For example, manufacturing plants established before the high energy cost period may need time to have a plant redesign before energy saving scheme can be incorporated.

3.4. Impact of Oil Price Increases on Macro Variables

Impact on Inflation

An investigation of Tables 1.7 and 3.5 shows that the rates of price change, as measured by the change in the consumer price index, or the GDP deflator, followed the movement of the rate of change in energy prices. Before the oil shock in 1973 , the rate of price increase was generally less than 5 percent per year. In 1973, even though the effect of oil price increase registered late in the year, the rate of inflation in Thailand jumped to a record high level of 15.4 percent for CPI, 22.9 percent for WPI, and 20.2 percent for the GDP deflator. The increase in oil price seemed to take its full effect in 1974 when the consumer price index increased at 24.3 percent and the wholesale price index at 28.9 percent.

However, during 1975-1978, the inflationary problem seemed to be contained since the rate of domestic price increases slowed down to a less than 2-digit level. The second oil price increase in late 1979 brought the inflation rate to a 2-digit level again, around 10-12 percent. The effect of the second oil prices increase registered fully in 1980 when the inflation rate jumped up again to 19.7 percent for CPI and 20.1 percent for WPI. This effect appeared to linger into 1981 but has slowed down and then in 1982 the inflation rate dropped to 5.2 percent for CPI and only about 1 percent for WPI. It should be emphasized that the small rate of inflation in 1982 was due partly to a slack in

aggregate demand and restrictive policies in addition to the slower increase in import prices.

Econometric estimates of the relationship between the level of domestic price and energy price are presented in Table 3.7. The first set of equation uses the price of commercial energy as an explanatory variable and the second set uses the average price of petroleum products. All equations are in log-linear forms so that the coefficients of energy prices can be interpreted as percentage responses of the domestic price level to the increase in energy prices. We can draw several remarks from the estimated results in Table 3.7.

Firstly, both the commercial energy and petroleum product prices appear to have a significant positive effect on the domestic price levels and can explain more than 93 percent of the movement in the domestic price levels.

Secondly, there is a problem of autocorrelation in some of the estimated relationships until the dummy variable for the post-oil embargo period was included. This indicates that the relationship between domestic price levels and energy prices has been shifted up since 1974.

Thirdly, the inclusion of the dummy variable not only got rid of the serial correlation but also improved the explanatory power of the independent variable.

Fourthly, in most cases, the petroleum product price can explain the movement of the domestic price levels better than the total commercial energy price which includes electricity and coal prices in addition to petroleum products.

Fifthly, concentrating on only the equations with the dummy variable which give better statistics, we can see that the magnitude of the effect of energy price is slightly larger on the wholesale price index than on the consumer price index. This is not surprising since the weight of petroleum products in WPI is 12.5 percent whereas the weight of transportation in CPI is 7.4 percent.

Other Impacts

The most obvious effect of the oil price increase is on the import bill. Prior to the oil embargo in October 1973 the value of fuel import (1) in 1972 was 3,115 million baht or about 10 percent of the total import value. In 1973 , the value of fuel import increased to 4,661 million baht but the oil price increase took its full effect in 1974 when the fuel import value rose to 12,571 million baht and became almost 20 percent of the total

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(1) The fuel import items are crude oil, petroleum products and coke and briquettes. The last item accounts for a very small percentage, less than one percent, of the total fuel import bill.

import bill. During 1975 and 1978 , the growth of the fuel import bill stayed between 10 and 25 percent and had a big jump of 42.8 percent in 1979 when the second oil price increase took its full effect , the value of fuel import rose by 80 percent to a level of 58,733 million baht and accounted for more than 30 percent of the total import value.

The big jumps in the oil import bill contributed considerably to the high growth rates of the total import value during the first and second oil shock periods. This, of course, aggravates the trade balance of the country which has already been in deficit even without the oil shocks. The trade deficit in 1972 was -8,885 million baht and deteriorated to -10,802 in 1973 , and -14,302 in 1974. In comparison, the second oil shock seemed to have a more serious effect on the trade balance than the first one since during the first oil shock, particularly during 1972-1974, there was a boom in primary commodity trade. The increased value of exports tended to offset the adverse effect of the oil import bill on the trade balance.

During the second oil shock period there was no boom in commodity trade so the magnitude of the adverse effect of the oil import bill was very large. The trade deficit in 1978 was -28,540 million baht and become -47,053 in 1979 and -57,985 in 1980. In 1981 , the trade deficit continued at a record high of -65,782 million baht and the government decided to devalue the baht in this year.

As Table 1.6 shows, the overall balance of payments during 1973-1982 did not seem to be affected by the two oil shocks. The offsetting factor comes from the net movemment of capital flows which increased significantly during both oil shock periods. The net capital movements in 1973 were 2,939 million baht and increased to 9,055 in 1974. In 1978 the net value of capital movements was 14,858 million baht and it increased to 33,767 and 50,737 in 1979 and 1980 respectively.

A considerable part of the capital movements is the foreign loan. During the first oil crisis, increases in both the short - term and long - term loans were large and contributed positively to the balance of payments. The share between direct investment and foreign loans were about 40 and 60 percent respectively. However, during the second oil shock the foreign loans accounted for about 92 - 97 percent of the capital movements. The increased share of foreign loans reflects its very high growth rates during the oil crises period. For example, the growth rates of net private long term loans were 240 percent in 1979 and 60.6 percent in 1980. The growth rates of net private short term loans were 110 percent and 115 percent for 1979 and 1980 respectively. In addition, the public sector debt during this period has substantially increased. The increased foreign debts put considerable burden on the country's foreign exchange position when the high debt service payments become due.

TABLE 3.1 : Growth Rates of GDP and Energy Demand and Percentage Changes in Energy Real Prices

	Pre-embargo		First Oil shock	Intermediate	Second Oil Shock	Post - embargo
	1965	1971-73	1974-1975	1976-1979	1980-1982	1974-1982
1. GDP Growth rate	12.9	6.1	6.2	8.0	5.3	6.7
2. Growth rate of total energy demand	14.9	16.0	3.9	11.3	3.5	7.1
- Total commercial energy demand	19.2	16.5	3.3	8.7	1.0	4.9
- Electricity demand (hydro)	225.9	5.6	32.0	4.3	18.6	15.2
- Non - electricity commercial demand	10.5	17.6	0.9	9.7	0.6	4.7
- Demand for petroleum products	11.3	18.1	0.4	9.5	-3.7	3.0
LPG	n.a	19.7	16.3	14.0	22.5	17.3
Gasoline	n.a	17.4	8.3	7.2	-4.5	3.5
Diesel	n.a	12.2	-3.5	11.3	-3.7	3.0
Kerosene	n.a	22.2	0.5	13.6	7.3	8.6
Fuel oil	n.a	23.3	1.0	10.6	-7.7	2.3
- Demand for coal	-17.7	-1.4	28.8	21.2	20.3	22.6
- Demand for non-commercial energy	-9.9	9.3	12.9	39.4	17.2	26.1
3. Percentage Change in Energy Real Price						
Total commercial energy	-	-6.9	26.2	3.3	16.1	12.6
Electricity prices	-	-11.1	2.5	0.8	20.6	7.8
Non-electric energy prices	-	-5.6	29.2	6.0	12.8	13.4
Petroleum product prices	-	-6.0	30.2	6.3	13.8	14.1
LPG	-	-6.2	-9.7	2.4	4.5	0.4
Gasoline	-	-4.5	16.6	8.7	12.9	11.9
Diesel	-	-5.0	30.2	6.5	14.1	14.3
Kerosene	-	-6.9	12.5	3.4	7.4	6.8
Fuel Oil	-	-5.5	69.5	5.2	14.3	22.5
Coal Prices	-	-2.8	-18.7	17.9	15.2	8.9

Source : See Tables 1.2 and 2.1. Changes in energy prices are computed from Table 3.6

TABLE 3.2 : GDP and Price Elasticities of Energy Demand 1971-1982

	Pre-embargo 1971-1973	First Oil Shock 1974-1975	Intermediate 1976-1979	Second Oil Shock 1980-1982	Post-embargo 1974-1982
1. GDP Elasticities					
1.1 Total Energy demand	2.62	0.63	1.41	0.66	1.06
1.2 Commercial energy demand	2.70	0.53	1.09	0.19	0.73
1.2.1 Electricity demland a/	0.92	5.16	0.54	3.51	2.27
1.2.2 Non-electrictiy demand	2.89	0.15	1.21	0.11	0.70
1.2.3 Petroleum Product demands	2.97	0.06	1.19	-0.70	0.45
- LPG	3.23	2.63	1.75	4.25	2.58
- Gasoline	2.85	1.34	0.90	-0.85	0.52
- Diesel	2.00	-0.56	1.41	-0.70	0.45
- Kerosene	3.64	0.08	1.70	1.38	1.28
- Fuel Oil	3.82	0.16	1.33	-1.45	0.34
1.2.4 Coal demand	-0.32	4.65	2.65	3.83	3.37
1.3 Demand for non-commercial	1.52	2.08	4.93	3.25	3.89
2. Price Elasticities					
2.1 Total Commercial energy dem	-2.45	0.13	2.64	0.06	0.39
2.2 Electricity demand a/	-0.50	12.80	5.38	0.90	1.95
2.3 Non-electric commercial dem	-3.09	0.03	1.62	0.05	0.35
2.4 Petroleum Product	-3.02	0.01	1.52	-0.27	0.21
- LPG	-3.18	-1.68	5.83	5.00	43.25
- Gasoline	-3.87	0.50	0.83	-0.35	0.29
- Diesel	-2.44	-0.12	1.74	-0.26	0.21
- Kerosene	-3.22	0.04	4.00	0.99	1.26
- Fuel Oil	-4.24	0.01	2.04	-0.54	0.10
2.5 Coal demand b/	0.50	-0.65	0.84	0.75	0.39

NOTE : a/ Include only hydroelectric part but the price used to calculate elasticities is the average price of total electricity sales.

b/ The prices used are weighted cost of production at Mae Moh and Krabi Mines converted into Baht per 10^6 Kcal since retail prices and import prices are not available.

SOURCE : Computed from Table 3.1.

TABLE 3.3 : Per Capita Energy Demand and Energy Intensity

	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Per capita GDP (1975 prices, B/person)	4,720.2	6,193.5	6,296.6	6,301.0	6,621.5	6,707.2	7,049.2	7,517.6	7,867.1	8,610.8	8,816.9	9,156.5	9,549.9	9,742.8
- Growth rate	-	-	1.7	0.07	5.10	1.3	5.1	6.6	4.6	9.4	2.4	3.8	4.3	2.0
- Average growth rate			← 6.9 →			← 3.2 →		← 5.7 →				← 3.4 →		
2. Per capita Energy (TOE/ person)	0.0899	0.1527	0.1803	0.1953	0.2121	0.2085	0.2160	0.2417	0.2537	0.2638	0.3048	0.3032	0.3147	0.3196
- Growth rate	-	-	18.1	8.3	8.6	-1.7	3.6	11.9	4.9	4.0	15.5	-0.5	3.8	1.6
- Average growth rate			← 11.7 →			← 0.9 →		← 9.1 →				← 1.6 →		
3. Energy Intensity (TOE/ 10^6 B, 1975 prices)														
- Total energy/GDP	88.00	24.70	28.60	31.00	32.00	31.10	30.60	32.10	32.20	30.60	34.60	33.10	32.90	32.80
- Commercial energy/GDP	16.90	22.90	26.90	29.30	30.10	28.90	28.50	29.40	29.70	27.90	29.30	26.30	25.90	25.80
- Electricity/GDP (a) ($Kwh/10^6$ GDP)	n.a. -	1.39 (17,280)	1.54 (19,073)	1.77 (21,995)	1.88 (23,399)	1.90 (23,540)	2.01 (24,992)	2.13 (26,466)	2.30 (28,557)	2.35 (29,145)	2.46 (30,548)	2.46 (30,550)	2.44 (30,229)	2.54 (31,561)

NOTE : a/ Use electricity sales which include electricity generated from all types of plants.

SOURCE : Computed from data in (1) BOT, Monthly Bulletin, various issues;
(2) NEA, Thailand Energy Situation, various issues; and
(3) NEA, Electric Power in Thailand, various issues.

TABLE 3.4 : Composition and Growth of Economic Sectors. (%)

	1965	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Composition														
Agriculture	36.1	32.0	32.1	30.3	31.2	29.9	30.5	29.5	27.3	27.7	25.7	24.8	24.9	24.2
Mining and Quarrying	1.7	1.7	1.8	1.7	1.4	1.5	1.2	1.3	1.4	1.5	1.6	1.6	1.4	1.4
Manufacturing	14.3	15.4	16.0	16.9	17.5	18.1	18.0	19.0	20.0	20.1	20.8	20.6	20.7	20.8
Construction	5.7	5.7	4.8	4.3	4.0	3.9	4.1	5.3	5.9	5.2	5.2	5.6	4.9	4.7
Electricity and Water Supply	0.5	1.0	1.2	1.3	1.4	1.4	1.5	1.6	1.7	1.7	1.8	1.9	2.0	2.1
Transportation & Communication	6.4	6.5	5.9	6.3	6.2	6.3	6.6	5.9	6.0	6.2	6.3	6.4	6.4	6.7
Commercial a/	18.9	21.4	21.4	22.3	21.6	22.7	22.3	21.9	22.0	21.8	22.0	22.4	22.5	22.9
others b/	16.3	15.9	16.4	16.5	16.3	15.8	15.5	15.1	15.3	15.5	16.1	16.4	16.7	17.2
2. Growth Rates														
Agriculture	3.8	2.8	4.6	-1.2	12.7	1.3	9.0	6.1	-0.5	14.5	-4.9	1.9	6.7	1.0
Mining and Quarrying	49.5	-0.9	11.8	1.1	-7.0	8.8	-14.8	16.9	21.3	16.3	10.5	5.5	-3.3	-4.2
Manufacturing	16.2	6.9	8.1	10.6	13.1	6.5	9.6	15.6	13.0	9.7	9.6	9.8	6.4	4.4
Construction	11.3	-0.2	-11.7	-6.8	0.7	3.3	14.1	17.7	19.7	17.9	2.9	13.9	-6.5	-2.6
Electricity and Water Supply	27.6	20.0	14.7	19.8	16.7	6.1	14.2	14.5	13.8	8.6	15.1	7.4	13.8	6.7
Transportation & Communication	5.1	16.5	-4.3	12.2	7.7	7.0	11.0	9.0	10.2	14.2	-4.2	6.5	7.4	7.5
Commercial a/	7.3	12.3	4.4	9.0	6.0	8.3	7.5	8.0	7.7	8.5	6.6	7.5	7.1	5.5
Others b/	8.9	7.9	7.4	5.5	8.5	5.5	1.5	7.0	8.3	10.7	10.1	7.7	8.4	7.5

NOTE : a/ Includes wholesale and retail trade, and banking insurance and real estate.
b/ Includes ownership of dwellings, public administration and defence, and other services.

SOURCE : Computed from NESDB, National Income of Thailand, various issues.

TABLE 3.5 : Real Prices of Energy (B/10^6 Kcal)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Total Commercial Energy [a] PTCE	209.149	205.246	186.223	168.139	257.308	255.814	246.580	251.542	255.187	288.325	386.733	423.717	442.653
2. Electricity [b] PE	350.479	340.115	297.888	244.529	261.420	256.429	246.449	247.216	324.760	244.913	381.957	387.332	404.222
3. Non-electric energy [c] PNE	190.920	190.924	176.249	161.676	256.861	255.735	246.598	252.012	250.509	316.146	406.232	427.054	447.354
4. Petroleum Products [d] PPET	197.506	195.089	178.999	163.847	263.538	262.620	252.865	256.664	255.796	326.925	421.057	443.256	475.335
- LPG PLPG	595.648	592.659	564.819	489.321	412.565	396.522	380.636	363.963	400.926	432.698	537.609	505.365	482.086
- Gasoline PGS	391.64	387.711	393.784	339.485	460.109	449.035	431.055	452.607	495.356	616.813	751.726	799.833	884.377
- Diesel oil PDS	187.066	184.718	171.166	160.068	254.081	258.456	248.639	255.362	243.197	321.097	444.883	462.063	461.210
- Kerosene PK	273.922	274.245	227.370	219.073	285.021	270.474	259.698	262.392	248.706	303.125	395.150	381.357	364.116
- Fuel oil PF	78.465	71.748	66.558	66.049	160.085	154.488	148.585	149.196	142.377	183.594	232.240	270.201	270.812
5. Coal & Lignite [e] PCL	54.19	51.47	54.01	49.60	40.98	32.78	43.96	62.82	73.49	57.22	59.46	75.03	86.71

NOTE : a/ Weighted average of electricity and non-electric
b/ Average price of electricity sales deflated by wholesale price index, where the price index in 1972 = 100
c/ Weighted average of petroleum products and coal & lignite.
d/ Weighted average of individual product real prices (LPG, gasoline, and kerosene retail prices are deflated by consumer price index; fuel oil and diesel prices by wholesale price index), where the price indices in 1972 = 100
e/ Weighted average of cost of production at Mae Moh and Krabi Mines only, and deflated by wholesale price index, where the price index in 1972 = 100

SOURCE : NEA, EGAT, and Ministry of Commerce.

TABLE 3.6 : Percentage Share of Energy Consumption by Economic Sectors (1982)

Sector (Type)	LPG	Gasoline	Kerosene	Diesel Fuel Oil	Jet Fuel	ty	Electricity	Lignite
1. Agriculture	2.00	2.80	0.33	31.90	0.03	0.00	0.73	0.00
2. Mining & Quarrying	0.04	0.04	0.06	0.17	0.17	0.00	63.10	7.70 b/
3. Manufacturing	12.10	2.50	12.70	5.90	44.70	0.00		
4. Construction	0.00	0.04	0.28	2.90	0.32	0.00	a/	0.00
5. Electricity & Water Supply	0.00	0.31	c/	0.66	50.80	0.00	a/	92.30
6. Transportation & Communication	34.10	88.80	1.30	52.70	1.90	100.00	a/	0.00
7. Trade & Banking	0.00	0.77	0.76	0.97	c/	0.00	11.30	0.00
8. Residential	49.20	0.00	48.00	0.00	0.00	0.00	24.20	0.00
9. Other Services	2.50	4.70	36.50	2.90	2.00	0.00	a/	0.00
10. Total	100.00	100.00	100.00	100.00	100.00	1000.00	100.00	100.00

NOTE : a/ The rest of electricity is used in street lighting and others (0.7%)
b/ This figure includes industry (3.1%) and tobacco curing (4.6%)
c/ The proportion consumed isless than 0.01 percent.

SOURCE : Computed from NEA data.

TABLE 3.7 : Relationship between Domestic Price Levels and Energy Prices 1970-82.

Dependent Var.	Const.	Energy Price	Dummy	R^2	D.W.
1. Price of Commercial energy					
CPI	1.604	0.542		-	1.740
	(8.717)	(16.477)			
CPI	1.723	0.512	0.103	0.961	2.037
	(8.707)	(13.353)	(1.357)		
WPI	1.399	0.574	-	0.934	1.189
	5.685	(13.047)			
WPI	1.627	0.518	0.197	0.950	1.886
	(6.833)	(11.215)	(2.154)		
DFLA	1.768	0.513	-	0.930	1.402
	(7.821)	(12.706)			
DFLA	1.932	0.473	0.142	0.934	1.825
	(8.141)	(10.275)	(1.558)		
2. Price of Petroleum Products					
CPI	1.740	0.516	-	0.960	1.749
	(10.192	(16.967)			
CPI	1.838	0.492	0.089	0.961	1.990
	(9.786)	(13.462)	(1.169)		
WPI	1.540	0.547	-	0.938	1.213
	(6.779)	(13.516)			
WPI	1.742	0.497	0.183	0.951	1.867
	(7.773)	(11.347)	(2.000)		
DFLA	1.896	0.489	-	0.934	1.412
	(8.993)	(13.024)			
DLFA	2.038	0.454	0.129	0.939	1.790
	(9.024)	(10.332)	(1.409)		

NOTE : 1. Dummy values are equal to zero during 1970-1973 and equal to one thereafter.
2. t-values of coefficients are in parentheses.

Chapter 4

Sectoral Demand for Energy

4.1 Introduction

We have seen in chapter 2 that in aggregate terms, the growth rate of energy consumption has a slowly declining trend. Furthermore, the importance of imported energy as the major source of energy has reduced from the level of over 90 percent in the early 1970's to about 68 percent in the early 1980's. In this chapter we will examine the pattern of energy consumption in the major economic sectors to capture the changes in sectoral demands and the impact that they may have on the aggregate demand for energy.

Table 4.1 shows the distribution of petroleum products consumption among various economic sectors. It can be clearly seen that in 1982 the transportation sector is the largest user of petroleum products, about 40 percent of total consumption. Next is the manufacturing sector which consumes about 18.2 percent, followed by the electricity and water supply sector, 16.3 percent. It is worth noting here that prior to 1982, the electricity and water supply sector is the second largest consumer of petroleum products. However, starting in 1981, this sector has substituted domestic natural gas for fuel oil in generating electricity. The fourth largest user of petroleum product is the agricultural sector, 13.3 percent. All the other sectors together consume the remaining 12.2 percent with

individual shares varying between less than one percent to 6 percent.

Tables 4.2 and 4.3 show the distribution of electricity and lignite consumption respectively among various sectors. For electricity, the manufacturing sector is the largest user, about 63 percent, followed by the residential and the commercial sectors. These three sectors together consumed about 98.6 percent of electricity sales in 1982. The use of lignite is even more concentrated as the power plants take more than 92 percent of lignite and the remaining is taken up by the industry

The above description points out the importance of the manufacturing, transportation, electricity and agricultural sectors as major users of commercial energy. The commercial energy includes petroleum products, electricity, lignite and natural gas. Although there is no detail about the consumption of non - commercial energy, we can accurately infer that most of fuel wood and charcoal is used by the agricultural households, most of paddy husk by rice mills, and most of bagasse by sugar factories.

We will discuss the pattern of energy consumption among large users in detail and briefly discuss that of the remaining sectors.

4.2 Agriculture, Forestry and Fishery

The agricultural sector is the fourth largest user of both petroleum products and electricity. Its relatively low share of energy use reflects the traditional method of production which is very labour intensive. In 1982, this sector consumed only 109.8 million Kwh of electricity (0.7 percent of total electricity consumption), and 1326.1 million litres of petroleum products (13.4 percent of total petroleum products).

Diesel is the most significant item of energy consumption in this sector, accounting for 94 percent of all types of energy consumed. This is not unexpected since diesel is used as fuel in fishing boats and in operating farm machines and water pumps. The average growth rate of diesel consumption during 1971 - 1982 is around 4.6 percent. However, the growth rates considerably fluctuated from year to year.

The other types of fuel used in this sector are gasoline, LPG, kerasene, and fuel oil, but in very small amounts in comparison to the other sectors. The pattern of energy consumption in this sector does not appear to forego a drastic change in the futute since the agricultural sector is only moderately growing and substitution of other fuels for diesel may not be practical.

Table 4.4 shows the energy consumption of the agricultural sector by types of fuel in original units, in metric ton of oil equivalent, and their percentage share.

4.3 Manufacturing Sector

The details about energy consumption by type in the manufacturing sector are shown in Table 4.5. This sector is the second largest consumer of electricity, and one of the two users of lignite. Therefore any changes in the energy demand in this sector will have a large and significant effect on the aggregate energy demand.

Apparently, among the several types of energy consumed by this sector, petroleum products account for the highest share, followed by electricity and lignite. The proportion of petroleum products has declined from about 76.8 percent of commercial energy in 1974 to about 66.7 percent in 1982 whereas that of electricity increased from 21.7 percent to 32 percent. The share of lignite fluctuates around 1 percent even though the absolute quantity of lignite consumption appears large, 140, 872 tons in 1982. This quantity is only 7.7 percent of total lignite consumption. Slightly more than half of this is used for tobacco curing and the remaining is used in the cement industry.

Among the petroleum products consumed by the manufacturing sector, fuel oil takes the largest share, followed by diesel and LPG. It should be noted that since 1979 the use of fuel oil in this sector has been declining both in absolute terms and in percentage share whereas the use of electricity has an increasing trend. This may be due to the large increase in oil prices in 1979-80 which reduced the difference between the real price of fuel oil and price

of electricity per unit of heat content (see Table 3.6) while electricity is more convenient to use than fuel oil.

Although the shares of LPG and kerosene in total fuel consumption of the industrial sector are only 3.2 percent and 1.8 percent respectively, it should be noted that the industrial sector accounts for considerable proportions of the total LPG and kerosene consumption. The manufacturing sector is the third largest user of both LPG (12.1 percent) and kerosene (12.7 percent).

As for electricity, the manufacturing sector is the largest consumer since it takes about 43 percent of total electricity sales. It is also a growing consumer since during 1971-1982, its electricity consumption has an average growth rate of more than 10 percent per year.

The ten major fuel users of the manufacturing sector, in order of importance, are the textile, food, non-metallic, iron and steel, chemical, paper, metal, rubber, beverage, and petroleum refinery industries. Altogether they consume about 82 percent of total energy consumption in the manufacturing sector. The textile industry alone accounts for over 25 percent of energy consumption. The textile, food, non-metallic, iron and steel, and chemical industries together account for more than 70 percent of energy consumption in the manufacturing sector and more than 30 percent of energy consumption in all economic sectors. (1)

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(1) Arayah Preechametta, "Econometric Model of Energy Demand: A Study of Major Manufacturing Subsectors in Thailand", an M.A. Thesis, Faculty of Economics, Thammasat University, 1984, p.8.

Considering that the growth rate of the manufacturing sector as a whole has been high, around 18-20 percent, and the growth rates of the above mentioned subsectors are quite considerable, it is rather surprising that during 1980-1982, this sector could have reduced its commercial energy consumption on as average of about 3.7 percent per year. This may be an evidence of more efficient use of energy in this sector in response to the oil price increase. The energy intensity for the whole sector and for most industry groups, as shown in Table 4.6, fell consistently over the period between 1977 and 1981. This evidence is not inconsistent with a study done by the Asian Institute of Technology in 1980 which indicated that considerable energy saving can be achieved in many industries by more appropriate use of plant and equipment.(1) If considerable energy saving can be achieved in the manufacturing sector, then the aggregate commercial energy consumption will grow more slowly since it is a large energy consuming sector.

4.4 Transportation Sector

The sector which takes the highest share of petroleum products consumption is the transportation sector, the share of which is about 40 percent in 1982. It can be observed that during the first oil crisis, the use of petroleum products in this sector did have some reduction, from 2,551.660 thousand MTOE in 1973 to 2,343.099 thousand

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(1) Asian Institute of Technology, Division of Industrial Engineering and Management, A Study of Energy Consumption Pattern and Its Potential Savings in Selected Industries in Thailand, Bangkok, 1980.

MTOE in 1973 to 2,343.099 thousand MTOE in 1974. Then the consumption level had an increasing trend during the adjustment period (1975-1978) and it reversed to a declining trend after the second oil shock, during 1980-1982, The consumption level dropped from 3,648.432 thousand MTOE in 1979 to 3,497.706 in 1982.

The adjustment to the seco . oil price increase in this sector registered not only in terms of reduced consumption but also in terms of fuel switching. As can be seen in Table 4.7 prior to the second oil crisis, the use of LPG in this sector was either zero or insignificant. However, because LPG can be substituted for qasoline in motor cars and because it is much cheaper to run on LPG than on qasoline especially after the oil price adjustment, many people have switched to using LPG as car fuel. Table 3.6 shows that up to 1973, the price of qasoline per unit of heat content was cheaper than that of LPG. But since 1974 this situation is reversed and the difference between their prices was getting bigger. In 1982, the price of gasoline per unit of heat content was almost double that of LPG.

During 1975-1978, LPG consumption increased on the average at 14 percent per year but during 1979-1981, the average rate was 20 percent per year. This large increase in LPG consumption was made possible by the increase in LPG imports which, during 1979-1981 increased at the rate of 56 percent per year. A survey study done by the National Energy Administration of Thailand in 1981(1) reported

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(1) "A survey of LPG use in motor cars", a preliminary report by NEA, December 1981, mimeagraph.

that from their sampling in Bangkok about 98.45 percent of privatel - owned cars still use gasoline as car fuel, 0.52 percent use diesel, and about 1.03 percent use LPG. The types of cars which significantly use LPG as fuel are two-row minibuses and taxicabs. About 58 percent of all minibuses and 90% of taxicabs use LPG as fuel. The main reason for making this switch is the much cheaper price of LPG. Another major reason is that LPG stations provide services 24 hours a day.

This points to the increasing importance of LPG in the transportation sector. Even though LPG accounted for only 6 percent of petroleum product consumption in this sector in 1982,the LPG consumption of the transportation sector accounted for 34 percent of total LPG consumption (see Table 4.10). Therefore a few percentage changes in LPG consumption in this sector can have a significant effect on the total demand for LPG.

We cannot, at any rate, disregard the importance of gasoline and diesel as major fuels in the transportation sector. Although there appears to be a tendency for car users to switch to LPG, the majority of private car drivers still uses gasoline for their "believed" safety resson. The use of gasoline has an increasing trend up to 1979 and a decreasing trend afterward. The average decreasing rate of about 5 percent per year during 1980-1981 is due mainly to the large increase in gasoline price in itself and in comparison to LPG which stimulated the fuel switching. Nevertheless, in 1982, gasoline accounted for 40 percent of petroleum products consumption in the transportation sector and the transportation sector is the largest consumer of gasoline. It accounted for 88.8 percent of total gasoline consumption.

Another major fuel used in this sector is diesel which as widely used in buses, trucks, and pick-up cars. Diesel accounts for the largest share of petroleum products used in the transportation sector is also the largest user of diesel as it takes about 52.7 percent of total diesel consumption in 1982.

It is quite clear that when we consider the petroleum products as a whole, the transportation sector is the largest consumer. And since the country is heavily dependent on external supply for petroleum products, any change in the energy demand of the transportation sector has grave implications on the import bill and the trade balance of the country. As it stands, the recent trend shows that the growth of energy demand in this sector seems to have slowed down in response to high energy prices.

4.5 Electricity and Water Supply Sector

This sector is the largest consumer of fuel oil and the third largest user of all petroleum products. In 1982, it takes 50.8 percent of the total fuel oil consumption and 16.3 percent of the total petroleum products consumption. It is also the largest consumer of lignite and the only consumer of natural gas and hydropower.

The significance of each type of fuel in this sector can be from Table 4.8. Prior to the discovery and use of natural gas in 1981, fuel oil was the most important fuel used in generating electricity, followed by hydropower, lignite, and diesel. However,

the use of nature gas in 1981 and 1982 has reduced the importance of fuel oil in this sector dropped from 3,000 million litres in 1980 to 2457 in 1981 and to 1523 in 1982. Conseqently the share of fuel oil dropped from 78 percent in 1980 to 61 percent in 1981 and 35 percent in 1982 whereas the share of natural gas increased from 5.7 percent in 1981 to 27 percent in 1982

We can see that there are considerable fluctuations in the use of hydropwer which, of course, depends to large extent on the natural availability of water supply. However, there seems to be a long-term increasing trend in the use of hydropower in electricity generation.

It is obvious that the increasing imported price of oil and petroleum products and the burden it puts on the trade balance has encouraged the substitution away from imported energy toward the available domestic fuel such as lignite, natural gas, and hydropower.

4.6 Residential Sector

Table 4.9 presents the detail about energy consumption by this sector. Prior to 1979, the breakdown of petroleum products consumption included the household sector with other services sector. However, we can infer from Table 4.10 that the household sector took the largest share of both LPG and Kerosene during 1970 - 1978 just as it did during 1979 - 1982.

In 1982, the residential sector is the largest user of LPG taking 49.2 percent of total LPG consumption. It is also the largest user of kerosene, taking 48% of total kerosene consumption. It may not be far from reality to say that the residential use of LPG will increase with the increase in income and population since it is more convenient to use in household cooking than charcoal and fuelwood. During 1979-1982, the average growth rate of household use of LPG was about 12 percent per year.

In contrast, the household consumption of kerosene as a lighting fuel in the rural area should decrease with the increased availability of electricity, and with the increase in income. It can be observed that during 1979-1982, the use of kerosene by households has a decreasing rate on the average of about 7.5 percent per year whereas the electricity consumption as lighting has increased. (1)

The household sector is the second largest consumer of electricity, next to the manufacturing sector. In 1982, the share of the residential use of electricity in the total electricity consumption was 25 percent. On the average, the growth rate of electricity consumption duing 1971-1982 was about 13 percent per year. Again, we can predict that with the increase in income and the expansion of

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(1) NEA, Electric power in Thailand, 1982.

the supply of electricity, the household use of electricity will increase. At present, electricity is the most important fuel used by households, it accounts for about 98 percent of all commercial fuels used in 1982.

4.7 Other Sectors

Table 4.10 shows that if we consider the mining and quarrying sector, the construction sector, the commercial sector, and the other services sectors together as one consuming unit of energy, we should find that it accounted for about 2.54 percent of total LPG, 5.58 percent of total gasoline, 37.66 percent of total kerosene, 8.8 percent of total diesel, 2.5 percent of total diesel, and about 11 percent of all petroleum products consumption. It also accounted for about 27.9 percent of total electricity consumption.

The above percentage shares show the importance of other sectors in kerosene and electricity consumption. The important user of electricity is the commercial sector as it took about 14.7 percent of total electricity consumption in 1982. It is also very likely that the commercial sector is the most important user of kerosene (next to households), since it is widely used as lighting fuel by movable vending stalls throughout the country.

4.8 The Total Demand for Energy

From the above data analysis, we probably can say that the transportation sector will remain the biggest user of petroleum products, taking the most part of gasoline, diesel, and an increasing part of LPG. The manufacturing sectro seems to have an increasing use of electricity and a slowly decreasing

use of electricity and a slowly decreasing use of petroleum products There appears to be an increasing trend of the household demand for electricity also.

Since, the electricity sector has reduced its reliance on petroleum products to some extent by substituting demestic sources of energy in electricity generation, we may say that this will reduce the country's reliance on imported energy. However, since the transportation sector and the agricultural sector still rely heavily on petroleum products, the contry's reliance on imported oil still remains unless, through some good fortunes, more oil deposits could be found in the country.

TABLE 4.1 : Consumption of Petroleum Products (10^3 TOE)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Agriculture	671.240	695.668	681.906	814.621	932.086	851.316	916.445	997.500	1,007.737	1,072.876	1,162.490	1,031.307	1,161.330
Mining & Quarrying										84.936	86.131	73.519	74.486
Manufacturing	954.959	1,174.530	1,325.489	1,429.337	1,217.494	1,437.387	1,563.938	1,743.275	1,625.866	2,025.785	1,920.233	1,755.053	1,595.806
Construction	125.188	140.603	143.195	106.873	112.751	36.546	86.063	93.466	102.120	97.666	129.899	126.828	111.988
Electricity	643.070	733.776	976.488	1,174.583	1,160.366	1,156.854	1,418.391	1,846.064	2,466.237	2,227.692	2,928.462	2,355.205	1,430.740
Transportation	1,383.503	2,028.364	2,201.167	2,551.660	2,343.099	2,480.618	2,891.199	3,172.051	3,370.623	3,648.432	3,363.825	3,566.511	3,497.706
Residential	255.053	403.476	443.168	530.387	805.519	685.508	694.521	827.448	875.448	330.139	335.250	342.541	337.874
other										479.798	461.417	555.982	552.314
Total All Sectors	4,033.013	5,175.423	5,771.422	6,607.461	6,571.315	6,621.229	7,570.557	8,680.306	9,488.031	9,967.324	10,387.707	9,806.946	8,762.244

SOURCE : Calculated from NEA, Oil and Thailand, various issues.

TABLE 4.2 : Electricity Consumption 10^6 kwh

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Residential	966.7	1,023.8	1,221.2	1,290.1	1,490.3	1,726.6	2,005.9	2,427.4	2,737.8	3,025.2	3,192.6	3,630.6
2. Commercial	515.0	596.1	922.2	923.5	1,094.6	1,267.2	1,469.3	1,740.9	1,846.5	1,665.5	1,564.4	1,693.4
3. Industrial	2,897.6	3,650.1	3,996.2	4,268.0	4,836.5	5,543.6	6,377.6	7,091.7	7,739.5	8,350.0	8,968.1	9,480.8
4. Agriculture	5.5	3.3	2.6	3.5	4.9	5.6	13.6	8.0	17.0	22.6	20.1	109.8
5. Street lighting	37.2	43.0	47.6	40.3	46.5	42.6	53.6	60.3	55.9	55.6	63.1	68.5
6. Other	0.0	0.0	0.0	0.0	0.0	11.7	25.6	20.2	22.5	17.3	11.5	34.8
7. Total	4,422.0	5,316.3	6,189.8	6,525.4	7,468.0	8,597.3	9,945.6	11,348.5	12,419.2	13,136.2	13,819.6	15,017.9

SOURCE : NEA, Electric Power in Thailand, 1971-1982

TABLE 4.3 : Lignite Consumption (Tons)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Power Plant	n.a.	n.a.	n.a.	429,288.8	432,142.2	489,349.9	370,694.8	533,799.1	1,253,200.2	1,321,333.6	1,534,427.9	1,686,971.0
Tobacco Curing	n.a.	n.a.	n.a.	4,045.8	2,702.6	10,102.9	2,139.0	13,000.7	19,147.5	10,421.0	77,107.2	84,518.5
Industries	n.a.	n.a.	n.a.	97,890.8	73,064.6	103,605.8	114,759.3	113,472.0	83,451.7	87,671.7	24,151.4	56,353.5
Total				531,225.4	507,909.4	603,058.6	487,593.1	660,271.8	1,355,799.4	1,419,426.3	1,635,686.5	1,827,843.0

SOURCE : NEA, Thailand Energy Situation, 1982.

TABLE 4.4 : Energy Consumption by Agricultural Sector

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
A) In Original Units													
LPG (10^6 lt)	0.000	0.000	0.000	0.000	0.000	6.000	0.000	0.030	0.010	11.417	12.791	11.619	12.014
Gasoline	0.100	0.000	0.030	0.500	0.400	0.300	3.000	3.300	3.500	53.942	54.919	55.553	56.654
Kerosene	0.000	0.008	0.010	0.009	0.010	0.009	0.020	0.020	0.020	0.085	0.212	1.050	1.294
Diesel	764.300	792.200	776.500	920.500	1,055.300	961.000	1,040.600	1,132.600	1,144.100	1,158.039	1,255.006	1,107.611	1,255.270
Fuel Oil	0.000	0.000	0.000	6.400	5.500	7.800	0.300	0.300	0.300	1.630	3.963	2.061	0.824
Electricity (10^6 kwh)	n.a.	5.500	3.300	2.600	3.500	4.900	5.600	13.600	8.000	17.000	22.600	20.100	109.800
Lignite (Tons)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
B) Percentage share by heat content													
Petroleum Products	n.a.	99.940	99.960	99.970	99.970	99.950	99.950	99.890	99.940	99.870	99.840	99.840	99.240
Electricity	n.a.	0.060	0.040	0.030	0.030	0.050	0.050	0.110	0.060	0.130	0.160	0.160	0.760
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	n.a.	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
C) In 10^3 metric ton of oil equivalent													
Petroleum Product	671.240	695.668	681.906	814.621	932.086	851.316	916.445	997.500	1,007.737	1,072.876	1,162.490	1,031.307	1,161.330
Electricity	n.a.	0.443	0.266	0.210	0.282	0.395	0.452	1.096	0.645	1.370	1.822	1.620	8.840
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	671.240	696.111	682.172	814.831	932.368	851.711	916.897	998.596	1,008.382	1,074.246	1,164.312	1,032.927	1,170.170

Source : NEA, Oil and Thailand 1975, 1977, 1979, 1982;
Electric Power in Thailand, 1971-1982;
Thailand Energy Situation 1982.

TABLE 4.5 : Energy Consumption by Manufacturing Sector

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
A) In Original Units													
LPG	n.a.	0.000	0.000	0.000	0.000	0.000	0.000	26.500	33.400	66.920	64.242	81.916	72.639
Gasoline	13.600	33.100	30.300	14.600	18.100	19.800	25.500	28.400	36.000	55.977	103.903	46.135	50.607
Kerosene	33.400	20.400	28.700	22.400	25.800	22.100	13.100	11.200	10.400	64.254	61.834	47.768	49.235
Diesel	124.000	221.700	247.600	287.500	245.900	352.700	316.700	344.700	374.600	309.908	282.595	209.243	231.814
Fuel Oil	875.700	1,016.600	1,150.400	1,244.500	1,047.900	1,186.900	1,362.300	1,499.600	1,330.000	1,642.791	1,595.818	1,528.976	1,339.824
Electricity (10^6 kwh)	n.a.	2,897.600	3,650.100	3,996.200	4,268.000	4,836.500	5,543.600	6,377.600	7,091.700	7,739.500	8,350.000	8,968.100	9,480.800
Lignite (Tons)	n.a.	n.a.	n.a.	n.a.	101,936.600	75,767.200	113,708.700	116,898.300	126,472.700	102,599.200	98,092.700	101,258.600	140,827.000
B) Percentage share by heat content													
Petroleum Products	n.a.			n.a.	76.800	77.910	76.760	76.300	73.000	75.770	73.400	70.160	66.690
Electricity	n.a.			n.a.	21.700	21.130	21.930	22.500	25.660	23.330	25.720	28.890	31.930
Lignite	n.a.			n.a.	1.500	0.960	1.310	1.200	1.330	0.900	0.880	0.950	1.380
Total	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000	100.000
C) In 10^3 metric ton of oil equivalent													
Petroleum Product	954.959	1,174.530	1,325.489	1,429.337	1,217.494	1,437.387	1,563.938	1,743.275	1,625.866	2,025.785	1,920.233	1,755.053	1,595.806
Electricity	n.a.	233.515	294.158	322.049	343.953	389.768	446.753	513.964	571.512	623.718	672.917	722.730	764.047
Lignite	n.a.	n.a.	n.a.	n.a.	23.881	17.750	26.639	27.386	29.629	24.063	22.980	23.722	33.002
Total			n.a		1,585.328	1,844.905	2,037.330	2,284.625	2,227.007	2,673.539	2,616.130	2,501.505	2,392.855

SOURCE : NEA, Oil and Thailand, 1975, 1977, 1979, 1982;
Electric Power in Thailand 1971-1982;
Thailand Energy Situation 1982

TABLE 4.6 : Energy Intersity in Industry (Energy/GDP)
(Kcal per Baht GDP at 1972 prices)

Industry	1977			1979			1981		
	Oil	Oil and Electricity	Total a/	Oil	Oil and Electricity	Total a/	Oil	Oil and Electricity	Total a/
Total Industry	424	517	713	388	475	672	330	424	596
Food	346	455	1491	370	487	1718	192	317	1465
Textiles	387	593	593	345	521	521	301	469	469
Paper and Paper Products	1598	1951	1951	1228	1505	1505	1022	1308	1308
Chemicals and Chemical products	430	508	573	343	406	406	205	263	300
Petroleum refining and petroleum products	858	905	905	874	920	920	962	968	968
Non-metallic mineral products	2117	2318	2422	2052	2329	2253	2016	2225	2251
Basic Metal Industries	607	1230	1496	526	526	1136	821	1722	1946
Metal Products, etc.	600	775	775	688	528	688	346	600	600

Note : a/ Total includes oil, electricity, lignite, bagasse, and paddy husk.
Source : Calculated from data provided by NEA.

TABLE 4.7 : Energy Consumption by Transportation & Communication Sector

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
A) In Original Units													
LPG (10^6 lt)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.003	75.391	32.669	81.537	205.012
Gasoline	721.5	1,142.0	1,147.4	1,370.6	1,495.9	1,640.5	1,830.7	2,035.60	2140.4	2092.89	2,000.734	1,853.785	1,789.519
Kerosene	13.9	32.6	45.9	35.7	41.1	35.3	27.8	19.80	18.5	2.405	2.600	3.797	5.220
Diesel	863.4	1,184.2	1,375.7	1,555.3	1,214.0	1,247.6	1,598.9	1,740.40	1870.3	2,110.909	1,942.839	2,227.407	2,069.796
Fuel Oil	75.1	66.7	61.9	82.8	69.6	68.8	24.2	26.70	30.1	72.603	50.871	68.596	57.603
Electricity (10^6 kwh)	n.a.												
Lignite (Tons)													
B) Percentage share by heat content													
Petroleum Products	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
LPG	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline	41.04	44.30	40.90	42.27	50.24	52.04	49.83	50.50	49.97	45.14	46.81	40.90	40.26
Diesl	0.87	1.40	1.81	1.22	1.53	1.24	0.84	0.54	0.48	0.06	0.07	0.09	0.13
Fuel Oil	53.09	51.27	54.71	53.52	45.50	44.16	48.56	48.18	48.73	50.81	50.72	54.84	51.96
Electricity	5.00	3.03	2.58	2.99	2.74	2.55	0.77	0.78	0.82	1.83	1.39	1.77	1.52
Liginite	n.a.												
C) In 10^3 metric ton of oil equivalent													
Petroleum Product	1,383.503	2,028.364	2,201.176	2,551.660	2,343.099	2,480.618	2,891.199	3,172.051	3,370.623	3,648.432	3,363.825	3,566.511	3,947.706
Electricity	n.a.												
Lignite													

SOURCE : NEA, Oil and Thailand 1975, 1977, 1979, 1982;
Electric Power in Thailand 1971 - 1982;
Thailand Energy Situation 1982.

TABLE 4.8 : Energy Consumption by Electricity & Water Supply Sector

4=21

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
A) In Original Units													
LPG (10^6 lt)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.01	0.01	0.0	0.0	0.0	0.0
Gasoline	4.5	6.4	7.2	7.0	20.8	26.6	7.6	8.4	8.5	7.273	7.032	7.535	6.375
Kerosene	0.0	0.01	0.02	0.01	0.1	0.1	0.2	0.003	0.007	0.023	0.02	0.035	0.026
Diesel	245.0	150.5	86.9	80.9	73.0	65.9	75.2	81.9	154.3	192.308	182.794	99.126	26.133
Fuel Oil	460.9	647.9	968.2	1,192.5	1,172.8	1,170.8	1,462.2	1,919.6	2,524.0	2229.726	3,000.074	2,456.843	1,523.448
Lignite (Tons)	n.a				429,288.8	432,142.2	489,349.9	370,694.8	533,799.1	1,253,200.20	1321333.6	1,534.429	1,686,971.0
Natural gas (10^6 SCF)	0.0										0.0	9,265.4	47,446.81
Hydropower (10^6 kwh)	1,999.9	2,294.0	2,148.2	2,328.8	2,976.5	4,057.9	4,330.4	3,928.9	2,658.2	4,051.0	2,039.2	3,713.9	4,589.0
B) Percentage share by heat content													
Petroleum Products	n.a				58.38	51.45	54.76	63.83	76.11	63.46	78.39	61.33	35.18
Electricity	n.a												
Lignite	n.a				5.06	4.50	4.42	3.00	3.86	8.36	8.29	9.36	9.72
Hydropower	n.a				36.56	44.05	40.81	33.16	20.03	28.17	13.32	23.61	27.55
Natural Gas	n.a				0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.70	27.55
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
C) In 10^3 metric ton of oil equivalent													
Petroleum Product	643.07	773.776	973.488	1,174.583	1,160.366	1,156.845	1,418.391	1,846.064	2,466.237	2,227.692	2,928.462	2,355.205	1,430.740
Electricity	n.a												
Lignite	n.a				100.57	101.20	114.64	86.84	125.05	293.59	306.55	359.47	395.21
Hydropower	488.2	560.0	524.4	568.5	726.6	990.6	1057.1	959.1	648.9	988.9	497.8	906.6	1120.3
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	218.8	1120.6
Total (without) Electrictiy)	n.a				1,987.536	2,248.654	2,590.131	2,892.004	3,240.187	3,510.182	3,735.812	3,840.075	4,006.850

NOTE : a/ Converted from original units by using the heat content conversion of Mae Moh lignite which is 2,500 kcal/kg.

SOURCE : NEA, Oil and Thailand, 1975, 1977, 1979, 1982

Electric Power in Thailand 1971-1982

TABLE 4.9 : Energy Consumption by Households

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
A) In Original Units													
LPG[a] (10^6 lt)	n.a.	93.000	122.300	144.100	161.200	94.500	123.200	217.400	243.700	209.853	239.095	269.733	295.635
Kerosene (10^6 litres)	93.400	137.600	143.700	150.600	173.800	149.000	252.200	253.000	236.000	235.863	221.708	209.102	185.990
Electricity (10^6 kwh)	n.a.	996.700	1,023.800	1,221.200	1,290.100	1,490.300	1,726.600	2,005.900	2,427.400	2,737.800	3,025.200	3,192.600	3,630.600
B) Percentage share by heat content													
LPG	n.a.									1.000	1.100	1.100	1.100
Kerosene	n.a.									1.600	1.300	1.200	0.900
Electricity	n.a.									97.400	97.600	97.700	98.000
Total	n.a.									100.000	100.000	100.000	100.000
C) In 10^3 metric ton of oil equivalent													
LPG[a]	n.a.									125.027	142.448	160.702	176.134
Kerosene[b]	n.a.									187.771	176.502	166.466	148.067
Electricity	n.a.	4,125.668	4,369.358	5,211.819	5,505.869	6,360.280	7,368.758	8,560.750	10,359.621	1,684.341	12,910.903	13,625.330	15,494.620
Total	n.a.									11,997.139	13,229.853	13,952.498	15,818.821

NOTE : a/ For the year 1970-1978, the LPG figures, include the consumption of other services and public administration.
During 1979-1982, the proportion of residential in the total of residential plus others was about 97 %

b/ For the year 1970-1978, the Kerosene figures include the consumption of other services and public administration.
During 1979-1982 the proportion of residential in the total of residential plus others was about 78%

SOURCE : NEA, Oil Thailand, various issues.
NEA, *Electric Power in Thailand*, various issues.

TABLE 4.10 : Energy Percentage Share by Type and by Economic Sectors in 1982.

Sector \ Type	LPG	Gasoline	Kerosene	Diesel	Fuel Oil	Petro Products	Electricity	Lignite
1. Agriculture	2.00	2.80	0.30	31.90	0.03	13.30	0.90	-
2. Mining & Quarrying	0.04	0.04	0.06	2.00	0.20	0.90	0.90	-
3. Manufacturing	12.10	2.50	12.70	5.90	44.70	18.20	43.30	7.90
4. Construction	-	0.04	0.30	2.90	0.30	1.30	0.20	-
5. Electricity and Water Supply	-	0.32	0.01	0.70	50.80	16.30	2.20	92.30
6. Transportation	31.40	88.80	1.30	52.70	1.90	39.90	0.70	-
7. Residential	49.20	-	48.00	-	-	3.90	25.00	-
8. Others	2.50	5.50	37.30	3.90	2.00	6.30	26.80 b/	-
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

NOTE : a/ Percentage share of petroleum products was calculated on the basis of heat content.
b/ Others for electricity include commercial (14.7%), street lighting and other services (12.1%) This detailed breakdown is available for only the year 1982, from Electric Power in Thailand'82. For the previous years the available breakdown was only for agriculture, industry, commercial, residential, street lighting and others as shown in Table 4.2.

SOURCE : Compiled from data from NEA.

Chapter 5

Policy Reactions and Formulation

5.1 Thailand's Macroeconomic Setting Before 1973

In the 1960's the Thai economy grew rapidly at around 7%-8% per year. The structural changes which accompanied the growth during this period were characterized by the fact that the non-agricultural sectors, particularly manufacturing and transportation, registered higher production growth than the agricultural sector. As a result, agriculture, though still the largest, has been losing its share consistently. Growth in manufacturing could be attributed to various factors, among which the most important one seemed to be the policy of promoting industrial investment. Like in several developing countries, industrialization in Thailand was encouraged by the government's protective measures, e.g. high tariff, import quotas and bans on finished goods, which led to widespread import substitution. In the initial stage of industrial growth, as in the 1960's, the substituted imports were mainly nondurable consumer goods. It is important to note that in most cases these industrial activities which produced import-substituting finished products had to rely on imported machines, equipment, raw materials, and energy in the form of oil. A trade deficit, which occurred every year even during the decade before the first oil crisis, was mainly a result of this reliance of industry on imported capital goods and

raw materials.

In the case of oil, though it is a significant import item, its share was relatively stable at about 10% and it was never considered a major or critical import item until the first oil crisis. In the 1960's, with the capacity to increase its agricultural exports to finance growing industry-related imports, and with the relatively stable and healthy world economy, Thailand seemed to be able to afford both high economic growth and price stability, while at the same time increasing its dependence in trade, finance and investment on the rest of the world.

5.2 Policy Reactions After the 1973/74 Oil Crisis

The first oil crisis in 1973/74 was characterized not only by massive oil price increases by the OPEC, but also by the oil embargo imposed by the Arab countries in the OPEC. Thailand was classified by these Arab countries among the countries not exempted from the oil embargo. This meant that, though Thailand was not totally embargoed, the oil delivered to Thailand from the Arab countries must have been allocated after the oil import demand of the so-called "friendly" and "exempted" countries had been satisfied; the allocation was based on Thailand's oil import during the first nine months of 1973. Therefore, Thailand, like several oil-importing developing countries, was hit by drastically higher oil prices and rather restricted oil supply

during the first oil crisis.

Policy reactions to the first oil crisis can be analysed by dividing the period into two subperiods, i.e. the crisis period of 1973/74, and the after-crisis period of 1975-1978.

5.2.1 The Crisis Period of 1973/74

As far as the energy policy measures are concerned, the first and most important measure is oil pricing. Between January 1973 and January 1974, while the import price of crude oil rose from $2 per barrel to over $8 per barrel, the government-controlled prices, both at the ex-refinery and retail levels, of oil products were also raised with some time lag. At first, most of the burden of higher import prices was shifted towards oil consumers, while the government was able to gain its revenue in the form of taxes on oil products. Some profit was also reaped by the local oil refineries and oil trading companies as they could sell their old-stock oil products at higher prices. However, because of the political instability caused by the students' uprising in October 1973, and because of the widespread inflation impact created by big jumps in oil retail prices, the appointed care-taker government which was attempting to bring back economic and political stability decided to keep local oil prices constant after February 1974. In doing so, the burden of high oil prices was then shifted to the government in the form of foregone tax revenue (and subsidy in later periods), and to the local

refineries and oil companies in the form of lower profits.

There were some quantitative restriction measures taken immediately after the first oil shock. Most of these measures were adopted in early 1974, after the Royal Decree on the Solution and Prevention of Oil Shortages was enacted in December 1973. The Decree empowered the Prime Minister to issue order on matters concerning the production, the distribution, the transportation, the domestic and foreign trade, and the storage of petroleum, electricity, and other forms of energy. On the supply side, oil companies were ordered to supply some specific amounts of high-speed diesel oil to most coastal provinces which depended economically on coastal fishery. Large stocks of oil products had to be reported to a government authority in order to prevent shortages and speculation. On the demand side, various measures were adopted to curb the use of energy, especially electricity. Limits were put on the use of advertising lights and street lights, and the operating hours of movie theaters and massage parlours were curtailed. The Electricity Generating Authority of Thailand (EGAT) was asked to reduce its voltage--the measure which proved to be the most effective in energy saving among these quantitative restriction measures. However, these measures were regarded as being temporary and were abandoned in 1975 when the crisis was seen as having abated.

As already mentioned in Chapter 3, the adverse impacts of the first oil crisis on Thailand's balance of trade and domestic

price level were very significant. At the same time of the crisis in 1974 Thailand also enjoyed the world's commodity boom which boosted the prices of several major primary commodities, including rice, sugar, rubber, and maize which were Thailand's major export items. This caused significant increases in its export earnings and helped to reduce and cushion the impact of the oil price increases on the balance of trade. However, combined with the oil crisis, the commodity boom brought about very high level of inflation which was never experienced by the Thai economy before in its post-war history. Inflation then became an immediate concern of the government, which tried to control and lessen its impact on the economy by some macroeconomic policy measures. On the fiscal side, attempts were made by the government to hold down production costs by reducing tariff rates on over 300 import items which included some raw materials, capital goods, and finished products. Business taxes on some essential goods and services were also cut. On the other hand, taxes on major agricultural exports, notably rice and sugar, were imposed or raised to absorb excess profits and restrain the rises of their domestic prices which could otherwise aggravate the inflation problem. It is worth noting that despite the reductions in tariff and business tax, the increases in export tax and the shortfall in government expenditure (or the so-called fiscal drag) caused by the political unrest in October 1973 led to a government budget surplus in fiscal year 1974---the first budget surplus in 13 years. The monetary policy was also restrictive in 1973 and the first half of 1974 as the Bank of

Thailand increased commercial banks' required cash reserve ratio and its loan rate to tighten bank credit and slow down inflation. However, in the later half of 1974, the policy was eased to compensate for the deflationary impact of the budget surplus on money supply and to avoid recession. Therefore, the overall macroeconomic policy was rather contractionary and restrictive in 1973/74, with some easing toward the end of 1974.

5.2.2 The After-Crisis Period of 1975-1978

The oil supply situation seemed to improve after the middle of 1974. However, the OPEC reference price of oil still kept rising from $8 per barrel in January 1974 to $11.50 per barrel in October 1975. It then remained constant throughout 1976, and rose again in 1977 to $12 per barrel in January and $12.70 per barrel in July, and was kept unchanged during 1978. Compared with the price increases in 1973/74, those in the 1975-78 period can be considered to be rather mild.

During the period, Thailand still experienced further political instability and there were frequent and abrupt changes of the government. Five governments were in power during this 4-year period; three were appointed after political turmoil and violence and two were elected. Because of this political volatility, effective decisions on economic matters were difficult to be made in such a situation where the government was unstable for most of the time.

Against this political background, therefore, the government, either elected or appointed, was very reluctant to raise the domestic prices of oil products to reflect higher import prices, which would create higher cost of living. As a result, the retail prices of oil products remained constant for almost three years from February 1974 to March 1977. A planned increase in oil retail prices in early 1976 had to be called off because of a protest by labor unions against the high prices of rice and sugar. For most of the time during the period, the use of fuel oil was subsidized by the government, and an additional subsidy was given to the use of fuel oil by EGAT to hold down the price of electricity. Even though no explicit subsidy was given to the use of LPG and kerosene, the differences between their retail and ex-refinery (or import) prices were very small. Most of the burden created by these subsidies was borne by the government which financed them by the revenue collected from local oil refineries as part of the royalty agreed upon in the contracts. In early 1976, the fund used by the government in compensating the oil companies for selling the products at constant retail prices while buying them at higher ex-refinery (or import) prices amounted to 80-100 million baht per month. Finally, in March 1977 the government had to raise the retail prices of oil products to relieve its fiscal burden, and later the electricity price was also raised in July 1977.

On the non-price energy policy, in October 1975 a new set of quantitative restriction measures was adopted in place of the old

one. The new measures aimed not only at the use of electricity, but also at that of some oil products, especially gasoline. Both the public and private sectors were urged to curb the use of energy. Government agencies and state enterprises were asked to reduce the use of gasoline and electricity by 10%. There was restriction imposed on the operating hours of television stations and gas stations. Some efforts were made to ease the traffic congestion in Bangkok, and a publicity campaign was launched to promote the concept of energy conservation. EGAT was asked to rely more on hydro-power in its electricity generation in order to save oil. The country's sources of imported crude oil and oil products were diversified away from the Middle East and towards China and other ASEAN countries (Indonesia and Malaysia). There were active discussions and plans on how to reduce the oil import dependence and to increase the use of indigenous energy. These plans concerned the establishment of a national oil company and a ministry responsible for energy, the use of natural gas in the Gulf of Thailand, the expansion of local oil refining capacity, and the use of indigenous energy by power plants. In June 1979, a number of measures on oil conservation were proposed (and some were later adopted), e.g. the reduced use of official vehicles, the staggered office and school hours, the closing of gas stations during weekends, and higher registration fees on cars.

On the macroeconomic level, in 1975 as Thailand's exports declined as a result of the world economic recession, the question was how to stimulate the economy without reviving

inflation. The government expenditure in that year was increased by 25%, partly as a result of the launching of the rural employment creation program in which a government fund was spent on some development projects in rural areas with the purpose of creating jobs during the dry season. There were further reductions in tariff and business tax on some raw materials and textile products in order to control inflation. The export tax on rice was also cut to promote its export as the world price started to fall. The fiscal policy, which was quite expansionary in 1975, continued into 1976. However, the government expenditure was abruptly slowed down in October 1976 as another political unrest turned into violence and forced changes in the government. The monetary policy was also expansionary from the second half of 1974, and was designed to encourage investment and improve the country's financial structure in 1975 and 1976.

There were some worrying signs in the balance of payments situation as Thailand's international reserves started to fall in 1976. It was the first time in history that the government resorted to borrowing from foreign private banks. A compensatory financing credit was obtained from the IMF to offset a shortfall in export earnings in 1975.

There were three factors which caused the government to become more cautious in their macroeconomic policy in 1977/78:

i) A large balance of payments deficit occurred three years

in a row from 1975 to 1977.

ii) There were also large government cash deficits in these years.

iii) The prospect for export was dim in 1977/78 as a serious drought developed in 1977; and another round of oil price increases was expected to recur in 1977.

As a result, the policy had been restrained to reduce the so-called "overspending" by the economy and several restrictive fiscal and monetary measures were introduced in 1978. There were import bans on 18 luxury items, and tariff rates were raised on 141 luxury imports. The excise tax on gasoline and alcoholic beverages was also raised. The increases in these and some other taxes enabled the government to boost its revenue by 20%, while the government expenditure was increased at a low rate. In the monetary policy, the Bank of Thailand raised its loan rate and put a limit on credit for durable consumer goods and some luxury imports. The exchange rates between the baht and major foreign currencies were made more flexible than in the previous period when the baht was completely tied with the US dollar. The law was passed to allow the value of the baht to be based on a basket of currencies, and there was the so-called "daily fixing" which enabled the exchange rate of the baht to change from day to day. Although in practice the movements of the exchange rate were rather small, the move towards more flexibility indicated that

the monetary authority was more willing to use the exchange rate as another macroeconomic policy instrument in insulating the economy from external disturbances, the most important of which was oil price increases.

5.3 Policy Reactions During the 1979-1982 Period

After a relatively quiet year of the world's oil situation in 1978, OPEC started to increase its oil prices again in 1979, and the second oil crisis began. The posted price of the Saudi light crude went up from $13 per barrel in January 1977 to $24 per barrel in November 1979, $26 per barrel in January 1980, $28 per barrel in May 1980, $30 per barrel in September 1980, $32 per barrel in December 1980, and reached the peak of $34 per barrel in October 1981. It was not until March 1983 that the price started to decline to $29 per barrel. As in the first oil crisis, the world's oil supply was disrupted during the second crisis in 1979/80. The revolution in Iran reduced its oil export and caused some shortages in the world market, although the impact of the shortfall was not as widespread and serious as in the first crisis.

Compared with the situation in 1973/74, the second oil crisis in 1979/80 seemed to create more serious and long-lasting adverse impacts on the Thai economy. There are several reasons for this. For one thing, the second oil crisis was immediately followed by the world economic recession which lasted longer and

was more severe than any recession since the Great Depression in the 1930's. As a result, world trade declined and Thailand experienced lower demand and prices for its exports. This is clearly in contrast to the 1973/74 commodity boom which brought some relief to Thailand's international position during the first crisis. Moreover, the stress and strain on the economy caused by rising oil prices since 1973/74 already weakened Thailand's capability to cope with another oil crisis. Problems had been accumulated in the form of increasing deficits in the balance of payments and government budget, and higher foreign debts incurred by both public and private sectors. The historically high interest rate in the world's major financial centers in 1979/80 only aggravated Thailand's debt situation. On the local scene, the drought in 1978 seriously reduced production of most major crops and restricted the available supply of the country's major export commodities.

As far as politics is concerned, the governments during the period were relatively more stable than in the past. All governments, which were led by military leaders, received strong support from most major political parties and power factions. There were some changes in the cabinet caused by rivalry among political parties, but the changes were made in a more orderly and predictable fashion. Nevertheless, the seed of instability still remained an important obstacle to any drastic economic adjustment, particularly in the area of oil pricing.

The governments' policy reactions to the second oil crisis were somewhat different from those during the first crisis. In energy policy, the governments' adjustment of oil prices in response to higher oil prices were more swift and systematic. Both retail and ex-refinery prices in 1979 and the early part of 1980 were adjusted upward within one month after the OPEC price increases. The mechanisms and procedures of oil price adjustment were clearer and more definite than before. In particular, an extra-budgetary fund called "the oil fund" was established in order to stabilize the retail prices of oil products by taxing oil consumers when the prices were raised and subsidizing them when the prices were kept unchanged as import prices increased. The government seemed to be better equipped in planning ahead on oil pricing because OPEC had openly announced its intention to implement its step-by-step price increases during the 1979-80 period.

Between January 1979 and March 1980, the retail prices of oil products were adjusted upward such that all subsidies on oil were eliminated, and the burden of higher import prices was passed on to oil consumers, while local oil refineries and oil companies were adequately compensated without long delays. If the revenue collected into the oil fund was taken into account, the government revenue from oil products also increased during this period.

The political constraint on the oil pricing policy was clearly demonstrated in February 1980 when Prime Minister Kriangsak Chomanand was pressured to step down mainly as a result of his decision to substantially raise the retail prices of oil products across the board in response to OPEC's price increases in November 1979 and January 1980. The new government led by General Prem Tinsulanon bent to the political pressure by adjusting downward in March 1980 the retail prices of all oil products, except for gasoline. Since then till January 1981, the retail prices were kept constant and the oil fund was used to finance rises in the ex-refinery prices as import prices went up. For most part of the period between the middle of 1980 and April 1983, kerosene, LPG, and fuel oil were subsidized and diesel oil was taxed at a low rate. The prices of gasoline, on the other hand, were raised mainly through tax increases, and the gaps between their prices and those of other products were widened. The price distortion led to the adulteration of oil products and the demand substitution among different oil products. The most noticeable substitution was between gasoline on the one hand and diesel oil, LPG, and kerosene on the other. In 1982/83 the price difference between premium gasoline and regular gasoline was so large that there was a significant shift of consumption from the former to the latter.

The non-price measures adopted during the second oil crisis were more restrictive than those used during the first crisis. In 1979 television stations were ordered to cut their broadcasting

period by three hours on weekdays (1), and entertainment establishments had to close by midnight. These restrictions were aimed at saving electricity. To improve the traffic congestion in Bangkok and save transport fuel, no parking was allowed in several roads in the city. The highway speed limits were reduced for both cars and trucks. In 1980 the operating hours of gas stations were reduced, and at one time they were ordered to close on Sundays. All offices of the government and state enterprises were also ordered to cut their electricity consumption by 10%. But like in the first oil crisis, most of these measures was totally scrapped or relaxed once the oil supply and price problems subsided. Some long run measures on energy conservation were more actively implemented during the second crisis than in the past. These included education programs and publicity campaigns on the conservation of electricity and oil products. In 1982 the registration fee of passenger cars was raised and the raes were made progressive and based on the engine size to discourage the use of large-engine cars.

Despite what seemed to be a more active energy demand management policy, most of the efforts and resources in energy policy went into the development of indigenous energy resources and the increase of imported oil supply security. Huge

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(1) It is interesting to note that even at present television broadcasting is still prohibited during 6.30 p.m. amd 8 p.m. to conserve electricity.

investments were made to transport and to use natural gas from the Gulf of Thailand and oil from the north, as well as to increase lignite production. Long-term oil purchase contracts were successfully made with Saudi Arabia, Indonesia, Malaysia, and China.

The macroeconomic problems in Thailand during and after the second oil crisis were more varied and difficult than those caused by the first crisis. As already mentioned, the oil problem was followed by the world economic recession, the sharp rises of interest rates, and exchange rate fluctuations. There was also an internal political pressure on the government to support crop prices. These factors contributed to high inflation, growing trade and budget deficits, all of which made it difficult for the government to decide on its policy reactions. The main thrust of the monetary policy in 1979-1981 was to adjust to the rising interest rates abroard which tended to induce capital outflow. The withholding tax on interest paid on foreign loans was exempted, and the domestic interest rates were raised in order to attract capital inflow and stem capital outflow. The baht had to be devalued in 1981 as a result of a capital flight caused by the increasing strength of the US dollar, the rising US interest rate, and Thailand's own growing trade deficit.

After successive years of budget deficits since 1975, the government fiscal position in 1979 began to reach a critical point. While there were efforts to cut government spending by

setting limits on budget increases, there was also a pressure to increase government expenditure and reduce taxes. In 1980, for example, an increase in official salaries, the rural job creation program, and the crop price support operation resulted in a substantial rise in government expenditure. Tax deductible allowances wre raised to lighten the burden of high inflation, thus resulting in below-target tax revenue. Export taxes on some major export crops were reduced in order to promote exports which fetched lower prices in the world market. On the other hand, there were attempts to increase the tax revenue by introducing a new tax on land transfer and by increasing excise and business tax rates. Despite the increasing need to trim government spending, the budget deficit in 1982 was doubled.

The multiplicity of the problems and policy tradeoffs created during and after the second oil crisis prompted the government to employ more policy instruments than before. The monetary and fiscal discipline was constantly preached but, because of certain constraints, could not be practiced to the full extent. As the oil prices started to remain stable in 1982, the macroeconomic policy objective of coping with economic recession, excessive trade and budget deficits, and other short run problems tended to dominate the objective on how to deal with the energy problem.

5.4 Policy Formulation

This section will focus mainly on the policy formulation of Thailand's energy demand management (EDM) policy. Due to the very significant impacts of the energy problem since 1973/74, the energy policy has always been in the forefront among economic policies, particularly during the oil crises. Among energy and other economic policy measures, EDM often received most attention by the top level of the government, because of its immediate impacts on major economic variables and its political implications. A number of ministries, committees, subcommittees, and working groups have been assigned to study and make recommendations on the EDM policy. The government major goals in restraining energy demand are clearly stated in the fifth and current five-year plan. They are to:

- reduce energy consumption growth to 4.8% p.a. during the 1982-86 period

- reduce oil import volume by 3% p.a.

- lower energy dependence on imported oil from 75% in 1980 to 46% in 1986.

The demand strategies according to the plan are to improve energy efficiency, particularly in the transport and industrial sectors, and to develop an energy pricing policy which would

reflect the real energy cost and avoid wasteful interfuel substitution. Moreover, a number of studies by foreign and Thai experts have been commisioned by the government to make recommendations on the EDM policy, e.g. the studies on the energy master plan, energy pricing, industrial energy audits, incentives on industrial energy conservation, energy demand forecast, and lignite pricing. If the statemant in the plan and the resources spent on these energy studies can be any indication at all, the government in the last 10 years has been strongly committed to actively pursue the EDM policy and other policies in order to solve the energy problem.

However, the degree of government commitment and the objectives in the EDM policy seemed to vary over time, depending on the urgency of the energy problem relative to other problems, the political climate, the fiscal position of the government, and the type of economic problems associated with the energy policy. In the first oil crisis, Thailand, like all other oil-importing countries, was caught unprepared by OPEC's oil price increases. Hence, the main objective of EDM and other policies then was to lessen the short run impacts on energy supply, inflation, and trade deficits. The economic choices had to be made among (a) reducing the impact on the cost of living, (b) minimizing the trade and balance of payments deficits, and (c) ensuring adequate supply of oil.

During and after the second oil crisis, although the short run goals were still regarded as the most important in the EDM policy, some long run goals were also taken into account, e.g. energy efficiency and long run energy conservation, as reflected in the fifth plan. Nevertheless, because of the accumulated impacts of the first oil crisis and other associated problems, more short run goals came into the picture. The most prominent were the reduction in the size of budget deficit (specifically the deficits of the oil fund), and the revival of the economy during the worldwide economic recession.

Because the government was unprepared for the energy problem, and because the problem itself was unpredictable, the energy policy, especially the EDM which was regarded as the first line against the energy problem, was formulated on a rather ad hoc basis. The importance of energy for the economy and the seriousness of the problem made it inevitable that major decisions on the EDM policy always be made at the cabinet level. Below that level, all matters concerning EDM and other energy-related issues were normally considered by the National Petroleum Policy Committee, chaired by either the prime minister or a deputy prime minister, and comprising of relevant ministers and the secretary genaral of the NESDB. For most important energy-related issues, the cabinet would make decisions on policy alternatives recommended by the Committee. The Committee usually appointed subcommittees or working groups to work out the details on energy issues concerning oil pricing and other EDM measures.

It was possible that the cabinet may appoint its own special committees, subcommittees, and working groups to study some specific issues. The agencies represented in the National Petroleum Policy Committee and most of the special committees, subcommittees, and working groups on EDM matters were the Ministry of Industry, the Ministry of Finance, the NEA, the NESDB, and the Ministry of Commerce. Other agencies less involved in the policy formulation were the Ministry of Defence, the Ministry of Agriculture and Agricultural Cooperatives, the Ministry of Communication, and the Ministry of Foreign Affairs.

Although the duties and responsibilities of each committee, subcommittee, and working group were clearly specified, the mandates of some could overlap one another due to the lack of coordination and cooperation among various agencies. Moreover, the system of policy formulation in the energy area allowed different agencies and committees to initiate and consider the same policy issues at the same time. There has not been one definite agency which was assigned to initiate, study, monitor, and make recommendations on energy issues, particularly EDM issues, on a permanent basis, thus performing a staff function for the cabinet and the National Petroleum Policy Committee.

Chapter 6

Energy Pricing Policy

6.1 Introduction

Energy pricing policy (EPP) is a policy used by a government to influence energy prices either through a control on those prices charged by private firms and by government enterprises or through taxes and subsidies imposed on energy products or through some combinations of both means. In the Thai context, the energy products subject directly to the EPP are oil products, natural gas, electricity, and lignite, all of which are commercial energy. Although the prices of most noncommercial and traditional energy products, namely fuel wood, charcoal, paddy husk, and bagasse are not directly regulated by the policy, it is reasonable to believe that they are indirectly influenced by the EPP which directly affects most of energy consumption in the country. For our purpose, the main emphasis of our analysis in this chapter will be placed upon the pricing policy concerning oil products which form a large bulk of the country's energy requirement. However, some mentions will be made on other commercial energy products when they are considered relevant to the policy.

6.2 Goals and Principles of Energy Pricing

The fifth and current economic and social development plan is so far the only government document which clearly expresses the goals and principles of the EPP in Thailand. As mentioned in the previous chapter, the plan regards the EPP as a demand strategy which enables energy prices paid by users to reflect the real cost to the economy in order to :

a) reduce energy consumption growth,

b) reduce oil import volume and energy dependence on imported oil,

and c) avoid wasteful interfuel substitution.

All these goals imply that energy pricing should lead to better energy efficiency by energy conservation and by the substitution of oil by other energy sources, particularly indigenous sources. As in the cases of many other policies, what has actually implemented in the EPP and what has been planned can and do differ.

Governments in most oil-importing countries have tried to use oil pricing policy and other restrictive measures to discourage excessive oil consumption. The policy which sets domestic oil prices in order to reflect higher cost of imported

oil is very difficult to implement. There is an understandable reluctance to impose hardship on low and middle income population by raising oil prices. In Thailand, the pricing of oil products has become such a sentitive political issue because of its significant impact on the cost of living that one government was brought down in 1980 after it sharply raised the retail prices of oil products and electricity. In setting oil prices, the government is caught in a situation in which it has to trade off among different conflicting policy objectives, e.g. a trade-off between an equitable burden distribution of higher cost of living on various income groups and the saving of foreign exchange spent on imported oil. Conflicting policy objectives stem from the fact that there are arguments both for and against keeping oil prices high.

The high-price proponents advocate that oil pricing policy should ensure that the price of oil in various uses reflect its real economic cost in order to promote energy conservation and efficiency, and foreign exchange savings. A premium can be charged over and above the economic price of oil where uncertainties in import oil supply exist. This is to accelerate a shift away from oil and to avoid or reduce the shock effects caused by sudden disruptions in oil supply. Oil pricing should also encourage more use of indigenous energy resources and spur investment in exploration and development of local energy resources. At the ex-refinery level, high oil prices can be set to ensure adequate supplies of finished oil products by local

refineries. Moreover, in the case where taxes are imposed on some oil products, the government can earn additional tax revenue which help financing more and better public services.

On the other hand, there is a pressure on the government to use some restraints in raising oil prices. The arguments for low oil prices are mainly based on distributional grounds. For instance, the impact of oil price increases on inflation adversely affects the poor and fixed-income earners by creating inequitable burden of higher cost of living for different income classes. The impact can be large enough to cause social and political discontent. The higher cost of production resulting from oil price increases may hurt some small and numerous producers who cannot fully pass on the burden to consumers due to the lack of their market bargaining power. Moreover, the cheap oil policy can maintain or increase the international competitiveness of local industries in the short run. These arguments may call for a pricing policy which subsidizes the use of oil by some groups of consumers and producers. In practice, it is administratively difficult to implement a policy which differentiates the price of an oil product in different uses or among different types of users. Even when there is no price differentiation for the same type of oil product, subsidies can lead to energy inefficiencies and undesirable interfuel substitution. Keeping oil prices low by subsidization may be a short run political solution, but it will make a long run economic solution difficult, or even impossible.

However, there is a pure economic case for price subsidy on some oil products in a situation where there are externalities in the use of some traditional fuels. For instance, the use of charcoal and wood are still common in rural areas where these resources are almost free goods to the users. If the prices of commercial fuels, particularly oil products, are too high, there will be more use of charcoal and wood which leads to the problem of deforestation. Subsequently, a social cost will be incurred in the form of environmental, ecological and soil problems affecting agriculture and various aspects of the rural life. It might be better to enact a law which prevents forest destruction, hence making these fuels more expensive; but this is difficult to enforce when the pressure of growing population on land is already great.

In Thailand the major considerations in setting goals of energy pricing, particularly oil pricing, can be listed as follows :

a) To minimize the general effects of inflation ;

b) To mininize the inflationary effects on the cost of living of poor people;

c) To ensure short-run and long-run adequate supply of energy ;

d) To minimize the deficits in the balance of trade and balance of payments, or specifically to minimize the foreign exchange spending on oil import ;

e) To minimize the government subsidy on some oil products and to maximize the government tax revenue from the remaining oil products ;

f) To minimize the adverse effects on short-run and long-run economic growth;

and g) To maintain or increase the competitiveness of local industries in the short run and long run.

The "real cost" energy pricing which promotes energy conservation, energy efficiency, and appropriate interfuel substitution, can be associated with the considerations on adequate supply of energy (c), trade and payments deficits (d), government revenue (e), long-run economic growth (f), and long-run industrial competitiveness (g). On the other hand, the considerations on inflationary effects (a and b), short-run economic growth (f),and short-run industrial competitiveness imply energy pricing which may lead to low taxes or subsidies for some energy products.

As we may observe in the previous chapter, in practice the importance of these considerations and goals would vary according to the urgency of the energy problem, the political strength of

the government, the government's fiscal position, and the external balance of the economy in monetary and trade areas. During the oil crises, energy pricing by the government was directed more towards such short-run goals as inflation, short-run economic growth and industrial competitiveness, than towards long-gun goals. During the second oil crisis, more consideration was given to the position of the oil fund which had accumulated an increasing deficit since the first crisis. Attempts were made to use the tax revenue from gasoline in subsidizing other oil products, thus leading to price disparities which encouraged undesirable interfuel substitution. These price differences were reduced in 1983 when the OPEC oil price started to decline. Even then reductions of the retail prices were delayed in order for the government to turn the oil fund deficit into a sizable surplus. It was during July 1979 and March 1980 that oil prices were substantially adjusted to fully reflect higher import costs and to promote energy conservation. As we have observed, this was done at a high political cost.

In determining the domestic prices of oil products, the reference prices on which these prices were based were import prices. While the ex-refinery prices were directly related to the ex-refinery prices in Singapore, the retail prices were made different from the c.i.f. and ex-refinery prices by taxes, subsidies and the oil fund contribution or compensation. The levels and the structure of oil retail prices have been dependent upon not only their foreign-exchange costs but also the impacts

of their prices on the economy. Electricity, on the other hand, has been priced more on the basis of the long run marginal cost of power generation.(1) However, its pricing was still subject to a political constraint, and no peak-load pricing has been introduced. Natural gas prices paid by EGAT and a cement company have been based on the import price of fuel oil. There is no available information on how lignite has been priced.

6.3 Mechanism and Procedure of Oil Prices Determination

The government imposes a price control on all oil products because it regards them as being vital to the livelihood of the population. Though it is debatable whether this price control is desirable, one cannot deny that for political and economic reasons, some of which are noted above, the government should have some influence on domestic oil prices.

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(1) See Mohan Munasinghe and Jeremy J. Warford, Electricity Pricing, Theory and Case Studies, The Johns Hopkins University Press, 1982.

For locally refined products in Thailand, the government controls their prices at two levels, namely retail prices and ex-refinery prices. Excise, municipal and business taxes are collected at different rates for different types of product.(1) In addition, there is a component called the "oil fund" which is equivalent to a variable tax or subsidy allowing the government to change the ex-refinery price without changing other components and the retail price. The remaining component of the retail price is a marketing margin which includes marketing costs and profits of oil traders. Therefore, the breakdown of retail price components for a locally refined product is as follows :

Retail Price = Ex-Refinery Price + Excise Tax + Municipal and Business Taxes ± Oil Fund + Marketing Margin

There is no import tax on crude oil import. For imported refined products, the government collects an import tax as well as business and municipal taxes. The rates of these taxes are based on the "import price" set by the government on the basis of c.i.f. price. The retail price components of an imported refined product are as follows :

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(1) A business tax has been exempted for locally refined products since February 1979.

Retail Price = Import Price + Import Tax + Municipal and Business Taxes ± Oil Fund + Marketing Margin

The oil fund collected from (or paid to) local refineries and importers usually differs to equalize the marketing margins and the retail prices of both locally refined and imported finished products. The difference is due to the fact that taxes on both products are slightly different and the ex-refinery prices are lower than the import prices for most types of product. These differences can be seen in Table 6.1 which shows the retail price components of five oil products, both locally refined and imported, as applied from 1981 to August 1985.

It is clear that the Thai government has been trying to control not only the retail prices of oil products, but also those components of the prices. Therefore, it is interesting to examine these components individually.

Ex-refinery price :

Prior to the first oil crisis in 1973/74 the government set the ex-refinery price for the biggest local refinery (The Thai Oil Refining Company or TORC) by using the following formula :

Ex-refinery Price = F.O.B. Ex-refinery Price in Singapore + Singapore-Bangkok Transport Cost + Insurance Cost + Losses (0.5% of c.i.f. Bangkok Price)

After the world oil price began to rise very sharply at the end of 1973, transport and insurance costs, including losses, were taken out of the formula. Since then the ex-refinery price in Thailand has been tied with the Singaporean f.o.b. ex-refinery price (or posting price), though the prices still differ slightly for some products. Thailand's ex-refinery prices are now based on the average of the posting prices of six major oil refineries (Shell, Esso, Mobil, British Petroleum, Caltex and Singapore Refining Corporation) in Singapore. Because Singapore is the biggest refining center in the region and is likely to have the economies of scale which ensure efficiency, such a price setting formula should force local refineries to be as efficient as those in Singapore. One interesting issue is whether this method of ex-refinery price determination is appropriate. Different conditions in the two countries, e.g. the price of imported crude oil , oil demand patterns, refinery yield patterns, and domestic cost components in refineries, may require differences in their ex-refinery prices. It has been observed that an incentive provided to Thailand's local refineries for producing fuel oil is relatively greater than for diesel oil; and this contributed to shortages in diesel oil in the past and will lead to fuel oil surpluses in the future when lignite and natural gas will

substitute for much of fuel oil used in electricity generation.(1) Price differentials among different products as well as among different refineries need to be considered by taking into account various cost and demand differences.

Taxes and oil fund :

Before the first oil crisis, taxes were the biggest component which was added to the ex-refinery prices of all oil products. All taxes as percentages of ex- refinery prices range from over 100% for gasoline and LPG to 30% for diesel oil. (See Table 6.2) After December 1973 these percentages began to decline as the government tried to reduce the oil tax burden in order to soften the impact of import prices on domestic prices. Retail prices remained stable from December 1975 to March 1977, and the relative tax shares reached the lowest level for gasoline and diesel oil during that period. These shares picked up gradually until early 1980 when the political pressure which caused change in the government pushed them down again. As of May 1984, fuel oil and LPG were subject to only minimal taxes, while the tax shares on gasoline, diesel oil, and kerosene were slightly lower than those in early 1973.

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(1) See Thailand : Energy Issues and Prospects, a World Bank report, May 1980, pp. 76-78.

Oil is one of the very few commodities which bring substantial tax revenue to the government. The excise tax revenue from oil products is in fact the largest among various types of excise tax. As a percentage of total tax revenue, the revenue from oil excise tax seemed to be directly related to oil price increases after 1974. It went down from 7.2% in 1974 to 6.6% and 6.3% in 1975 and 1976 respectively when domestic oil prices remained constant; then it climbed up to 8.4% and 12.9% in 1979 and 1980 respectively when oil prices were substantially raised. The percentage went down again to about 10% in 1981-1983 when the tax rates on oil products were reduced to prevent the retail prices from increasing at high rates. (See Table 6.3) The revenue from import tax on oil products follows a similar pattern, reaching the lowest level of about 1% of total tax revenue in 1975 ad 1976. The revenue from both taxes as a percentage of total tax revenue reached its peak at 16% in 1980. This seems to imply that high domestic oil prices in 1980 was caused not only by the OPEC's action but also by the government's action, intentional or not, of shifting its tax base towards oil products. However, the tax share fell in 1982 to 12%, which, though lower than in 1980, was still higher than in the 1970's.

Because the taxes on oil products are indirect taxes, most of the oil tax burden would fall on oil final users. And like other indirect taxes, the oil taxes tend to be regressive, thus creating relatively larger burden on the poor than on the rich. But since the government taxes the types of oil product used

mainly by the rich (e.g. gasoline) at higher rates than those used mostly by the poor (e.g. kerosene and fuel oil), the degree of tax regressivity should be reduced or even reversed.

Apart from the oil taxes mentioned above, there is another type of government levy called the oil fund. This fund was set up in 1974 when the government collected the oil company's windfall profit arising from higher retail prices of the "old cost" oil stock. In 1975 the government began to collect the oil fund from oil users by adding it as another component of the retail price. The component is a positive levy every time the government raises the controlled retail prices, and it will be reduced when ex-refinery prices are raised, as a result of higher oil import prices, in order to keep the retail price constant. For kerosene, fuel oil and LPG, the retail prices and taxes have been set at such low levels that the oil fund often becomes negative, i.e. subsidies are given by drawing from the oil fund, until there is another round of retail price adjustments. It is only for gasoline that the oil fund remains positive all the time. (See Table 6.2) From 1975 to 1977 and from 1979 to early 1981, payments were drawn from the oil fund to subsidize the prices of fuel oil and diesel oil used by EGAT to keep down the price of electricity. These subsidies, the rates of which were

quite high (1), were one of the main causes of a large deficit in the oil fund. It was estimated that the oil fund deficit amounted to 3,600 million baht at the end of 1980. To the extent that electricity is used mainly by people in big cities, particularly Bangkok, these large subsidies would benefit only city dwellers, perhaps at the expense of the rural sector, thus worsening the distribution of oil tax burden.

One may question the government's strategy of raising oil prices by also including the oil fund in retail prices. This strategy means that the new price levels will have to be high enough so that the oil fund can be adjusted downwards to stabilize domestic prices when imported oil is getting more expensive. An alternative strategy is to raise domestic prices every time import prices move upwards. Therefore, price adjustment will be more frequent and the average prices over time may be lower than in the first strategy. The question is whether one price strategy will have a greater impact on inflation than the other. The answer depends on the nature of price speculation and the accuracy with which all actors in the economy (including the government) can anticipate changes in import prices.

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(1) In 1979, for instance, the price paid by EGAT fo fuel oil was 1.58 baht/litre while the market price was 2.86 baht/litre. The subsidy amounted to 1.28 baht/litre or nearly 50% of the market price.

When the taxes and the oil fund are combined, it is worth noting that oil subsidies by the government become widespread during and after the second oil crisis. During the middle of 1980 and March 1983, all oil products except gasoline were subsidized for most of the time through compensation paid out of the oil fund (i.e. negative oil fund) which more than offset taxes. It was not until April 1983 as the import prices of oil started to decline when the government began to remove subsidies for kerosene, diesel oil, and fuel oil. As of May 1984, the only oil product which was subsidized was LPG.

Marketing margin

The marketing margin is supposed to include storage cost, transport cost, other marketing costs, and oil traders' normal profits. If the margin is too low, the profits will be squeezed and supply problems may emerged in the form of lower import supply, fewer gas stations, oil adulteration, and black markets. On the other hand, if the margin is too high, oil traders may earn excessive profits. The government, therefore, has to deal with the question as to what the marketing margin should be. So far, there is no government agency which has been assigned to study this question on a continuous basis. In practice, the margin set is based on the cost information occasionally given by oil companies, with no independent research to check its accuracy and reliability. This does not mean that the margin allowed by the government has been excessive. On the contrary, the margin

for premium gasoline actually declined during the 1973-May 1984 period, and the margins for other products increased slightly. (See Table 6.4) While the actual oil marketing costs are likely to have increased significantly during the period, the small increases in the margin would squeeze the profits earned by oil traders and dealers.

6.4 Analysis of Energy Pricing Policy and Energy Demand

The EPP will be analysed and evaluated by examining the effects of the policy on the demand for various important energy products, as well as on the demand substitution among them. We saw the estimation of income and price elasticities based on the average annual changes in income, price and energy demand, as shown in Table 3.2 of Chapter 3. We commented there that these results can be misleading because we obtained positive demand responses to price changes for several products in different periods. Recognizing the defect of the simple and straightforward calculation, the regression estimates of energy demand are made using real income and real prices as explanatory variables. The details of the estimates are shown in Appendix 1. Most of the equations run for the 1970-1973 period are not statistically acceptable because they have too few observations, but the estimates are made simply for the purpose of comparing the period before the first oil crisis (1970-1973) and the period after (1974-1982).

Table 6.5 presents the regression estimates of both income and price elasticities for both periods of different types of energy. During 1974 and 1982, income elasticities for all types of energy were found to be close to or greater than unity, and they were all lower than those estimated for the period before the first oil crisis. This implies that while energy demand was in general rather responsive to income changes, it become less income-elastic after the first oil crisis. One explanation for smaller income elasticities is that after the crisis oil consumers become more aware of energy conservation and tried to use energy more efficiently as income increased.

The price elasticity estimates of most energy products during 1974 and 1982 show that their demand was price-inelastic. This should indicate that the use of energy during the period was at a necessity level, and any increases in energy prices could bring about only small reductions in energy use. Moreover, the adjustment of energy consumption in response to price increases would have a long time lags, as it generally involves changes in lifestyle, and considerable amounts of investment in energy-consuming machines and equipment.

Examining the types of energy consumed in Thailand over the 1971-1982 period in Table 6.6, we can observe that there was a shift away from oil towards electricity, natural gas and lignite. The share of oil in total energy demand declined from over 80% in the early 1970's to just over 70% in 1980, and went down

substantially to 60% in 1982 as natural gas from the Gulf of Thailand began to replace fuel oil in some power plants. This was caused not only by oil shortages during the oil crises, but also by the growth rates of oil price which were much higher than those of other energy products. As shown in Table 3.1 during the period the average real price of petroleum products increased by 14% per year, while those of electricity and lignite went up by 8% and 9% per year respectively. As noted in Chapter 3, the sharp price increases of oil during the crises brought about pronounced substitution effect between oil and electricity, lignite, and non-commercial energy. At an aggregate level, the figures indicate that the EPP, together with oil supply shortages during the crises has encouraged the substitution of oil by other energy products, most of which are indigenous. It also has helped in moderating the growth of total energy demand, which was 3.5%-4% per year during the crises, compared with over 10% per year in other years. (See Table 3.1)

If the annual consumption of oil products is considered, we can observe in Table 6.7 that the demand for oil declined by a few percentage points in 1974, 1980, 1981 and 1982. It is clear that these reductions were caused to some degree by sharp rises in the retail prices of oil products, particularly in 1974 and 1980 when the average price was raised by 54% and 48% respectively. (See Table 6.8) During 1975 and 1979 when the retail prices went up by relatively low rates, oil consumption tended to increase. In 1983 there was a 6% reduction in the

average retail price of oil products, which caused oil demand to increase by 17%. Of course, there were other factors which affected changes in oil consumption. As mentioned earlier, during the crisis years of 1974 and 1980, the oil shortages due to OPEC's actions, also constrained oil demand. In 1981 and 1982 the introduction of local natural gas into the country's energy picture contributed to the lower demand for fuel oil. The 1982 economic recession which slowed down most industrial activities brought about further reduction in the use of fuel oil.

We can also look at changes which took place in terms of demand elasticities, consumption and prices of individual oil products, as shown in Tables 6.5, 6.7, 6.8 and 6.9. The elasticity estimates indicate that gasoline was the most price- and income-elastic oil product. Its demand growth declined sharply in 1974, 1979 and 1980 in response to large increases in its retail price. Gasoline consumption actually declined in 1980 -1983, as the price gap between gasoline and LPG widened, causing substantial substitution of LPG for gasoline in gasoline-engine cars, vans, and small trucks, notably in Bangkok taxis and mini-buses. This interfuel substitution is confirmed by our estimate of LPG-gasoline cross price elasticity of 1.32 which was found to be rather statistically significant. It should be noted that before 1974 LPG was more expensive than gasoline in terms of retail price per heat value, but the trend has been increasingly reversed since the first oil crisis. (See Table 3.5)

For diesel oil, its price elasticity estimate of -Ø.243 shows that it is rather price-inelastic. Nevertheless, its price percentage changes, which were higher than those of gasoline during the oil crises, were significant enough to bring out reductions in consumption in 1974, 198Ø and 1981. There are reasons to believe that diesel oil consumption was most sensitive to supply shortages. First of all, in terms of heat content, diesel oil was the most important oil product, accounting for one-third to 4Ø% of total oil consumption. Secondly, its use was spread all over the country in trucks and fishing boats. And lastly, local refineries could not satify its domestic demand, and the balance had to be imported in its refined form. These factors should cause the impact of supply disruption on the use of diesel oil to be more significant than in the case of other oil products. It is believed that diesel oil has been used to substitute for gasoline in road transport, though we cannot detect the substitution by our statistical method.

LPG, fuel oil and kerosene were the oil products whose prices have been held down by the government in order to lessen the impact of oil price increases on the general cost of living and income distribution. The three products were believed to be vital to the livelihood of low- and middle-income population because :

a) LPG has been used increasingly as cooking gas in most urban and some rural households;

b) fuel oil was consumed mainly in manufacturing industries and electricity generation;

and c) kerosene was one of the major fuels for lighting in rural areas.

In the case of LPG, the retail price was kept constant until 1977, and though the price was allowed to rise afterwards, its consumption grew consistently and substantially at over 10% per year. Its share in total oil consumption rose from 1% in the early 1970's to almost 5% in 1983. Most of the increases were due to the fact that its use in passenger cars expanded rapidly, replacing the much more expensive gasoline. In 1983 the government decided to discourage the use of LPG in cars by stopping subsidizing the use of LPG for purposes other than cooking. This, in effect, was a two-tier pricing system which incurred higher administrative cost borne by the government. The increase in LPG consumption was also the result of more use in household and commercial cooking in place of fuelwood and charcoal which became more expensive and less convenient for consumers.

The elasticity estimates show that fuel oil was also as price- and income-elastic as gasoline, with its price elasticity of -0.458 and its income elasticity of 1.217 during 1974 and 1982. This was because fuel oil could potentially be substituted by a wide variety of energy products, notably bagasse, paddy

husk, lignite, electricity and natural gas. And the high income elasticity of manufactured products and electricity would also make the demand for fuel oil rather income-elastic. There was a slight decline in fuel oil consumption in 1974 and 1979 due to a sharp rise in its price and a supply shortage. The 27% reduction of its use in 1982 was caused by its substitution by natural gas in power generation and a lull in most manufacturing activities. The share of fuel oil in total oil demand started to fall from about one-third to 30% in 1982, and it is expected to decline further as more natural gas will become available in the future.

Kerosene consumption fluctuated widely from year to year, as its retail price was always kept at low levels to ease the burden on the rural poor. However, because its property is close to that of gasoline, the increasing price disparity between the two products tended to encourage the adulteration of gasoline and diesel oil by mixing kerosene in these products. This type of interfuel substitution can perhaps explain fluctuations in kerosene consumption, though this is not positively confirmed by our statistical analysis.

TABLE 6.1: Retail Price Structure of Oil Products

AVERAGE RETAIL PRICE STRUCTURE FOR LOCALLY REFINED PETROLEUM PRODUCTS

PREMIUM GASOLINE

YEAR	EX-REFINERY PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE	YEAR
1981	6.0723	4.1057	0.5097	1.2047	11.9123	1981
1982	6.1637	4.5916	0.5097	2.1850	13.4500	1982
1983	5.5620	4.6334	0.5097	2.0210	12.7262	1983
1984	5.5717	4.9631	0.5247	0.6402	11.7000	1984
1985	6.2227	4.9631	0.5873	(0.0553)	11.7000	1985

REGULAR GASOLINE

YEAR	EX-REFINERY PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE	YEAR
1981	5.7037	3.8036	0.4719	1.2186	11.2827	1981
1982	5.6972	3.8917	0.4719	1.3392	11.4000	1982
1983	5.0826	4.0631	0.4719	1.5284	11.1460	1983
1984	5.0619	4.5814	0.4853	0.6714	10.8000	1984
1985	5.6775	4.5814	0.5252	0.0159	10.8000	1985

KEROSENE

YEAR	EX-REFINERY PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE	YEAR
1981	6.3334	0.3954	0.3964	(1.0292)	6.0970	1981
1982	6.5413	0.3956	0.3964	(1.2133)	6.1200	1982
1983	5.7674	0.4407	0.3964	(0.4846)	6.1200	1983
1984	5.3497	0.9272	0.3964	(0.5533)	6.1200	1984
1985	5.9996	0.9272	0.3964	(1.2032)	6.1200	1985

HIGH SPEED DIESEL

YEAR	EX-REFINERY PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE	YEAR
1981	6.0389	0.7926	0.4014	(0.0894)	7.3434	1981
1982	6.2555	0.9527	0.4014	(0.2476)	7.3900	1982
1983	5.4143	0.9533	0.4014	0.2817	7.0407	1983
1984	5.0843	1.0151	0.4110	0.1896	6.7000	1984
1985	5.7350	1.0151	0.4765	(0.5267)	6.7000	1985

FUEL OIL/1500

YEAR	EX-REFINERY PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE	YEAR
1981	4.5506	0.0010	0.1003	(0.2290)	4.4229	1981
1982	4.2692	0.0010	0.1003	0.0995	4.4700	1982
1983	3.9125	0.0010	0.1003	0.1668	4.1806	1983
1984	4.0924	0.0010	0.1122	(0.1156)	4.0900	1984
1985	4.7800	0.0010	0.1474	(0.8384)	4.0900	1985

LPG (LARGE)

YEAR	EX-REFINERY PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE	YEAR
1981	8.7460	0.0001	1.8266	(1.1379)	9.4348	1981
1982	8.3322	0.0001	1.8266	(0.6989)	9.4600	1982
1983	8.0568	0.0414	1.8270	(0.4652)	9.4600	1983
1984	8.1699	0.4862	1.8766	(1.0227)	9.4600	1984
1985	8.2261	0.4887	1.8678	(1.0826)	9.4600	1985

TABLE 6.1 (Continued)

AVERAGE RETAIL PRICE STRUCTURE FOR IMPORTED PETROLEUM PRODUCTS

PREMIUM GASOLINE

YEAR	IMPORT PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE
1981	6.1819	3.8096	0.5097	1.4112	11.9123
1982	5.1637	3.9280	0.5097	2.8486	13.4500
1983	5.5366	3.8937	0.5097	2.7852	12.7262
1984	5.5184	4.1545	0.5247	1.5023	11.7000
1985	6.1679	4.9731	0.5593	(0.0103)	11.7000

REGULAR GASOLINE

YEAR	IMPORT PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE
1981	5.7884	3.7624	0.4715	1.2601	11.2827
1982	5.6972	3.7714	0.4719	1.4595	11.4000
1983	5.0551	3.7715	0.4719	1.8479	11.1460
1984	5.0172	4.0025	0.4853	1.2549	10.5600
1985	5.6440	4.5914	0.5252	(.0394	10.3000

KEROSENE

YEAR	IMPORT PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE
1981	6.9637	0.4256	0.3964	(1.1937)	6.6870
1982	6.6797	0.4221	0.3964	(1.3677)	6.1300
1983	5.7197	0.4221	0.3964	(0.4264)	6.1200
1984	5.3268	0.4916	0.3964	(0.1648)	6.1200
1985	5.9076	0.4372	0.3964	(1.1212)	6.1200

HIGH SPEED DIESEL

YEAR	IMPORT PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE
1981	6.1821	1.0027	0.4014	(0.2426)	7.3434
1982	6.3909	1.0053	0.4014	(0.4081)	7.3900
1983	5.4179	0.7841	0.4014	0.2574	7.0607
1984	5.0781	0.9678	0.4110	0.2431	6.7000
1985	5.5168	1.0251	0.4394	(0.2813)	6.7000

FUEL OIL/1500

YEAR	IMPORT PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE
1981	4.6789	0.0310	0.1003	(0.3573)	4.4229
1982	4.3857	0.0010	0.1002	(0.0170)	4.4700
1983	4.0127	0.0010	0.1003	(.0665	4.1896
1984	4.1407	0.0011	0.1122	(0.1640)	4.0900
1985	4.7164	0.0023	0.1474	(0.7773)	4.0900

LPG. (LARGE)

YEAR	IMPORT PRICE	TAXES	MARKETING MARGIN	OIL FUND	RETAIL PRICE
1981	9.8382	0.0010	1.8366	(2.2253)	9.4745
1982	8.3322	0.0010	1.8262	(0.6995)	9.4600
1983	8.4192	0.0010	1.8265	(0.7957)	9.4600
1984	7.8146	0.4054	1.8261	(0.3553)	9.4600
1985	8.1523	0.4905	1.8279	(1.0111)	9.4600

NOTE: The 1985 figures cover the period from January 1, 1985 to August 6, 1985.

TABLE 6.2: Taxes and Oil Fund Percentages of Ex-Refinery Prices for Locally Refined Products

	Premium Gasoline			Kerosene			High Speed Diesel Oil			Fuel Oil 600			L.P.G.		
	Taxes	Oil Fund	Taxes + Oil Fund	Taxes	Oil Fund	Taxes + Oil Fund	Taxes	Oil Fund	Taxes + Oil Fund	Taxes	Oil Fund	Taxes + Oil Fund	Taxes	Oil Fund	Taxes + Oil Fund
1 April 71	139.34	-	139.34	61.46	-	61.46	30.24	-	30.24	-	-	-	100.14	-	100.14
4 July 73	106.04	-	106.04	52.28	-	52.28	25.27	-	25.27	-	-	-	65.73	-	65.73
14 Nov. 73	108.97	-	108.97	39.09	-	39.09	19.40	-	19.40	-	-	-	65.73	-	65.73
12 Dec. 73	139.92	-	139.92	39.09	-	39.09	39.77	-	39.77	9.70	-	9.70	65.73	-	65.73
27 Feb. 74	91.39	-	91.39	27.03	-	27.03	25.35	-	25.55	4.98	-	4.98	65.73	-	65.73
10 Dec. 75	47.27	-6.55	40.72	0.25	6.56	6.81	16.41	-9.02	7.39	0.06	-7.36	-7.30	5.87	-	5.87
15 March 77	60.34	-	60.34	15.72	-	15.72	15.93	-	15.93	0.06	-	0.06	5.87	-	5.87
9 March 78	83.69	5.15	88.84	11.41	-	11.41	11.55	-	11.55	10.60	-5.27	5.33	5.85	-	5.85
31 Jan. 79	77.09	20.14	97.23	10.93	7.78	18.71	11.18	12.22	23.40	0.06	5.40	5.16	8.35	-	8.35
1 May 79	73.56	-8.49	65.07	-9.50	-16.03	-6.53	9.89	-11.42	-1.53	0.05	-12.39	-12.34	5.00	-38.30	-33.30
14 July 79	87.07	11.16	98.23	21.73	11.17	32.90	21.56	11.00	32.56	0.04	10.53	10.57	7.87	13.39	21.26
10 Feb. 80	83.72	7.93	91.65	20.70	7.86	28.56	23.81	24.77	48.58	0.03	9.02	9.05	7.37	13.12	20.49
19 March 80	83.72	7.93	91.65	7.97	-	7.97	21.06	9.87	30.93	0.03	9.02	9.05	-	-	-
23 May 80	79.89	3.00	82.89	7.27	-8.77	-1.50	19.68	2.49	22.17	0.03	4.77	4.80	-9.11	-	-9.11
2 Dec. 81	72.98	-5.91	67.07	6.85	-13.98	-7.13	18.15	-5.75	12.40	-	-12.04	-12.04	-0.97	-13.26	-14.23
21 Jan. 81	73.06	31.78	104.84	6.93	-6.70	0.23	18.18	9.78	27.96	0.98	9.93	10.91	0.01	-8.74	-8.73
5 Feb. 81	69.09	24.62	93.71	6.33	-14.69	-8.36	16.99	2.60	19.59	0.02	-1.81	-1.79	-	-10.32	-10.32
2 Dec. 81	70.93	28.96	99.89	5.92	-20.36	-14.44	15.49	-6.42	9.07	0.02	-2.74	-2.72	-	-14.98	-14.98
1 Aug. 82	75.79	37.81	113.60	6.12	-17.63	-11.51	16.13	-2.76	13.29	0.03	3.49	3.52	-	-6.78	-6.78
29 March 83	76.04	23.53	99.57	6.12	-17.63	-11.51	15.22	-8.37	6.85	0.02	-5.05	-5.03	-	-6.78	-6.78
20 Oct. 83	83.90	36.30	120.20	7.15	1.49	8.64	18.94	13.91	32.85	0.02	3.81	3.83	-	-4.27	-4.27
1 Dec. 83	90.39	13.42	103.81	17.66	-8.64	9.02	20.47	6.53	27.00	0.02	3.81	3.83	6.10	-10.37	-4.27
11 May 84	90.39	13.42	103.81	17.66	-8.64	9.02	20.47	6.53	27.00	0.02	3.81	3.83	6.16	-9.54	-3.38

TABLE 6.3 : Oil Tax Revenue As Percentage of Total Tax Revenue

	Oil Excise Tax Revenue	Oil Import Tax Reven	Revenue from Oil Excise and Import Taxes
1970	6.2	3.2	9.4
1971	8.1	1.8	9.9
1972	7.4	1.5	8.9
1973	7.0	1.4	8.4
1974	7.2	1.5	8.7
1975	6.5	1.1	7.6
1976	6.3	1.3	7.6
1977	6.7	1.3	8.0
1978	6.3	1.9	8.2
1979	8.4	2.4	10.8
1980	12.9	3.4	16.3
1981	10.5	2.3	12.8
1982	10.9	1.1	12.0
1983	9.43	n.a.	n.a.

SOURCE : 1. Budget Bureau, Ministry of Finance
2. Quarterly Bulletin, Bank of Thailand, 1 March 1984

TABLE 6.4 : Marketing Margin of Oil Products

(Unit : Baht/litre)

	April 1, 1971	Dec. 17 1973	Dec. 18 1974	March 15, 1977	Jan. 3, 1979- July 13, 1979	July 14, 1979- Feb. 9, 1980	Feb. 10, 1980- March 18, 1980	March 19, 1980- May 11, 1984
Premium Gasoline	0.5435	0.5487	0.4340	0.3986	0.5958	0.4489	0.5097	0.5097
Kerosene	0.1384	0.32	0.2635	0.2844	0.3229	0.3756	0.3951	0.3964
High Speed Diesel	0.2028	0.2929	0.2650	0.2842	0.2880	0.3357	0.4014	0.4014
Fuel Oil (600)	-	-	0.0926	0.0777	0.0769	0.1006	0.0964	0.0964
LPG (baht/kg.)	-	-	-	-	1.5865	1.7120	1.8266	1.8266

TABLE 6.5 : Regression Estimates of Income and Price Elasticities of Energy Demand (Log - Linear Equation)

	Income Elasticities		Price Elasticities	
	1970-1973	1974-1982	1970-1973	1974-1982
1. Total Commercial Energy	3.994 (0.868)	1.014 (8.296)	1.217 (0.347)	-0.304 (-3.209)
2. Electricity				
2.1 Electricity (Hydro)	4.667 (3.161)	0.737 (0.898)	1.902 (2.754)	-0.900 (-1.260)
2.2 Electricity (General)	4.112 (1.134)	1.656 (32.097)	0.663 (0.391)	-0.148 (-3.292)
3. Non-Electric energy	4.452 (1.028)	1.067 (5.472)	1.775 (0.439)	-0.275 (-1.899)
3.1 Petroleum Products	4.091 (0.889)	1.074 (5.114)	1.288 (0.317)	-0.314 (-2.104)
- LPG	4.447 (1.755)	2.047 (6.449)	1.153 (0.545)	0.242 (0.542)
- Gasoline	2.869 (1.400)	1.227 (5.504)	0.778 (0.351)	-0.560 (-3.762)
- Kerosene	-0.854 (-0.137)	0.847 (2.685)	-2.360 (-0.588)	0.142 (0.426)
- Diesel Oil	3.313 (1.473)	0.985 (4.332)	1.644 (0.692)	-0.243 (-1.623)
- Fuel Oil	1.382 (41.917)	1.217 (3.287)	-2.216 (-70.424)	-0.458 (-1.718)
3.2 Coal	-1.513 (-1.984)	2.571 (3.553)	-2.067 (-1.495)	-0.364 (-0.843)

TABLE 6.6 Percentage Breakdown of Total Energy Demand, 1971-1982.

Year	Oil	Electricity	Lignite and Coal	Natural Gas
1971	83.30	14.36	2.35	0.00
1972	85.76	12.50	1.74	0.00
1973	85.81	12.67	1.52	0.00
1974	82.10	15.55	2.35	0.00
1975	79.97	17.81	2.22	0.00
1976	79.17	18.54	2.28	0.00
1977	81.79	16.31	1.90	0.00
1978	83.31	14.38	2.31	0.00
1979	74.94	22.13	2.92	0.00
1980	73.14	24.03	2.84	0.00
1981	68.37	27.30	2.88	1.45
1982	59.10	28.60	2.23	7.18

TABLE 6.7 : Annual Percentage Change of oil Consumption, 1971 - 1983

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Gasoline	34.24	-0.5	18.33	7.08	9.76	11.37	11.19	5.71	0.74	-2.65	-7.13	-4.09	7.25
Diesel oil	18.39	5.05	13.59	-4.17	-2.97	17.08	8.87	7.46	12.34	-7.32	-3.93	0.11	17.10
LPG	10.14	31.41	17.72	11.90	20.75	14.77	9.33	13.56	18.61	10.73	30.97	26.55	44.55
Kerosene	48.34	40.80	-22.25	15.38	-14.29	42.75	-3.2	-6.78	21.72	-7.04	30.10	-0.91	30.60
Fuel oil	28.83	26.36	15.06	-2.4	4.41	10.14	20.46	12.20	-0.21	0.85	2.52	-26.63	17.39
Total	25.27	16.20	13.16	-2.69	3.50	12.91	11.08	8.21	5.96	-1.13	-1.08	-9.05	16.95

TABLE 6.8 : Annual Average Retail Prices of Oil Products in Thailand, 1971-1983

(Unit : baht/litre)

Oil Product	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Premium Gasoline	2.100	2.100	2.268	3.525	3.620	3.620	4.101	4.838	6.604	9.387	11.912	13.350	12.827
		(0)	(8.00)	(55.42)	(2.70)	(0)	(13.29)	(17.97)	(36.50)	(42.14)	(26.90)	(-12.91)	(-4.63)
Diesel Oil	0.980	0.980	1.073	2.216	2.330	2.330	2.578	2.640	3.869	6.189	7.343	7.390	7.060
		(0)	(9.49)	(106.52)	(5.14)	(0)	(10.64)	(2.40)	(46.55)	(59.96)	(18.65)	(0.64)	(-4.47)
LPG (baht/kg.)	4.000	4.000	4.000	4.000	4.000	4.000	4.722	4.900	6.366	8.730	9.360	9.460	9.460
			(0)	(0)	(0)	(0)	(18.05)	(3.77)	(29.92)	(37.13)	(7.22)	(1.07)	(0)
Fuel oil	n.a.	n.a.	1.490	1.490	1.490	1.490	1.626	1.660	2.320	3.532	4.423	4.470	4.180
				(0)	(0)	(0)	(9.13)	(2.09)	(39.76)	(52.24)	(25.23)	(1.06)	(-6.49)
Kerosene	1.340	1.340	1.438	2.312	2.410	2.410	3.361	2.680	4.000	6.577	6.097	5.120	6.120
		(0)	(7.31)	(60.78)	(4.24)	(0)	(39.46)	(-20.26)	(49.25)	(64.43)	(-7.30)	(0.38)	(0)
Weighted Average of all Oil Products	n.a.	n.a.	1.323	2.035	2.057	2.104	2.376	2.517	3.545	5.251	6.335	6.745	6.330
				(53.82)	(1.10)	(2.28)	(12.93)	(5.93)	(40.84)	(48.12)	(20.64)	(6.47)	(-6.15)

NOTE : Figures in parentheses are annual percentage changes.

TABLE 6.9 : Percentage Breakdown of Demand for oil Products, 1970-83

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Gasoline	16.86	18.06	15.52	16.23	17.86	18.94	18.68	18.7	18.27	17.37	17.1	16.06	19.93	15.53
Diesel Oil	43.41	41.02	37.09	37.23	36.66	34.38	35.64	34.93	34.69	36.77	34.47	33.48	36.86	36.9
LPG	1.14	1.00	1.13	1.18	1.36	1.58	1.61	1.58	1.66	1.86	2.07	2.75	3.82	4.72
Kerosene	2.53	3.00	3.63	2.49	2.96	2.45	3.1	2.7	2.33	2.67	2.51	3.30	3.6	4.02
Fuel Oil	29.07	29.89	32.51	33.05	33.15	33.44	32.62	35.37	36.68	34.54	35.24	36.52	29.47	29.57
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Chapter 7

Incentive Policies and Programs

7.1 Introduction

This chapter describes and briefly evaluates the effectiveness of incentive policies and programs which have been used in energy demand management in Thailand. As far as the non-price measures to promote energy conservation and fuel substitution are concerned, Thailand is a late starter compared with industrial countries. These measures were introduced in the country only in the early 1980's and they are not as varied and comprehensive as in those used in industrial countries. There are only three significant incentive policy measures which will be described here, namely, the annual car tax, the low-interest loan programs, and the tariff reduction scheme.

7.2 Annual Car Tax

Before 1982, the collection of an annual tax on all road vehicles was based only on their weights, and the tax rates, though progressive, were relatively low compared with the prices and the import tariff rates of vehicles. In 1981, the Car Act of 1979 was revised in such a way that from January 1982 onwards the annual tax on private passenger cars (capable of carrying not more than 7 persons) has been based on the sizes of their

engines. The revision in effect raised the annual tax on this type of vehicle and made it more progressive in order to discourage the use of large-engine cars. Table 7.1 compares the tax estimates for cars with different weights and engine sizes before and after 1982. The figures clearly show that the tax increases due to the law revision are rather small for small-engine (1,000-1,300 cc.) cars, moderate for medium-size (1,600-1,800 cc.) cars, and quite high for large-engine (above 2,000 cc.) cars. In fact, the new tax structure even reduces the tax payment for cars with engine sizes below 1,000 cc., thus presumably encouraging the use of small-engine cars. This car tax measure is intended primarily to promote the conservation of gasoline which is the main fuel for passenger cars. The effectiveness of this scheme in energy conservation can only be assessed by examining the sales figures of passenger cars before and after the introduction of the measure. The lack of these data does not allow us to evaluate this energy conservation measure. However, it should be noted that while the new car tax scheme may affect the stock distribution of passenger cars and other types of vehicles, it does not necessarily imply that the tax alone would curb the mileage use and gasoline consumption of passenger cars. Moreover, since the new tax is imposed on only passenger cars, it is possible that a shift towards other types of road vehicles could reduce the effectiveness of the measure in energy conservation by road transport.

7.3 Low-Interest Loan Programs

Thus far, low-interest loan programs in Thailand have been directed towards the industrial sector. The National Energy Administration (NEA) and the Industrial Finance Corporation of Thailand (IFCT) are the only two institutions which provide soft loans to industries in energy-conservation and fuel-substitution projects. NEA began to promote its conservation-related activities a few years ago when it established the Energy Conservation Center. Based on the data from the Center's energy audits in over 100 industrial plants, it was found that there was a good potential for energy conservation in the industrial sector. In 1984 NEA lauched the energy-saving demonstration project which included the provision of soft loans by NEA. The plants eligible for participating in this project must meet the following criteria :

- Energy conservation can be done without capacity expansion.

- At least 10% of fuel use or at least 2% of electricity use can be saved.

- The payback period does not exceed 5 years.

- The plant must consume at least 100,000 kilowatt-hours per year, or at least 100,000 litres of petroleum products per

year, or at least 200 tonnes of coal per year.

- The plant must belong to the following industries: non-metallic, metallic, textiles, food, chemicals, paper, and other very energy-intensive industries.

- The plant must cooperate with NEA in its energy-conservation efforts, particularly by allowing the demonstration to be publicized.

The loan provided to each eligible plant under the energy-saving demonstration project ranges from 300,000 baht to one million baht, with the repayment period not exceeding 5 years at an annual interest rate of 10%. Detailed information on the progress of the project is not yet available. It appears that the project in its first year has not been successful as the participation rate was low and a substantial part of the allocated budget for loan provision was left unused. Given the fact that NEA's existing administrative capability will not be much improved in the future, the project is not likely to create a substantial impact on energy conservation in industries.

One semi-government organization which has been active in promoting energy conservation in industries is the Industrial Finance Corporation of Thailand (IFCT). The Energy Conservation Unit was set up within IFCT in 1979 to encourage and financially assist industries in reducing energy costs, using energy more

efficiently, and developing indigenous energy sources. The project to be promoted by obtaining a low-cost (14.5% interest rate) long-term credit must (i) conserve energy and/or use other types of energy to substitute for petroleum products and electricity, or (ii) promote the production of indigenous energy resources, or (iii) produce machines and equipment which use non-oil and non-electric energy, or (iv) improve the energy efficiency of the existing machine. As of the end of 1983, the total loan provided to the energy conservation projects by IFCT amounted to over 500 million baht. (See Table 7.2) The projects included those which used paddy husk to replace fuel oil in a fish-processing plant, produced insulators, used lignite instead of fuel oil in a cement plant, used solar energy for drying noodles, and utilized excess gas from formalene production as a fuel in a chemical firm. Substantial amounts of loans were granted to the food industry, the paper industry, the cement industry, the glass industry, the carpet industry, and the ceramic industry.

IFCT, in cooperation with NEA, has also produced and distributed to industries booklets and pamphlets which suggest simple energy conservation techniques for industrial plants. Since there is a good potential for economically and financially

feasible energy-saving projects in industries,(1) it is likely that the IFCT loan program, if further promoted, will create a significant impact on industrial energy conservation.

7.4 Fiscal Incentives

As for fiscal incentives for energy conservation, there is so far only one measure adopted by the government. Starting from November 1983, the Ministry of Finance reduced the tariff rates on machinery, materials and equipment which conserve energy and protect the environment. The rates are to be cut by either half or down to 10%, whichever is the lower. Some specific guidelines and conditions are laid down for considering the eligibility of the machinery, materials, and equipment under the tariff reduction scheme. These are :

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(1) This observation is based on the findings obtained from The Industrial Energy Audits and Conservation Projects in Thailand, 1985, by the Victorian Gas and Fuel Corporation, and The Study of Incentives for Energy Conservation in Thai Industry, 1985, by Acres International and Industrial Management Consultants.

1. The machinery, materials and equipment must either

   i) use the waste or the released energy in industries as energy;

or ii) use other types of energy to substitute for electricity or petroleum products;

or iii) use electricity or petroleum products with high efficiency;

or iv) enable the existing machinery to achieve higher efficiency ;

2. The machinery, materials and equipment must be used only in industrial plants.

3. They must not be used or reconditioned ones.

4. They must not be replacements of the existing ones which must be replaced due to the end of their life or damage. This prohibition does not apply to materials.

5. They must not be of the same kind as or substitutible with those which can be produced or assembled by the firms promoted by the Board of Investment.

Those who wish to import these machinery, materials and equipment under this scheme must seek approval from a committee set up by the Ministry of Science, Technology and Energy to consider their eligibility. As of the end of 1984, 61 items have

been sent to the committee, 26 items have been granted approvals, 18 have been rejected, and 17 are still under consideration. Among those already approved include a solar collector, ceramic fiber, three heat exchangers, a high efficiency washing machine, two vacuum dryer systems, six boilers using bagasse, and two steam-engine electricity generators.

Table 7.1 : Annual Tax on Passenger Cars Based on Car Weight and Engine Size

Car Weight (Kg.)	Corresponding engine size (cc.)	Tax based on car weight (baht)	Tax based on engine size	Percentage increase in tax
800-900	1,000-1,300	1,100-1,300	900-1,350	-18-9
950-1,000	1,600-1,800	1,400-1,500	1,800-2,100	12.5-17
1,100-1,500	2,000-2,800	1,900-3,500	2,900-6,100	53-118

Source : The amounts are estimated from the tax rates in the car Act of 1979, and the revised Car Act of 1981. The rates based on the car weight are 1 baht/kg. for the first 500 kg., 2 baht/kg. for the next 500 kg. and 4 baht/kg. for the weight above 1,000 kg. The rates based on the engine size are 0.50 baht/cc. for the first 600 cc., 1.50 baht/cc. for the next 1,200 cc., and 4 baht/cc. for the size above 1,800 cc.

Table 7.2: Approved Loans for Energy Conservation Projects by IFCT

(million baht)

Industry	Loan Amount			
	1980	1981	1982	1983
Food	1.3	4.12	-	244.0
Cement	60.0	-	-	-
Other non-metallic	5	-	-	-
Ceramic	34.0	-	-	-
Chemicals	-	7.0	-	-
Bottle caps	-	-	5.0	-
Rice milling	-	-	-	20.0
Glass	-	-	-	40.0
Carpet	-	-	-	40.0
Paper	-	-	-	100.0
Mining	-	-	-	15.0
Compressed saw dust	-	-	-	1.2
Total	100.3	11.2	5.0	460.2

Source : Industrial Finance Corporation of Thailand

Chapter 8

Regulatory Measures

8.1 Introduction

This chapter is an attempt to present the issue of regulatory measures taken by the government during the oil crises in order to control energy demand down to an acceptable level. It comprises the description of the goals and objectives as well as the assessment of the measures. It also includes discussions on the effectiveness of the regulatory measures, their limitations and problems encountered when the government implemented the regulatory controls.

8.2 Reactions to the First Oil Crisis

Immediately after the first oil crisis, regulatory measures were not very effective because of the fact that the energy problem was thought of as temporary. However, after the successive increases of oil prices, the government as well as the public became more concerned about the problem. While the government attempted to slow down the process of oil price increases in the domestic economy, conservation measures received more attention. Most of the regulatory measures were of a short-run nature and mainly concerned with two types of energy, namely electricity and petroleum products.

8.3 Laws and Regulations Governing Regulatory Measures

Almost all of the regulatory measures were based on the Royal Decree 1973 which was enacted on December 26th, 1973. This Royal Decree gives the power to the Prime Minister to regulate energy demand by controlling the time and conditions of various types of businesses as well as rationing. Since the application of the Royal Decree covers only one year period at a time, there have been royal acts on the extension of the use of the Decree and also some revised versions of the Decree. (1)

Based on the Royal Decree, many Prime Minister's orders were announced. For example on January 2nd, 1974 the Sanya government ordered that advertisement lights were allowed only between 7 p.m. and 10 p.m.. The order also allowed only one set of lights for one business establishment. During weekdays, massage parlours were not allowed to open before 4 p.m. Beauty salons were allowed to open during 8 a.m. and 8 p.m. In addition, dancing halls or night clubs were not allowed to open on Sundays.

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(1) The Royal Decree in 1973 (during the Sanya government) was followed by the act for extension in December 1974. In December 1975, the revised version of the Royal Decree 1973 was announced during the Kukrit government. In December 1976 during the Tanin government, the Royal Decree was extended by another act and it was extended again in December 1977.

8.4 Policy Directions of Different Governments Since the First Oil Crisis

The Sanya government: It is interesting to note that the regulatory measures taken by the Sanya government were mild. Even though they were considered as energy saving measures, they could not really save the energy because the prohibition applied only during the slow business hours. For example, the massage palours and beauty salons all had slow business hours during the restricted times.

The Kukrit government: It was not until the Kukrit government in November 1975, that some of the more effective measures were used. The measures taken by the Kukrit government included the control of the use of gasoline especially for government vehicles, the reduction of electricity uses by 10 percent and the respecification of the cars used in government affairs, lessening the use of public lights, solving the traffic problems in Bangkok by specifying the parking areas for taxis and rearranging working hours for government agencies and state enterprises. In addition, the pricing policy on petroleum products as well as a public campaign were used to reduce the use of electricity.

The most well-known measures used by the government seemed to be the restriction on business hours of gas stations. On November 6, 1975, gas stations were restricted to open between

5.ØØ p.m. and 9.ØØ p.m. This measure was not abolished until 1983. The Kukrit government also considered the supply side of the problem i.e. more use of the indigenous sources of energy such as hydropower.

The Seni government: During the Seni government in October 1976, the business hours of gas stations were further shortened to be during 6.ØØ a.m. and 6.ØØ p.m. These were readjusted back to be between 5.ØØ a.m. and 9.ØØ p.m. by the Tanin government in December 1976.

The Kriangsak government: In December 1977, during the Kriangsak government, the restriction on business hours of dancing halls and night clubs was lifted and they were allowed to open on Sundays for the purpose of tourism promotion.

In April 1979, the cabinet agreed on the plan to reduce the broadcasting time of television stations by closing at 1Ø.3Ø p.m. except on Fridays and Saturdays when the closing time was 12.ØØ p.m. And In July 1979, the government agreed on the energy conservation plan which included:

1. Prohibition of parking along 39 roads in Bangkok.

2. Setting 9Ø km. per hour speed limit for cars and 8Ø km. speed limit for buses on highways.

3. Turning off advertisement lights.

4. Restricting the business hours of entertaining establishments to between 6.00 p.m. and 12.00 p.m.

After the second oil crisis, the Kriangsak government in January 1980prohibited gas stations in Bangkok from opening on Sundays. The prohibition was extended to cover the whole kingdom and the time was readjusted back to 6.00 a.m. to 6.00 p.m. in December 1980 during the Prem government. (1) Also in April 1980, dancing halls and night clubs were allowed to open only during 9 p.m. and 1 a.m. and there was a prohibition of television broadcasting between 6.30 p.m. and 8.00 p.m.

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(1) The adjustment in December 1980 also covered many other regulatory controls, for example, restrictions on the use of advertisement lights, opening of dancing halls, bars and night clubs, restuarants, massage parlours, beauty salons and electricity uses in industrial plants. They were subjected to different time schedules. An adjustment was made to allow for the sale of diesel oil on Sundays by gas stations outside of the municipal areas. The prohibition of opening gas stations on Sundays was lifted later in July 1982. The restricted sale of gasoline was eased in February 1983 to between 5.00 a.m. and 6.00 p.m. and finally abolished in November 1983.

During November 1980 and October 1981, the government urged government agencies as well as state enterprises to conserve the use of electricity to set an example to the public. However, it was later found out that the attempt was not satisfactory, i.e. there were only about 10 out of 199 agencies which were able to comply with the plan set by the government to reduce about 10 percent of thier electricity uses. There were 78 agencies which could partly achieve the target and about 111 agencies were unable to comply with the plan.

At present there are some measures which still remain effective. Most of these are related to traffic and electricity conservation, such as, the use of bus lanes, the one-way traffic system, the prohibition of parking along various main roads, highway speed limits and the restricted television broadcasting schedules.

Thienchay Kiranandana, based on his sample survey of the people's attitudes, reported the following: (1)

1. As to the restrictions on the sale of benzine and the closing of gas stations on Sundays, 65.4% of the people surveyed

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(1) Thienchay Kiranandana, Energy Uses of Families in Bangkok Metropolis, Research Report, Chulalongkorn University, September 1982.

replied that the measures were suitable and can really conserve the energy. The people who did not agree with the measures told that they needed to use gasoline on Sundays and that the measures tended to create stockpiling activities and black markets.

2. For the regulatory measure restricting the operating hours of gas stations, 61.6 percent of the people surveyed agreed with it. However, some of those who did not agree thought that the measure was not effective because drivers only tried to buy gasoline before the stations closed.

3. On bus lanes, 61.8 percent of the surveyed samples indicated that they agreed with the measure. Those who disagreed pointed out that bus lanes reduced the space for other vehicles and there might be problems from those who broke the law.

4. As to the limitation of television broadcasting, 80.9 percent agreed that the measure was effective. Disagreement came from those living in suburban areas where there was no other substitutes for entertainment.

5. The report also indicated that about 77 percent of the surveyed samples agreed that the reduction in movie hours was an effective way to conserve the energy.

6. As to the cut in the number of street lights, 90 percent of the samples believed that the measure could conserve energy. However, some noted that the measure tended to harm the public.

8.5 Evaluation

In general, it is interesting to observe that the governments frequently used regulatory measures on operating hours of gas stations in order to limit the use of oil. This was done with some uneasiness of the public and the measures were applied only for a short period when the impact of the oil crises were strong.

The regulatory measures taken by the government since the first crisis in 1973 had drawn at least some attention from the public but their impact on energy conservation is not easy to be evaluated. It was however noted that some of the regulatory measures were well accepted by the public to be effective in conserving energy.

Chapter 9

Education, Training and Information Programs

9.1 Institutions

This chapter describes the education, training and information programs and other related aspects of the energy demand management in Thailand. According to the fifth Plan the government would set up the strategy for energy conservation which involved the educational and general public campaign. As stated in the National Plan put out by the NESDB, the government would take the following actions:

1. Include in the curriculum the topic of energy and energy conservation at various levels of education.

2. Assign the Department of Public Relations and invite the mass media to advocate and promote energy conservation.

3. Promote the transfer of technology for government agencies and the private sector and inform the people of changes and movements on various aspects of energy in order to obtain cooperation in energy conservation in the future. It was also indicated that the related government agencies should inform the public of the situation, so that proper preparation can be made.

At present there are many institutions both public and private whose activities are related to education, training as well as information dissemination on energy conservation. These agencies include the National Energy Administration (NEA), the Department of Industrial Promotion, the Industrial Finance Corporation of Thailand (IFCT), the Technology Promotion Association (Thai-Japan), and the Engineering Association of Thailand.

However, since education, training and information cannot be quantified and for that matter easily evaluated, the chapter will focus mainly on the general description of the activities related to education, training and information programs for energy conservation.

9.1.1 The National Energy Administration (NEA)

Under the umbrella of the National Energy Administration, there is a center called the Energy Conservation Center. The Center's activities include producing documents, holding meetings, seminars and training. The Center also has 5 mobile units for collecting and analyzing data for various industrial plants.

In addition, it distributes posters, documents and manuals for energy conservation to households, industrial factories, educational institutions, and government agencies. The Center

also trains personnels of industrial plants as well as holding seminars, for example, on the use of energy and economic development, energy conservation in industrial plants and the energy management in the industrial plants.

9.1.2 The Department of Industrial Promotion

Even though the department is not directly involved in the energy issue, its activities are related to energy conservation in many ways. For example, the department held a meeting on the energy policy in Asia in 1979 which was about the formulation of the energy saving policy. It also organizes training and seminars on the energy conservation, and sends government officials to be trained in energy conservation in foreign countries. In addition, the department also gives advice to industrial plants on energy conservation, for example, conservation of steam in dying and finishing processes for firms in the textile industry, the construction and use of efficient ceramic ovens.

9.1.3 Industrial Finance Corporation of Thailand (IFCT)

Since 1980 the IFCT has given advice and conducted feasibility studies for industrial projects in addition to providing special lendings to industrial firms to install energy saving equipments.

9.1.4 Technology Promotion Association (Thai-Japan)

The Technology Promotion Association has been actively involved in the energy conservation. Activities of the association included holding seminars on the energy conservation and the management technique on energy conservation and substitution, giving advice on energy conservation, publishing books and booklets on energy saving technology, and organizing tours to the representative energy saving plants once in every two months.

9.1.5 Engineering Association of Thailand

The association is interested in energy conservation issues. It has organized a large meeting on energy saving technology and the increase in productivity.

In summary various government agencies and private institutions in Thailand have provided education on energy conservation in various ways i.e. by individually undertaking activities related to the energy conservation. These activities include:

1. Trainings and seminars on co-operation between government agencies and industrial factories in research and development on energy conservation methods.

2. Illustration of energy conservation measures as a technical aid to factories. This is used as a base for spreading conservation activities.

3. Publishing documents on energy conservation for factories and related government agencies.

4. Introduction of energy issues and energy conservation in various levels of education in order to increase the awareness of the need to conserve energy.

5. Trying to establish an energy conservation center which is run jointly by private and public sectors.

6. Establishing mobile units for analyzing energy use data of industrial firms.

9.2 Some Specific Programs Relating to Conservation

Since the oil shock in 1973, most governments have introduced education and public campaigns through various media such as radio, television and newspaper. From the survey by Thienchay Kiranandana(1), it was reported that 51 percent of the head of the families in Bangkok Metropolis, the main users of energy in Thailand, received their information from television, followed by radio (19 percent), personal discussion (5.8 percent) and newspapers (5.Ø). Thienchay Kiranandana also noted that the government campaign documents as well as other posters put up by various agencies including private institutions were not effective means of dissemination of the energy conservation information. The survey figure showed that only 1.4 percent of the sample got their information from documents, books and posters.

In 1981, the cabinet appointed the National Energy Administration to take action on the national conservation program by drafting the energy conservation plan emphasizing on the industrial sector.

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(1) Thienchay Kiranandana and others, The Energy Uses Behavior of the Households in the Bangkok Metropolis, A Research Report, Chulalongkorn University, Bangkok, Thailand, September 1982. (in Thai) The sample size was 1Ø72 households.

In addition, Thailand received some support from various developed countries such as Australia, the United States and Japan as well as the Asian Development Bank and UNDP in many pilot and research projects such as: (1)

1. The project on energy conservation in Thailand from the Government of Japan (1982-1984) in terms of specialists and documents on the methods of energy conservation especially the energy conservation in the industrial sector.

2. The project on industrial energy audit and conservation development from the Asian Development Bank for investment in energy conservation in the industrial sector (1982-1986).

The ADB project involves a study which will help to develop an "actionable and practical" conservation program for the Thai government. The study identifies:

--the overall potentials in energy conservation
--the most beneficial target areas
--the expenditures which would be required
--the factors which might limit the success of the program.

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(1) Thailand Energy Situation 1981-82, National Energy Administration, Ministry of Science, Technology and Energy.

The study team carried out energy audits of 49 companies chosen to represent the manufacturing firms contributing most to the growth of GDP, export earnings and total energy consumption. In addition, the study included a survey on management attitude of about 349 companies.

It was found in the study that there were potentials in improvements of energy uses and substitution in the industry, for example, in cement plants where oil was replaced by coal and natural gas.

As far as recommendations are concerned, the study suggested some strategies in energy conservation such as:

--Targeted program to change current attitudes of industry towards a greater awareness of the benefits and returns from conservation.

--Education and training of implementation-oriented personnels.

--Initiation of a series of demonstration projects to provide guidance and increase confidence in energy conservation programs.

--A joint private/public energy conservation center conducting such activities as publicity, training, data gathering, and development of an energy auditing program.

--Establishment of a separate Ministry of Energy responsible for developing energy policy, targets for energy supplies, setting of priorities and pricing.

Chapter 10

Sectoral Programs for Conservation and Fuel Switching

10.1 Industrial Sector and its Potentials in Conservation

At present the National Energy Administration (NEA) provides services in energy conservation for industrial plants. From a report on about 126 industrial plants surveyed, it was found that the potential savings in fuel oil and electricity were significant. (1) For fuel oil, the potential was about 55.3 million litres per year which was about 14 percent of the total fuel oil demand or about 217.9 million baht per year. For electricity, these industrial plants would be able to save up to 36.5 million units (kilowatt-hours) per year which was about 3 percent of total electricity demand or about 62.3 million baht per year. (See Table 10.1).

From about 119 feasible cases, the total adjustment cost would be about 92 million baht with the break even period of about 6 months to two years (93 plants could break even within 6 months, 21 plants could break even within a year and 5 plants would require more than one year).

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(1) Ithi Pitchayenyothin, "Energy use in Industry," (in Thai) a paper presented at Chulalongkorn University 28 May 1984.

Table 10.1: Potentials of Energy Saving in Industries

Industry	Number of Firms	Potential Fuel Oil Saving per Year		Potential Electricity Saving per Year	
		million litre	million baht	million unit	million baht
Non-metallic	21	15.1	71.9	3.5	3.8
Metallic	15	11.5	11.6	2.2	4.3
Paper Pulp	17	13.0	57.9	8.0	14.7
Food	30	4.0	11.6	3.2	6.4
Chemicals	17	3.9	20.3	4.0	5.8
Textiles	19	4.9	25.7	14.0	24.0
Tobacco	3	0.4	1.6	0.2	0.5
Rubber	3	0.9	4.0	1.0	2.2
Wood Products	1	1.6	7.4	0.4	0.6
Total	126	55.3	217.9	36.5	62.3

Source: Ithi Pitchayenyothin, "Energy use in Industry," (in Thai) Paper presented at Chulalongkorn University 28 May 1984.

Since, the public is becoming more interested in conservation which is motivated largely by the cost saving concept, there have been studies on energy conservation by various firms. For example, it was estimated that an energy saving program which involves an adjustment cost of 7.3 million baht in a sugar mill with the capacity of about 9,000 tonnes of cane per day would break even within one year. (1)

In the case of paper pulp, a case study showed that the application of energy saving measures with the project cost of about 20 million baht by converting a fuel oil boiler into a boiler which uses bagasse and rice husk would break even within two years. Comparing the data of the years 1978 and 1983, the paper production line can save about 10% of electricity and 40% of heating energy. The rate of saving is higher in the bagasse paper line i.e. it can save about 40% of the electricity used and about 50% of the heating energy. It was however noted that the cost of energy saving is relatively high because the technology and equipment for conservation have to be imported.

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(1) Virach Chunfung, a paper presented at Chulalongkorn University on May 28, 1984.

10.2 Fuel Substitution Programs

Lignite

From a survey of industrial plants in Bangkok and other 7 provinces around Bangkok which include Nonthaburi, Pathumthani Samutsakorn, Samutprakan, Samutsongkram, Nakornpathom and Saraburi, it was found that 2,500 industrial plants would be able to shift from fuel oil to lignite. The potential utilization of lignite was about 5 million tonnes per year. This involves the adjustment of energy-using equipment such as cement furnaces, lime furnaces, boilers, hot air furnaces and various types of furnaces. The boilers of about 2,000 industrial plants represented about 60% of the potentials or about 2.9 million tonnes per year. The immediate potential use would be about 500,000 tonnes per year. (1)

Agricultural Waste Products

At present, agricultural wastes are also used in industries, even though it might not be appropriate to think of them as fuel substitution per se. However, the use of such agricultural wastes as bagasse and paddy husk by sugar mills can save a large amount of energy. In 1982, it was estimated that about 5.6 million

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(1) Ithi Pitchayenyothin, op.cit.

tons of bagasse was used for energy purpose. This accounted for about 6.39 percent of the total energy demand. It was mainly used in making steam and generating electricity for the mills. (1) It was also estimated that in 1982, one million tons of rice husk were used for energy purpose. This was equivalent to about 0.8 percent of total energy demand. (2)

A research project on the application of gasohol for car has been conduted during August 1983 and December 1984 by the Office of Energy Substitution with the cooperation with the Science and Technology Research Institute of Thailand. The project requires 99.5% alcohol which is produced from tapioca roots. The gasohol will be able to reduce the lead compound content in the air. (3)

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(1) Bagasse was also used as raw a material in pulp industry.

(2) Rice husk was also used as a raw material in brick and earthenware industries.

(3) Siam Chronicle 1983 p.883

10.3 Conservation Effort of Government Agencies

In October 1980, there was a goverment announcement to save the electricity used by government agencies and public enterprises. It was reported that only 10 out of 199 government agencies was able to reduce their electricity use effectively. The majority of the government agencies (111 agencies) were unable to reduce their electricity uses. (1)

10.4 Conservation Potentials in Transportation

After the second oil shock in 1979, there has been an important adjustment in the energy consumption especially in Bangkok transportation. Because of wide differentials in the retail prices of oil products, the fuel switching from gasoline to LPG has become widespread among taxis in Bangkok as well as private cars. Moreover, there has also been a switch from gasoline to diesel oil. These interfuel substitutions have caused a very slow growth in gasoline consumption. (2)

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(1) Siam Chronicle

(2) Kanchit Piewnuan, Poonporn Saengbangpla and Vidhaya Roongsaeng, Energy Use in Transportation Sector, (in Thai) a paper presented at Chulalongkorn University Energy Seminar in August 1984.

In 1981, it was reported that there were about 17,548 cars and trucks which use LPG. (See Table 10.2) There has been an increasing trend of LPG use in motor vehicles in recent years.

Table 10.2: The Use of LPG in Vehicles, 1981

Type of Vehicles	Amount of LPG Consumption (thousand litres)	Number of Vehicles
Personal cars	8,273.64	2,436
Personal trucks	9,128.24	1,409
Taxis	99,530.16	12,021
Mini buses	12,287.52	1,484
Others	234.85	198
Total	129,504.41	17,548

Source: Registration Division, Police Department

The result of the survey in 1981 on the vehicles using LPG indicated that the main reason for converting to LPG was cheaper fuel price. About 42.51% of the sample indicate that the convenience of being able to buy LPG everyday was also the reason for converting.(1)

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(1) NEA, Report on the use of LPG in Automobiles, December 1981.

A study on the use of LPG in trucks and Bangkok buses revealed that the conversion is technically and economically possible. The economic possibility depended also on the length of time a bus would be further used. (1)

10.5 Fuel Substitution Program in Electricity Generation

As far as electricity generation in Thailand is concerned, EGAT has been successful in shifting from the use of imported oil to domestic energy resources. According to its plan EGAT will use domestic resources such as natural gas, lignite and hydro power in order to substitute for the use of fuel oil.

The hydro generated electricity is supposed to increase from 1,269 megawatts (MW) in 1980 to about 2,013 MW at the end of the Fifth Plan in 1986. There are many hydro electricity generation projects constructed or under construction during the Fifth Plan. These include:

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(1) Kraiyudth Thiratayakinan, "Conversion of Diesel Engine to Use LPG: A Feasibility Analysis," Academic Paper Number 2707, Economic Research Unit, Faculty of Economics, Chulalongkorn University. 1984.

1. Bhumibhol Hydro Power Plant: 7th generator with the capacity of 133 MW.

2. Lower Kwai Yai (Tha Thung Na Dam) with the capacity of 38 MW.

3. Khao Laem Hydro Power Plant: Generators 1, 2 and 3 each with the capacity of 100 MW.

4. Sirinthorn Hydro Power Plant, Ubonratchathani: 3rd generator with the capacity of 12 MW.

5. Sri Nakarin Hydro Power Plant, Kanchanaburi with the capacity of 180 MW.

6. Mae Ngud Hydro Power Plant, Chiengmai: two generators each with the capacity of about 4.5 MW.

7. Multi-purpose Chiew Lan Dam, Surrat Thani: 3 generators each with the capacity of 80 MW.

Besides these large-scale power plants there are several small- and medium-scale power plant projects within the responsibility of NEA. The total capacity of these power plants is about 57 MW.

There have been more uses of indigenous lignite and natural gas to replace fuel oil in power plants. At the lignite Power Plant in Mae Moh, Lampang, the 4th, 5th, 6th and 7th steam generators, each with the capacity of 150 MW have been installed. The 4th genertor began operation in March 1983, while the 5th generator began operation in December 1984 and the 6th and the 7th generator will start operation in the beginning of 1985 and the end of 1985, respectively. In addition, there is a plan to install the 8th, 9th and 10th generators in the future.

The natural gas power plants include:

1. Bang Pa Kong Steam and Gas Turbine with the total capacity of 240 MW.

2. Lan Krabue Gas Turbine with the capacity of 15 MW.

10.6 Some Remaining Problems in Sectoral Programs

It should be noted that the government policy of increasing domestic energy supply will take several years to yield significant results. The government did not emphasize enough on the demand management. For example, the government focussed the public attention on the supply side of the energy picture, especially on the new discoveries of oil and gas, the expansion of the Bangchak and TORC refineries, the concessionary oil deals with China, ASEAN and the Middle East, and the possibility of LNG

export.

Meanwhile, the potentials for energy conservation in some energy-intensive sectors, particularly the industrial and transport sectors, are yet to be realized. The recent phenomenon on fuel switching in transport shows that pricing has created energy inefficiencies. Therefore, while the shift in fuel mix in electricity generation is in the right direction, in other sectors the programs in conservation and fuel switching cannot be said to be as successful.

Chapter 11

Organizational, Institutional and Legal Arrangements

11.1 Government Organizations at Policy Level

At present, there are many governmental agencies responsible for the energy issues. In general it can be classified into two different levels i.e. the policy level and the implementation level. At the policy level, there are organizations responsible for various aspects of national energy policy as follows:

Ministry of Industry

-Department of Mineral Resources. The department, or the division of mineral fuels in particular, is responsible for exploration and granting concessions to the private sector to undertake exploration activities in Thailand. The basis of their functions is the Petroleum Act 2514.

-Division of Oil Industry, Office of the Under-Secretary of Industry. The division is responsible for production planning, investment and expansion of local refineries to accommodate the government policy including planning for emergency.

Ministry of Science, Technology and Energy

-National Energy Administration. Its basic functions include energy planning for both production and distribution, setting the energy prices, and the promotion of appropriate energy use.

Ministry of Commerce

- Department of Commercal Registration is responsible for granting permission for oil trade, reserve and standardization. The basis of their operation is the Oil and Fuel Act 2521 and 2522.

Ministry of Finance

- Fiscal Policy Office is responsible for studying the legal problems of taxation including determining the petroleum tax and managing the Oil Fund.

Ministry of Defense

- Department of Defense Energy is responsible on planning , aquisition , reservation, and production of energy for security purposes.

Office of the Prime Minister

- National Economic and Social Development Board. The main function of this agency is economic planning. Its functions include planning for development and coordinating various plans for both government agencies and state enterprises.

- Board of Investment. Its responsibilities include the promotion of investment by offering various incentives such as import duty exemption and income tax exemption.

Committees on Energy

Apart from the above government agencies, there are also various special committees the functions of which are related to energy or some specific aspects of energy issues. These committees are as follows:

1. Committee on Petroleum, Ministry of Industry chaired by the Under-Secretary of Industry under the Petroleum Act 2514.

2. Committee on Oil Fuel, Ministry of Commerce, chaired by the Under-Secretary of Commerce under the Oil Fuel Act 2521.

3. Committee on Oil Shortage Problem appointed by the Prime Minister through the Royal Decree 1973.

4. National Energy Committee, chaired by the Prime Minister under the National Energy Act 2496, 2506 and 2522.

5. Committee on Preparation for Readiness under the National Security Council Act 2502, chaired by the Secretary-General of National Security Council.

There are some other ad hoc committees such as the National Petroleum Policy Committee, the Committee for the Development of the Eastern Seaboard, the Committee for the Development of Natural Gas for Export, the Committee for Negotiation on Crude Oil and Natural Gas Purchase, and the Sub-committee for Studying the Joint-Venture with Thai Shell Exploration and Production Company.

11.2 Government Organizations at Implementation Level

Ministry of Finance

Since the Ministry of Finance is responsible for taxation, there are three important units involved in petroleum products taxation.

1. Department of Excise- The operation is based on the Act of Petroleum Products Taxation of 2507 and 2508.

2. Department of Customs - Import duties and export taxes are collected on importation and exportation of petroleum products.

3. Comptroller Department - The main function is the management of the Oil fund, in accordance with the announcement of the National Petroleum Policy Committee. The rate of depositing into the fund and the rate of compensation to the refineries for both imported and domestically refined petroleum products were set by the Committee.

Ministry of Defense

The Department of Defense Energy is responsible for the exploration especially in the Northern Region of Thailand. They are also responsible for production activities at Fang District in Chiengmai and the Bangchak refinery in Bangkok. At the refinery, the Ministry of Defense is responsible for refining activities while the Petroleum Authority of Thailand is responsible for the purchase of crude oil and the marketing of oil products.

Ministry of Industry

The Division of Oil Industry, Office of the Under-Secretary is responsible for controlling the TORC which operates a refinery at Sri Racha and also monitoring the practice of the

ESSO Standard Thailand with respect to the contract made between the company and the Ministry of Industry.

The Division of Mineral Fuels, at the Department of Mineral Resources is responsible for the Petroleum Act 2514 which governs petroleum exploration activities.

State Enterprises

There are four state enterprises operating in the energy sector. The Petroleum Authority of Thailand (PTT) is the national oil and gas company under the Ministry of Industry. It has a wide range of activities in the petroleum industry including the marketing of crude and oil products, the transmission of natural gas, oil refining, natural gas processing, and some upstream activities. The Electricity Generating Authority of Thailand (EGAT), under the Office of the Prime Minister, is responsible for the generation of almost all of the nation's electricity. Buying from EGAT, the Metropolitan Electricity Authority (MEA) and the Provincial Authority of Thailand (PEA), both under the Ministry of Interior, sell electricity in Bangkok Metropolitan and provincial areas respectively.

11.3 Committees on Oil Problems (1)

As a result of the oil crises, the government has appointed several committees to study the situation and assist the government in their decision making. In November 1973, there was an appointment of a special committee. The functions of this committee include:

a. to collect information and data on oil for cabinet consideration.

b. to study the oil situation and report to the Prime Minister at least once every two weeks.

c. to coordinate work by various committees on oil.

Afterwards, there was an appointment of an advisory board to the Prime Minister and a sub-committee on oil problems consisting of representatives from various government agencies. The terms of reference for this sub-committee includes:

a. to study the oil situation and suggest some short-run measures to cope with the problem (excluding the long-run measure such as acceleration of the activities of the oil exploration).

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(1) See the chronology of legal changes and descriptions on energy matters in Appendix 2.

b. to gather information and statistical data for government agencies and the private sector.

In order to avoid duplication, the terms of this sub-committee was temporary and the deadline for recommendations was within 3 weeks from the first meeting on April 23, 1974.

Based on the Royal Decree 1973, the Prime Minister also appointed a committee working on his behalf which comprised of the Minister of Industry (chairman), Director General of the Police Department and the governor of EGAT in order to report the situation to him.

In addition, there was an appointment of a committee for controlling oil and lubricants on November 13, 1973. Its functions include:

a. setting the measures related to production, distribution, importation and exportation of oil products.

b. making decision on prohibition of importation and exportation of oil products in order to assure economic and national security.

Before the second Sanya government, there were five committees concerning oil, i.e.

1. The committee on controlling oil and lubricants.

2. The special committee for oil study.

3. The committee representing the Prime Minister according to the Royal Decree B.E. 2516 (1973).

4. The sub-committee for the economic advisory board to the Prime Minister.

5. The national energy committee.

During the second Sanya government the second and third committees were dissolved and there was an appointment of the committee on the oil policy. This committee was later called the National Petroleum Policy Committee. There were 12 members chaired by the Deputy Prime Minister. The terms of reference for this commitee include:

a. Setting the measures concerning production, distribution, import quota allocation and promoting the exploration of crude oil and petroleum products.

b. Preventing the shortage of petroleum products.

c. Adjusting the prices of oil products in such a way as to minimize the impacts on the economy and the security of the country.

d. Carrying out other functions of the previous committees to avoid repetition of work among ministries concerning oil.

The special committee on oil study was still effective and the study was to be reported to the oil policy committee and the report on oil situation will be reported to the chairman of the oil policy committee (the Deputy Prime Minister) at least once every two weeks. The special committee studied oil prices and measures in order to cope with the oil shortage.

When the Tanin government came into power in October 1976 there were organization readjustments and an appointment of a working group on oil policy in order to minimize the impact of oil price increases. The working group was chaired by the Director-General of the Fiscal Policy Office ,the Ministry of Finance. This working group was dissolved in March 1977 when their tasks of adjusting the structure of ex-refinery and retail prices were completed.

In August 1977, after an increase in crude oil price in July, three different committees on oil were appointed:

1. The Committee on Oil Policy (by the Prime Minister Order on August 2, 1977).

This committee was chaired by the Minister of Industry and its terms of reference include:

a. setting and revising the policy concerning crude oil and petroleum products, for example,

- setting measures for acquiring crude oil and every kind of petroleum products.

- setting measures concerning production, use, allocation, importation and exportation of crude oil and every kind of petroleum products.

- preventing crude oil and petroleum products shortage.

- setting the prices of petroleum products.

- setting the tax on petroleum products.

b. setting policy for related business.

2. Special Committee on Oil Study

This committee was chaired by the Director-General of the Industrial Promotion Department, the Ministry of Industry. The terms of references include:

a. To study the petroluem industry and related business.

b. To study the oil situation and assigned issues, and to summarize and report to the committee on oil policy.

3. Committee on Oil Industry Development

This committee is chaired by the Minister of Industry. The terms of reference are to advise the cabinet concerning:

1. Petroleum production planning to assure the efficiency, the economies of scale and the optimal relation between rate of production and the use.

2. Construction and expansion of oil refineries.

3. Other activities related to oil industry development.

Later during the Prem government there was an appointment of the National Petroleum Policy Commmittee (NPPC). The National Petroleum Policy Committee was established by the cabinet in

March 1980. This committee was chaired by the Prime Minister. There were about 17 members including the Prime minister, Deputy Prime Minister, Ministers of various Ministries, Secretary-General of the Juridical Council, Secretary-General of NESDB, Secretary-General of NEA, Governor of PTT, etc. Its functions include consideration of policy and targets for development of the petroleum industry for the country and the consideration of the petroleum product pricing policy. The fact that this committee was chaired by the Prime Minister indicated that this committee was important in terms of policy making. In 1983, the committee members were adjusted as a result of the government reshuffle and the Governor of EGAT was added to the list of committee members.

11.4 Oil Fund

Based on the Royal Decree 1973, the operation of the oil fund started in the Sanya Government in 1974. The situation at that time was that the oil price increased at a very high rate and the government allowed an increase in the ex-refinery and retail prices of petroleum products. The oil fund under the name "the Fund for Oil Price Stabilization" was founded in February 1974 in order for the government to collect the excess profit by oil companies derived from the existing stock from the previous purchase of oil before the oil price increase.

This fund was used to compensate the oil traders who have to buy oil at higher prices before the prices of petroleum products were adjusted. The objective is to delay an increase in retail product prices. Later, the fund is used to compensate for the higher price of fuel oil that the Petroleum Authority of Thailand sold to the Electricity Generation Authority of Thailand (EGAT). This is to delay a rise in the cost of electricity generation and electricity prices.

The decision on compensation from the oil fund, at present, is under the jurisdiction of the Sub-committee on Oil Price Determination and Compensation chaired by the Minister Attached to the Prime Minister's Office. The sub-committee members consist of 15 other representatives from various agencies including:

1. The Secretary-General of NEA
2. The Director-General of the Department of Energy for Defense
3. Deputy Under-Secretary of the Ministry of Industry
4. Governor of PTT
5. Director-General of the Commercial Registration Department
6. Director-General of the Business Economics Department
7. Representative of the Ministry of Industry
8. Representative of the Ministry of Finance
9. Director-General of the Internal Trade Department

10. Representative of NESDB
11. Representative of the Juridical Council
12. Representative of the Comptroller Department
13. Captain Somboon Intharaprasart - Secretary
14. Representative of the Ministry of Industry
15. Representative of NEA

11.5 Evaluation

As far as the energy demand management is concerned, there are many factors affecting organizations, institutions and legal arrangements. The most important of these is the frequent changes of the government which cause a lack of continuity in pursuing the energy conservation plan, especially after the first oil crisis. Regulations and measures were seriously undertaken in some governments such as during the Kukrit government in 1976 and the Prem government in the early 1980's. However, these were short-run measures and were later abolished.

Almost all of the governments were willing to cut tax revenue by using the tax revenue to compensate for the increased oil prices for the refineries.

Moreover, the public education on energy conservation was not effective enough. Some of the important information was still classified as secret and the public were not provided with

enough information and hence they were not able to fully cooperate with the government in energy conservation.

One may have already observed that the energy issue is one of the most important issues facing Thailand. However, the government agency which is resposible for the energy issue like the National Energy Administration does not have enough authority to manage the whole activities. The past experience did point out that when the energy issue became a serious problem, the Prime Minister or the Deputy Prime Minister must be in charge, for example, in many of the committees concerning petroleum products. Recently, there was also an attempt to create a ministry-level agency in charge of energy by grouping various agencies concerning energy together. It remains to be seen whether this approach of solving the organizational problems will be successful.

Chapter 12

Conclusions

For Thailand which is an energy-poor, oil importing developing country, the energy demand management policy is a very important tool for coping with its energy problems. In this study we have described and analysed various demand management measures, namely energy pricing, regulatory measures, incentives, education, training and information programs as well as conservation and substitution programs.

The achievements which can be attributed to these energy demand management measures can be seen in the form of oil import dependence, the efficiency in the consumption and use of energy, and various impacts of the energy problems on the economy. We have seen that Thailand has considerably reduced its dependence on oil import from 80% of the total energy use in the early 1970's to around 50% in 1983. This was quite a remarkable success which cannot be attributed only to the energy demand management policy but has also been due to the fact that significant amounts of petroleum, mainly natural gas, has been discovered and utilized in place of imported oil. The growth rate of energy consumption has also been reduced from over 10% per year in the pre-1973 period down to about 7% per year during 1974 and 1982. To some extent the reduction was caused by the energy pricing policy. However, the slowdown in energy demand in

the crisis years of 1974 and 1980 was also the result of supply shortages precipitated by some OPEC countries' actions.

There is some evidence that the overall efficiency in energy use has increased as shown by our finding that the income elasticity of energy demand has declined since the first oil crisis. Nevertheless, there is room for improvement by both energy conservation and fuel substitution. We have seen also that the impacts of the oil crises on the economy were quite substantial though their magnitudes vary from period to period. The most important impact seems to be on inflation which was quite severe during the crisis years. The impact on economic growth was less unfavourable in the first oil crisis than in the second. For the trade and payments balances as well as foreign debts, the impacts tended to be accumulative over time. The oil crises also contributed to the current government budget problem. Overall, it seems that the second oil crisis, coupled with the world economic recession in 1982, has put more severe strains on the Thai economy than the first one. Whether the downward tendency of the world oil prices will be substantial and long lasting enough to enable Thailand to improve its economic performance remains to be seen.

Our review of Thailand's energy demand management policy shows that the policy measures taken so far were rather mutually supporting. The single most effective measure was obviously energy pricing. However, due to some social and political

constraints and some conflicting policy objectives, the pricing of energy, particularly oil products, by the government cannot be said to be "ideal" in economic sense. A number of oil products and electricity have been subsidized during some periods, leading to wasteful interfuel substitution and adulteration. Various regulatory measures have been taken mostly on a short run basis when the energy problem was particularly acute. Although there was a plan for appropriate energy pricing and long run measures to encourage energy efficiency and to reduce the vulnerability of the economy to the vagaries of the world energy situation, these have not been implemented to the full extent. The government began to introduce some incentive programs for energy conservation in the early 1980's, and if the potential for further conservation in industries and transport as indicated by some studies is to be realized, these programs will become another important dimension in the energy demand menagement policy. It should be noted that appropriate energy pricing will be a very necessary condition for the success of other energy related policy measures.

It is obvious from our review that energy demand management has not been without any cost. The most significant economic costs were in the form of higher prices and production costs, somewhat slower economic growth, increasing trade and payments deficits, growing foreign debt burden, uncertainty in the exchange rate, and ballooning fiscal deficits. The policy also adversely affected income distribution as far as the oil taxes

and the burden of inflation were regressive. The pricing aspect of the energy demand management brought about unfavourable social and political consequences, mainly through reducing the stability and the decision-making capability of the government. These costs usually varied depending on whether they are considered on a short run or long run basis. Some could have been reduced in the short run but would have made other costs even higher in the long run. For example, a cheap oil price policy would have lowered the inflation rate in the short run, but consequently the international economic position of the country would in the long run have been weakened. It seems that these costs could not have been totally avoided. Given the economic, social and political milieu in the country during the study period, it is just a matter of trading off among various policy goals and their concomitant benefits and costs. In the future, the ability to reduce these costs will depend on the import dependence in energy, the public awareness of the energy problem, the improvement of energy planning, monitoring and evaluation by government agencies, and the right mix between economics and politics in government decision making in the area of energy.

While the recent decline in crude oil prices reduced the burden on the economy and made it easier for the government to improve its energy pricing and other non-price measures, it also caused the public to be less enthusiastic and conscious about the need to conserve energy. The baht devaluation in November 1984 in fact increased the baht cost of imported oil and made it more

difficult for the government to comply with the public demand for lower retail prices of oil products. At the time of the writing all oil products except gasoline and diesel oil are subsidized and the accumulated oil fund is believed to last until the middle of 1985 before it becomes negative again.

Despite some weaknesses in the energy demand management policy, the availability of indegenous energy resources such as natural gas, crude oil, lignite and some non-petroleum energy helps to brighten Thailand's energy future. The government did and will invest large sums of money in the production and use of these energy resources which will eventually substitute for a large proportion of imported energy up to the mid 1990's. There is a need for and more understanding about policy improvements concerning energy pricing, institutional arrangements, long term energy planning, investment strategy, energy conservation, and other energy issues. What is needed in the future is consistent and continuous efforts by the government and the private sector to implement these reforms in order to alleviate the energy problem.

Appendix 1

Regression Estimates of Energy Demand

Appendix 1

Regression Estimates of Energy Demand

Notation

Demand (all variables are in 10^6 Kcal)

LDTCE = log of total demand for commercial energy

LDE = log of demand for electricity (general)

LDHE = log of demand for electricity (hydroelectric)

LDNE = log of demand for non-electric energy

LDPP = log of demand for petroleum products

LDLPG = log of demand for LPG

LDGS = log of demand for Gasoline

LDK = log of demand for Kerosene

LDDS = log of demand for Diesel Oil

LDF = log of demand for Fuel Oil

LDCL = log of demand for Coal

Income (in million baht, constant prices)

LCTO = log of real gross domestic product.

Price (all price are in B/10^6 Kcal)

LPTCE = log of real price of total demand for energy

LPE = log of real price of electricity

LPNE = log of real price of non-electric energy

LPPET = log of real price of petroleum products

LPLPG = log of real price of LPG

LPGS = log of real price of Gasoline

LPK = log of real price of Kerosene

LPDS = log of real price of Diesel Oil

LPF = log of real price of Fuel Oil

LPCL = log of real price of Coal

SMPL 1970 -1973
OLSQ // DEPENDENT VARIABLE IS LDTCE

	COEF	S.E	T-STAT
C	-43.17725	73.48743	-0.587546
LPTCE	1.217327	3.511264	0.346691
LCTO	3.993821	4.602783	0.867697

R-SQUARED = 0.90821
ADJUSTED R-SQUARED = 0.72463
OBSERVATIONS = 4
SUM OF SQUARED RESIDUALS = 0.010566
S.E. OF REGRESSION = 0.102791
DURBIN-WATSON STATISTIC = 2.08863
F-STATISTIC = 4.94736

SMPL 1974-1982
OLSQ // DEPENDENT VARIABLE IS LDTCE

	COEF	S.E	T-STAT
C	0.720641	1.117933	0.644619
LPTCE	-0.303771	0.094654	-3.209266
LCTO	1.014037	0.122232	8.295742

R-SQUARED = 0.94832
ADJUSTED R-SQUARED = 0.93109
OBSERVATIONS = 9
SUM OF SQUARED RESIDUALS = 9.251E-3
S.E. OF REGRESSION = 0.037084
DURBIN-WATSON STATISTIC = 2.20431
F-STATISTIC = 55.0530

SMPL 1970 - 1973
OLSQ // DEPENDENT VARIABLE IS LDHE

	COEF	S.E	T-STAT
C	-58.23228	21.63182	-2.691973
LPE	1.901646	0.690468	2.754139
LCTG	4.666719	1.476407	3.160860

R-SQUARED = 0.94225
ADJUSTED R-SQUARED = 0.82677
OBSERVATIONS = 4
SUM OF SQUARED RESIDUALS = 8.401E-4
S.E. OF REGRESSION = 0.028983
DURBIN-WATSON STATISTIC = 2.75330
F-STATISTIC = 8.15904

SMPL 1974 - 1982
OLSQ // DEPENDENT VARIABLE IS LDHE

	COEF	S.E	T-STAT
C	5.077251	7.468374	0.679833
LPE	-0.899642	0.714084	-1.259854
LCTO	0.736600	0.820028	0.898262

R-SQUARED = 0.21120
ADJUSTED R-SQUARED = 0.05172
OBSERVATIONS = 9
SUM OF SQUARED RESIDUALS = 0.451554
S.E. OF REGRESSION = 0.274333
DURBIN-WATSON STATISTIC = 1.39360
F-STATISTIC = 0.80328

SMPL 1970 - 1973
OLSQ // DEPENDENT VARIABLE IS LDNE

	COEF	S.E	T-STAT
C	-51.57933	72.72098	-0.709277
LPNE	1.775421	4.041898	0.439254
LCTO	4.451527	4.332284	1.027524

R-SQUARED = 0.91422
ADJUSTED R-SQUARED = 0.74267
OBSERVATIONS = 4
SUM OF SQUARED RESIDUALS = 0.011218
S.E. OF REGRESSION = 0.105919
DURBIN-WATSON STATISTIC = 2.22161
F-STATISTIC = 5.32911

SMPL 1974 - 1982
OLSQ // DEPENDENT VARIABLE IS LDNE

	COEF	S.E	T-STAT
C	-0.190313	1.790853	-0.106269
LPNE	-0.274585	0.144594	-1.899012
LCTO	1.066911	0.194958	5.472516

R-SQUARED = 0.90013
ADJUSTED R-SQUARED = 0.86684
OBSERVATIONS = 9
SUM OF SQUARED RESIDUALS = 0.019602
S.E. OF REGRESSION = 0.057158
DURBIN-WATSON STATISTIC = 1.33186
F-STATISTIC = 27.0402

SMPL 1970 - 1973
OLSQ // DEPENDENT VARIABLE IS LDPP

	COEF	S.E	T-STAT
C	-44.76830	76.09887	-0.588291
LPPET	1.287642	4.061157	0.317062
LCTD	4.091046	4.599706	0.889414

R-SQUARED = 0.90851
ADJUSTED R-SQUARED = 0.72554
OBSERVATIONS = 4
SUM OF SQUARED RESIDUALS = 0.012662
S.E. OF REGRESSION = 0.112527
DURBIN-WATSON STATISTIC = 2.13490
F-STATISTIC = 4.96535

SMPL 1974 - 1982
OLSQ // DEPENDENT VARIABLE IS LDPP

	COEF	S.E	T-STAT
C	-0.075100	1.952939	-0.038455
LPPET	-0.314161	0.149321	-2.103929
LCTO	1.073815	0.209957	5.114449

R-SQUARED = 0.87418
ADJUSTED R-SQUARED = 0.83225
OBSERVATIONS = 9
SUM OF SQUARED RESIDUALS = 0.023031
S.E. OF REGRESSION = 0.061956
DURBIN-WATSON STATISTIC = 1.34405
F-STATISTIC = 20.8450

SMPL 1970 - 1973
OLSQ // DEPENDENT VARIABLE IS LDLPG

	COEF	S.E	T-STAT
C	-54.12194	43.44895	-1.245644
LPLPG	1.152590	2.115078	0.544939
LCTO	4.447164	2.533296	1.755485

R-SQUARED = 0.95652
ADJUSTED R-SQUARED = 0.86957
OBSERVATIONS = 4
SUM OF SQUARED RESIDUALS = 7.882E - 3
S.E. OF REGRESSION = 0.088778
DURBIN-WATSON STATISTIC = 3.36557
F-STATISTIC = 11.0011

SMPL 1974 - 1982
OLSQ // DEPENDENT VARIABLE IS LDLPG

	COEF	S.E	T-STAT
C	-19.41913	2.764331	-7.024893
LPLPG	0.242437	0.447506	0.541752
LCTO	2.047097	0.317446	6.448637

R-SQUARED = 0.94114
ADJUSTED R-SQUARED = 0.92152
OBSERVATIONS = 9
SUM OF SQUARED RESIDUALS = 0.085048
S.E. OF REGRESSION = 0.119057
DURBIN-WATSON STATISTIC = 0.99918
F-STATISTIC = 47.9685

SMPL 1974 - 1982
OLSQ // DEPENDENT VARIABLE IS LDLPG

	COEF	S.E	T-STAT
C	0.545268	3.444857	0.158284
LPLPG	-1.322446	0.441902	-2.999302
LPGS	1.322446	0.317348	4.167172
LCTO	1.087660	0.282919	3.844420

R-SQUARED = 0.98648
ADJUSTED R-SQUARED = 0.97894
OBSERVATIONS = 9
SUM OF SQUARED RESIDUALS = 0.019013
S.E. OF REGRESSION = 0.061666
DURBIN-WATSON STATISTIC = 1.66236
F-STATISTIC = 124.991

SMPL 1970 - 1973
OLSQ // DEPENDENT VARIABLE IS LDGS

	COEF	S.E	T-STAT
C	-29.79986	36.52211	-0.815940
LPGS	0.777600	2.212854	0.351401
LCTO	2.868966	2.049254	1.400004

R-SQUARED = 0.82792
ADJUSTED R-SQUARED = 0.48377
OBSERVATIONS = 4
SUM OF SQUARED RESIDUALS = 0.018999
S.E. OF REGRESSION = 0.137840
DURBIN-WATSON STATISTIC = 2.95016
F-STATISTIC = 2.40571

05/21/86

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