Chapter 5 Energy Situation

In this chapter, the global energy situation, the socio-economic conditions of Malaysia in brief and the energy situation Malaysia are described.

5-1 World Energy Situation

5-1-1 Energy Situation throughout World

(1) Total Primary Energy Supply (TPES) in the World

According to the data based on IEA, the world primary energy supply was 4,860 million TOE in 1971 and 8,200 million TOE in 1995, as shown in Table 5-1. The primary energy supply increased at a rate of approximately 2.2 percent per annum during 1971and 1995, mainly as a result of the increase of energy consumption in developing countries. In the recent five-year period between 1990 and 1995, the average rate of energy supply increase was approximately 1.1 percent per annum. By type of energy source, petroleum collectively accounted for 39 percent of the total supply in 1995. The rest came from solid fuel, natural gas, nuclear and hydro electricity.

Table 5-1 Total Primary Energy Supply in the World

	Primary Energy Consumption (Billion TOE)								Growth Rates (% p.a.)		Shares of Fuel (%)	
	1971	1973	1980	1985	1990	1993	1994	1995	1971 -1995	1990 -1995	1971	1995
TPES	**4.86**	**5.42**	**6.44**	**6.94**	**7.78**	**7.97**	**8.01**	**8.20**	**2.2**	**1.1**	**100**	**100**
Solid Fuels	1.43	1.49	1.74	2.02	2.16	2.13	2.15	2.20	1.8	0.4	29.5	26.8
Oil	2.33	2.70	2.99	2.80	3.07	3.14	3.14	3.19	1.3	0.8	47.8	38.9
Natural Gas	0.90	0.98	1.24	1.42	1.67	1.75	1.75	1.81	3.0	1.5	18.5	22.0
Nuclear	0.03	0.05	0.19	0.39	0.52	0.57	0.58	0.61	13.5	3.0	0.6	7.4
Hydro	0.10	0.11	0.15	0.17	0.19	0.20	0.20	0.21	3.1	2.8	2.1	2.6
Other fuels	0.07	0.08	0.14	0.14	0.16	0.18	0.18	0.18	4.0	2.4	1.5	2.3
TPES per Capita (TOE)	1.30	1.39	1.46	1.44	1.48	1.45	1.44	1.45	0.5	-0.4	-	-
TPES/GDP (TOE/Mill. US$ 1987 price)	463	461	443	425	408	404	396	396	-0.6	-0.6	-	-

Source: Based on Energy Balances of OECD Countries, Energy Statistics and Balances of Non-OECD Countries (IEA)

Notes:
(1) TPES (Total Primary Energy Supply)
(2) Consumption is based on net heating value
(3) Other fuels are combustible renewables and waste, and solar energy etc. However, combustible renewables and waste are not included for non-OECD countries

(2) Total Final Consumption of Energy (TFC) in the World

The global total final consumption of energy in 1971 was 3,770 million TOE; per capita consumption was 1.01 TOE. The world Total Final Consumption of Energy in 1995 was 5,790 million TOE, much larger than that in 1971; per capita consumption was 1.03 TOE, slightly larger than that in 1971. The difference between TPES and TFC consists of self-use and losses of energy in the energy transformation sector such as electricity plants, combined heat and power plants, heat plants, production of gas and gas works, and petroleum refineries. In the five years from 1990, energy consumption increased at a rate of approximately 0.9 percent per annum, as shown in Table 5-2. This is mainly as a result of the increase in consumption by transportation and other sectors including residential, commercial, agriculture, fisheries and public service, in contrast to a decrease in the industrial sector and non-energy use.[1]

Table 5-2 Total Final Energy Consumption in the World

	Final Energy Consumption (Billion TOE)								Growth Rates (% p.a.)		Shares (%)	
	1971	1973	1980	1985	1990	1993	1994	1995	1971 -1995	1990 -1995	1971	1995
TFC	3.77	4.17	4.81	5.03	5.53	5.65	5.63	5.79	1.8	0.9	100	100
Industry	1.63	1.81	2.04	2.04	2.19	2.12	2.10	2.17	1.2	-0.1	43.2	37.5
Transportation	0.85	0.96	1.14	1.22	1.42	1.47	1.49	1.54	2.5	1.6	22.7	26.6
Residential, Commercial & Agriculture	1.16	1.26	1.45	1.60	1.73	1.90	1.87	1.91	2.1	2.0	30.8	33.0
Non-Energy	0.13	0.14	0.18	0.17	0.19	0.17	0.18	0.17	1.3	-2.3	3.3	3.0
TFC per Capita (TOE)	1.01	1.07	1.09	1.05	1.05	1.03	1.01	1.03				
TFC/GDP (TOE/Mill. US$ 1987 price)	359	355	330	308	290	286	278	279				

Source: Based on Energy Balances of OECD Countries, Energy Statistics and Balances of Non-OECD Countries (IEA)

Notes:
(1) TFC (Total Final Energy Consumption)
(2) Consumption is based on net heating value
(3) Other fuels are combustible renewables and waste, and solar energy etc. However, combustible renewables and waste are not included for non-OECD countries

5-1-2 Energy Consumption in Selected Countries

The energy consumption of Malaysia, Japan, Germany, the United Kingdom, France, the United States, Singapore, Thailand, Indonesia and South Korea are described here.

[1] Non-energy use covers use of other petroleum products such as paraffin waxes, lubricants, bitumen and other products. Non-energy use of coal includes carbon black, graphite electrodes, etc. Please note that feedstock for the petrochemical industry is earmarked for the industrial sector.

(1) Trends in Energy Demand and GDP in Selected Countries

Malaysia's average GDP growth rate was 7.7 percent per annum in 1985-1995, which was higher than the average GDP growth rate in 1971-1985, 7.1 percent per annum. However, in terms of total primary energy supply (TPES), its growth rate was 8.1 percent per annum in 1985-1995, which was lower than that of 1971-1985, 8.5 percent per annum.

A fairly high increase rate of TPES has been observed together with GDP growth in ASEAN countries including Malaysia and NIES countries. The TPES growth rates for 1985-1995 in those countries were: 8.1 percent in Malaysia, 10.6 percent in Singapore, 12.8 percent in Thailand, 9.1 percent in Indonesia and 10.5 percent in South Korea. However, in OECD countries such as Japan, Germany, the United Kingdom, France and the United States for the period between 1985 and 1995, TPES increased at lower average annual rates between minus 0.6 percent and plus 3.1 percent, while GDP grew at rates from 2 to 3 percent per annum.

Table 5-3 TPES and GDP Growth Rate

	TPES (Million TOE)				GDP (Billion US$, 1990 Price)				TPES Growth		GDP Growth	
	1971	1985	1994	1995	1971	1985	1994	1995	1971 -1985	1985 -1995	1971 -1985	1985 -1995
Malaysia	5	15	33	33	12	31	59	65	8.3	8.1	7.1	7.7
Japan	270	367	483	497	1,358	2,369	3,144	3,191	2.2	3.1	4.1	3.0
Germany	308	361	337	339	1,041	1,421	1,750	1,781	1.1	-0.6	2.2	2.3
United Kingdom	211	204	221	224	632	828	1,013	1,040	-0.3	1.0	2.0	2.3
France	155	200	232	241	737	1,030	1,234	1,260	1.9	1.9	2.4	2.0
USA	1,593	1,782	2,058	2,088	3,348	4,846	6,005	6,147	0.8	1.6	2.7	2.4
Singapore	3	8	25	21	9	25	50	55	7.2	10.6	7.7	8.3
Thailand	7	16	44	52	22	52	118	128	6.4	12.8	6.4	9.4
Indonesia	9	36	75	86	32	81	154	166	10.6	9.1	6.9	7.4
South Korea	17	54	133	145	49	156	334	364	8.8	10.5	8.6	8.8

Source: Based on Energy Balances of OECD Countries, Energy Statistics and Balances of Non-OECD Countries (IEA)

(2) Trends in Energy Intensity (TPES/GDP)

The concept of energy intensity is a useful measure of changes in the relationship between energy consumption and GDP. The definition of energy intensity is the ratio of TPES to GDP. Changes in intensity reflect the combined effects of changes in the structure of economic output, energy efficiency improvements or losses, and changes in the fuel mix. None of these effects is separately identifiable at this level of aggregation, however, the measure remains a simple descriptive tool. Table 5-4 compares energy intensities using GDP estimates in selected countries.

Energy intensity in Malaysia was 512 TOE/million US$, which was around the same level as Indonesia, but higher than that in Singapore, Thailand and South Korea. Energy intensity in Japan, Germany, the United Kingdom and France was considerably lower than that in Malaysia, reaching only 30 percent to 42 percent of Malaysia's.

Energy intensity increased in Malaysia by 1.2 percent annually during 1971-1985, and 0.4 percent annually during 1985-1995. The energy intensity in OECD countries such as Japan, Germany, the United Kingdom, France and the United States has basically declined continuously in the same period.

Table 5-4 Energy Intensity

	TPES/GDP (TOE/Million US$, 1990 Price)				Increase Rate (% p.a.)	
	1971	1985	1994	1995	1971-1985	1985-1995
Malaysia	415	491	562	512	1.2	0.4
Japan	199	155	154	156	-1.8	0.1
Germany	296	254	192	190	-1.1	-2.9
United Kingdom	334	246	219	216	-2.2	-1.3
France	210	194	188	192	-0.5	-0.1
USA	476	368	343	340	-1.8	-0.8
Singapore	337	315	491	390	-0.5	2.1
Thailand	298	299	377	407	0.0	3.1
Indonesia	277	443	489	516	3.4	1.5
South Korea	335	343	397	399	0.2	1.5

Source: Based on Energy Balances of OECD Countries, Energy Statistics and Balances of Non-OECD Countries (IEA)

(3) Per Capita Energy Consumption

As outlined in Table 5-5, per capita TPES in Malaysia in 1995 was 1.65 TOE, which was considerably less than that in Japan, Germany, the United Kingdom, France, the United States and Singapore. It is clear that there is a relationship between per capita energy demand and per capita GDP.

Table 5-5 Per Capita Energy Demand

	Per Capita Energy Demand (TOE)				Increase Rate (% p.a.)	
	1971	1985	1994	1995	1971-1985	1985-1995
Malaysia	0.45	0.97	1.69	1.65	5.7	5.5
Japan	2.57	3.04	3.86	3.96	1.2	2.7
Germany	3.93	4.65	4.14	4.15	1.2	-1.1
United Kingdom	3.77	3.59	3.79	3.83	-0.3	0.6
France	3.01	3.62	4.01	4.15	1.3	1.4
USA	7.67	7.47	7.90	7.94	-0.2	0.6
Singapore	1.55	3.15	8.44	7.15	5.2	8.5
Thailand	0.18	0.30	0.77	0.90	3.9	11.4
Indonesia	0.07	0.22	0.39	0.44	8.2	7.2
South Korea	0.51	1.31	2.98	3.23	7.0	9.4

Source: Based on Energy Balances of OECD Countries, Energy Statistics and Balances of Non-OECD Countries (IEA)

(4) The Fuel Mix

There is a significant difference in the fuel mix between countries, largely depending on the indigenous resource base, as shown on Figure 5-1 and Table 5-6. In Malaysia, indigenous oil has been widely used, however there have been shifts from oil to natural gas, coal and lignite in line with the four-fuel diversification policy. In OECD countries such as Japan, Germany, the United Kingdom, France, the United States, and South Korea, nuclear energy holds an important position as well as oil, coal and lignite, and natural gas. Especially in France, nuclear energy accounted for about 40 percent of TPES.

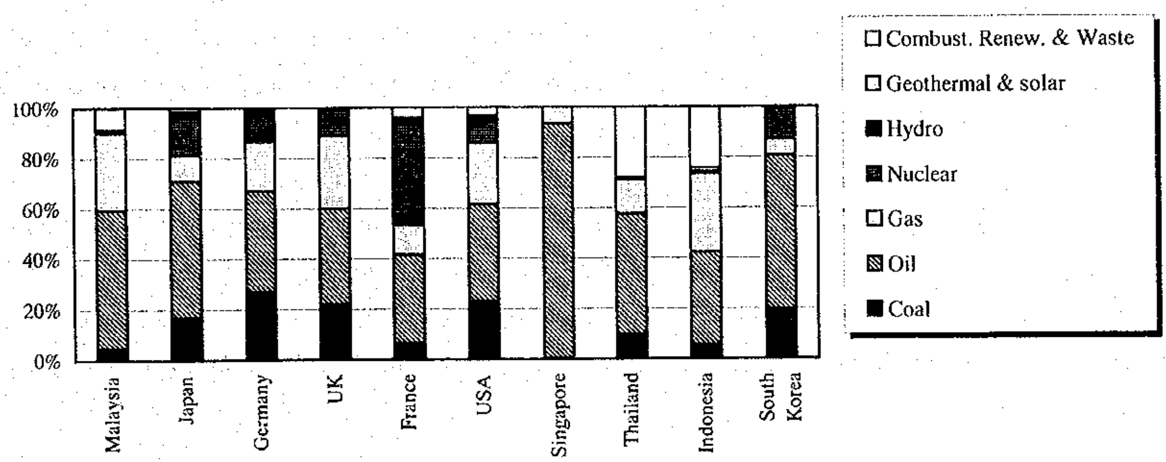


Figure 5-1 TPES in 1995

Table 5-6 Total Primary Energy Supply in 1995

	TPES (Million TOE)							
	Coal	Oil	Gas	Nuclear	Hydro	Geoth. Solar	Com. Renew	Total
Malaysia	1.6	20.0	11.1	0.0	0.5	0.0	3.1	36.3
Japan	82.6	269.6	52.0	75.9	7.1	2.9	7.0	497.0
Germany	91.0	135.7	66.4	39.9	1.9	0.1	3.5	338.6
UK	48.6	84.6	65.1	23.2	0.4	0.0	1.1	223.1
France	16.1	86.6	29.6	98.3	6.1	0.2	10.6	247.4
USA	475.3	804.4	508.7	186.0	27.0	13.2	70.6	2,085.2
Singapore	0.0	20.0	1.4	0.0	0.0	0.0	0.0	21.4
Thailand	6.9	34.9	9.7	0.0	0.6	0.0	20.4	72.5
Indonesia	6.1	41.8	35.3	0.0	0.7	1.9	27.5	113.2
South Korea	28.3	89.7	9.2	17.5	0.5	0.0	1.1	146.2

Source: Based on Energy Balances of OECD Countries, Energy Statistics and Balances of Non-OECD Countries (IEA)

(5) Total Final Consumption of Energy by Sector in Selected Countries

The final energy consumption by sectors such as industry, transport, others (including household, commercial, agriculture, fishery and public services), and non-energy use are shown in Figure 5-2 and Table 5-7. In Malaysia, final energy consumption by sector was; 41 percent for the industrial sector, 35 percent for the transport sector, 15 percent for other sectors, and 9 percent for non-energy use in 1995. In comparison, between 1985 and 1995, though the industrial sector's share did not change, the transport sector's share decreased by 6 percent and the share of other sectors and non-energy use increased by 2 percent and 4 percent, respectively.

The industrial sector's contribution to growth in final energy demand slowed from 1985 to 1995 in Japan, Germany, the United Kingdom and the United States, reflecting structural shifts in the major economies toward services and less energy-intensive industries. In these countries, contributions of the transport sector and other sectors increased in place of the industrial sector's contribution.

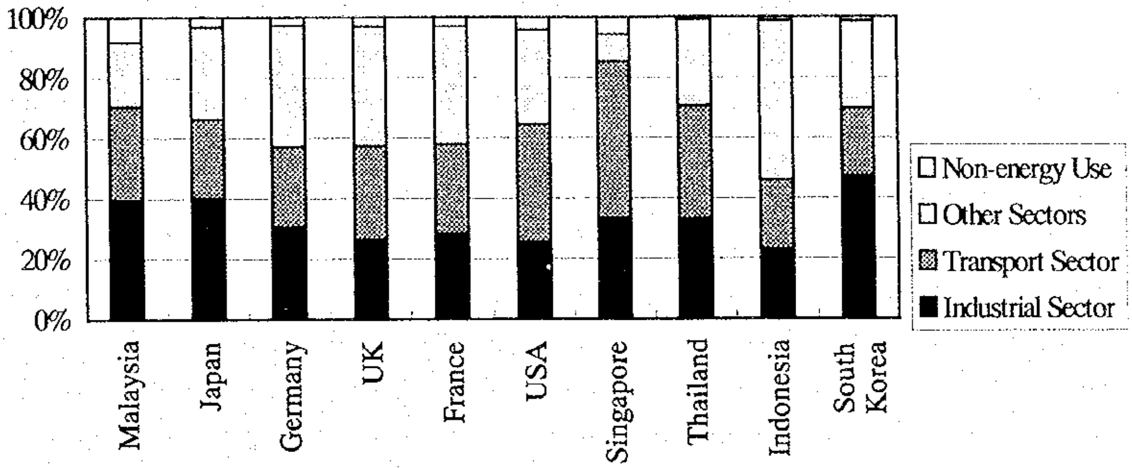


Figure 5-2 Final Energy Consumption by Sector

Table 5-7 Total Final Energy Consumption by Sector in 1985/1995

	1985				1995			
	Industry Sector	Transport Sector	Other Sectors	Non-energy Use	Industry Sector	Transport Sector	Other Sectors	Non-energy Use
Malaysia	41%	41%	13%	5%	41%	35%	15%	9%
Japan	47%	22%	27%	4%	43%	25%	29%	3%
Germany	37%	19%	41%	3%	32%	26%	39%	3%
UK	30%	26%	41%	3%	27%	31%	39%	3%
France	33%	25%	39%	3%	29%	29%	39%	3%
USA	30%	35%	31%	4%	25%	39%	31%	4%
Singapore	33%	47%	10%	9%	33%	52%	9%	6%
Thailand	25%	50%	24%	1%	32%	49%	17%	1%
Indonesia	31%	29%	39%	1%	35%	35%	28%	2%
South Korea	40%	17%	42%	1%	47%	23%	29%	1%

Source: Based on Energy Balances of OECD Countries, Energy Statistics and Balances of Non-OECD Countries (IEA)

5-2 Energy Situation in Malaysia

5-2-1 Socio-economic Conditions of Malaysia in Brief

(1) Natural Conditions

Malaysia is situated at a latitude between slightly less than 1 degree north and 7 degrees north, and longitude between 100 degrees east and 120 degrees east. It covers an area of about 329,733 square kilometers, consisting of Peninsular Malaysia and the states of Sabah and Sarawak and Wilayah Persekutuan Labuan in the north-western coastal area of Borneo Island. The two regions are separated by about 540 kilometers of the South China Sea. Peninsular Malaysia with an area of 131,573 square kilometers, has its frontiers with Thailand in the north and Singapore in the south. Both Sabah and Sarawak, covering 73,619 and 124,449 square kilometers, respectively, border the Kalimantan, which is Indonesian territory.

About four-fifths of Malaysia is covered with tropical rain forest. In Peninsular Malaysia a mountainous spine known as the Main Range runs from the Thai border southwards to Negeri Sembilan, separating the eastern part of the Peninsula from the western. A considerable part of the interior of Kelantan, Terengganu and Pahang is also mountainous area. In Sabah, the Crocker Range, which is the one of the most prominent mountain ranges there, separates the narrow low land of the north-western coast from the interior. The Crocker Range culminates in Gunung Kinabalu (4,101 meters), the highest mountain in Malaysia and Southeast Asia.

Malaysia lies entirely in the equatorial zone. The climate is governed by the regime of the northeast and southwest monsoons, which blow alternately during the course of the year. The northeast monsoon blows between mid-November and March, while the southwest monsoon blows from May till September. The period of change between the two monsoons is marked by heavy rain. The southwest monsoon period is a relatively dry period for the whole country, particularly for the other states of the western coast of the Peninsula, sheltered by the large mass of Sumatra.

Being in the tropics, the average temperature is constantly high (26°C) throughout the year. Regional variation in temperature and rainfall is mainly due to relief, e.g. Cameron Highlands has a mean temperature of 18°C and an annual rainfall of over 2,500 mm compared to Kuala Lumpur's 27°C and 2,410mm. Near the coasts, land and sea breezes modify the temperature, while being surrounded on virtually all sides by sea results in the Peninsula's rather equable climate. Mornings are generally fine and convectional rainfalls in the late afternoons are often accompanied by lightning and thunder. The humidity is high (about 80%) due to the high temperature and a high rate of evaporation, and the rainfall is heavy (more than 2,500 mm).

(2) Population

According to the Malaysia Government's population projections based on the 1991 Population Census, the mid-year population of Malaysia increased from 19.56 million in 1993, to 21.67

million in 1997, with an average annual increase rate of 2.6 percent, as shown on Table 5-8. Population was distributed into 13 states and two Wilayah Persekutuan, as shown on Table 5-8. Selangor had the largest population among states in Malaysia in 1997 and accounted for 13.8 percent of Malaysia's total population. The second largest state was Sabah in terms of population and Johor was third, whose populations accounted for 12.0 percent and 11.8 percent of all Malaysia, respectively. Population increased at a high rate in Sabah and Wilayah Persekutuan Labuan.

Table 5-8 Mid-year Population by State, Malaysia

Unit: Thousand

	1993		1997		Increase Rate
	Population	%	Population	%	% p.a.
Malaysia	**19,563.7**	**100.0**	**21,665.4**	**100.0**	**2.6**
Johor	2,309.9	11.8	2,554.1	11.8	2.5
Kedah	1,425.5	7.3	1,530.1	7.1	1.8
Kelantan	1,297.8	6.6	1,447.0	6.7	2.8
Melaka	555.4	2.8	582.0	2.7	1.2
Negeri Sembilan	754.8	3.9	810.5	3.7	1.8
Pahang	1,131.4	5.8	1,239.0	5.7	2.3
Perak	2,032.8	10.4	2,094.8	9.7	0.8
Perlis	199.5	1.0	217.4	1.0	2.2
Pulau Pinang	1,165.0	6.0	1,222.1	5.6	1.2
Sabah	2,048.8	10.5	2,593.4	12.0	6.1
Sarawak	1,801.0	9.2	1,954.3	9.0	2.1
Selangor	2,617.9	13.4	2,999.8	13.8	3.5
Terengganu	862.9	4.4	975.8	4.5	3.1
Wilayah Persekutuan Kuala Lumpur	1,301.0	6.7	1,374.7	6.3	1.4
Wilayah Persekutuan Labuan	60.0	0.3	70.4	0.3	4.1

Source: Social Statistics Bulletin, Malaysia, 1997

Note: Population projections based on the 1991 Population Census.

(3) Economic Conditions

Since 1993, the Malaysian economy has grown at a high growth rate of real GDP of over 8 percent. Particularly the manufacturing, construction, and transport, storage and communication sectors enjoyed high growth. The manufacturing sector's contribution to GDP grew year by year from 30 percent to 35 percent in the period between 1993 and 1997. However, recently Malaysia's economic status has deteriorates in the same way as other Asian countries, due to currency and financial crisis, which began with Thailand in July, 1997.

Table 5-9 shows the economic indicators of Malaysia between 1993 and 1997.

Table 5-9 Economic Indicators

Activity	1993	1994	1995	1996	1997
GDP at Current Price (Million RM)	165,206	190,294	218,703	249,610	280,888
GDP at 1978 Prices (Million RM)	100,617	109,915	120,309	130,227	140,639
1. Agriculture, livestock, forestry & fishing (Million RM)	16,205	16,047	16,230	16,616	16,955
2. Mining and quarrying (Million RM)	8,039	8,241	8,979	9,325	9,525
3. Manufacturing (Million RM)	30,324	34,782	39,825	44,664	49,577
4. Construction (Million RM)	4,023	4,589	5,385	6,085	6,879
5. Electricity, gas and water (Million RM)	2,176	2,474	2,797	3,119	3,479
6. Transport, storage and communication (Million RM)	6,921	7,776	8,855	10,006	11,311
7. Wholesale and retail trade, hotel & restaurant (Million RM)	12,428	13,427	14,781	16,111	17,536
8. Finance, insurance, real estate and business services (Million RM)	10,650	11,713	12,938	14,491	16,090
9. Government services (Million RM)	10,073	11,022	11,454	11,855	12,275
10. Other services (Million RM)	2,146	2,298	2,478	2,577	2,680
11. Less: Import bank service charges (Million RM)	6,411	7,381	8,503	9,966	11,360
12. Import duties (Million RM)	4,043	4,927	5,090	5,344	5,692
GDP Growth Rate		9.2%	9.5%	8.2%	8.0%
Population ('000)	19,564	20,112	20,689	21,169	21,666
Per Capita GDP at Current Price (RM)	8,444	9,462	10,571	11,791	12,964

Source: Yearbook of Statistics Malaysia 1997, Department of Statistics, Malaysia

5-2-2 Energy Situation in Malaysia

(1) Primary Energy Supply

1) Oil

Reserves

Table 5-10 Remaining Recoverable Reserves of Oil

(As of December 31, 1996)

Reserved Area	Billion Barrels
Peninsular Malaysia	2.7
Sarawak	0.7
Sabah	0.5
Total	3.9

Source: National Energy Balance Malaysia (1980-1996), Ministry of Energy, Telecommunication and Posts, Malaysia

Remaining recoverable reserves of oil totaled 3.9 billion barrels at the end of 1996 in Malaysia, as shown on Table 5-10, and the reserves/production ratio (R/P) was 16.6-year.

Upstream

Petroliam Nasional Berhad (PETRONAS), the national petroleum company of Malaysia, was incorporated in 1974 to undertake and regulate the development of the country's petroleum resources. PETRONAS has set up 41 wholly-owned subsidiaries and holds equity in 17 partly-owned subsidiaries and 26 associated companies, involved in the full spectrum of petroleum operations ranging from upstream exploration and production to downstream oil refining, gas processing, liquefaction and transmission, petrochemical manufacturing, marketing and transportation activities.

In the upstream sector, PETRONAS' efforts are concentrated on sustaining and enhancing Malaysia's reserves base. PETRONAS manages these activities by engaging a number of international oil and gas companies to participate in exploration, development and production of oil and gas in Malaysia through production sharing contracts (PSCs). The PSCs provide cost recovery for the PS Contractors and sharing of crude oil and natural gas production between PETRONAS and the PS Contractors. To date, PETRONAS has concluded 47 PSCs with 40 oil companies from 15 countries.

There are 33 oilfields in production at present. The average daily production volume of crude oil was 645,000 barrels in 1997. Since 1980, crude production volume has changed as shown on Table 5-11. During the period between 1980 and 1992, production volume increased and reached at 661,000 barrels per day in 1992. After 1993, it slightly decreased and stayed in the range between 640,000 and 650,000 barrels per day.

Table 5-11 Crude Oil Production

Unit: Thousand barrels per day

Year	1980	1989	1990	1991	1992	1993	1994	1995	1996	1997
Production	288.0	557.3	605.0	652.0	661.0	645.0	640.0	650.0	645.8	645.0

Source: International Petroleum Encyclopedia, 1998

Oil Refining

There are five oil refineries in production and their total capacity is 378,000 barrel per day. In addition, there is one refinery under construction with a capacity of 100,000 barrel per day in

Malaka, which will increase the country's refining capacity to 478,000 barrels per day.

Table 5-12 Oil Refinery Licensed Capacity

Company	Location	Capacity (Barrels Per Day)
Shell Refining Co. Berhad	Port Dickson	105,000
Sarawak Shell Berhad	Lutong	45,000
Esso Malaysia Berhad	Port Dickson	88,000
Petronas	Kertih	40,000
Petronas	Melaka	100,000
Sub-total		**378,000**
Under Construction:		
Petronas	Melaka	100,000
Total		**478,000**

Source: National Energy Balance Malaysia (1980-1996),

Ministry of Energy, Telecommunication and Posts, Malaysia

2) Natural Gas

Reserves

Malaysia's natural gas reserves totaled 79.8 trillion standard cubic feet at the end of 1996, as shown on Table 5-13, which was equivalent to about 3.6 times the remaining recoverable oil.

Table 5-13 Remaining Recoverable Reserves of Gas

(As of December 31, 1996)

Unit: Trillion Standard Cubic Feet

	Associated Gas	Non-associated Gas	Total
Peninsular Malaysia	8.9	29.3	38.2
Sarawak	3.0	32.6	35.6
Sabah	1.2	4.8	6.0
Total	13.1	66.7	79.80

Source: National Energy Balance Malaysia (1980-1996),

Ministry of Energy, Telecommunication and Posts, Malaysia

Upstream

In the upstream sector of gas, PETRONAS manages exploration, development and production by PSCs in the same way as the upstream sector of oil. Natural gas production volume has increased considerably from 746 billion cubic feet to 1.3 trillion cubic feet since 1990, as shown on Table 5-14.

Table 5-14 Natural Gas Production

Unit: Billion Cubic Feet

Year	1990	1991	1992	1993	1994	1995	1996	1997
Production	746.0	746.9	796.3	880.4	922.7	1019.9	1295.3	1300.0

Source: International Petroleum Encyclopedia, 1998

Natural Gas Utilization

PETRONAS has embarked on various global scale gas and petrochemical projects for the purpose of adding value to national abundant gas resources. Gas development and utilization projects have been implemented in Sarawak, Sabah and Peninsular Malaysia. Natural gas is very versatile and can be used in a wide range of applications from fuel for electricity generation, industries and households to feedstock for the petrochemical and fertilizer industries. In its liquefied state, it has become an important export commodity.

LNG

Natural gas from Central Luconia Province offshore Sarawak is processed and exported as Liquefied Natural Gas (LNG). Malaysia LNG Sdn. Bhd., a joint venture involving PETRONAS, Shell Gas, Mitsubishi Corporation and the Sarawak State Government, owns and operates the LNG plant in Bintulu. Its current output of 8.1 million tons per annum of LNG is exported to Japan. Under an expansion project, referred to as the LNG-2 projects, three additional trains have been constructed adjacent to the existing plant. The LNG-2 plant was fully operational in early 1996, doubling the Bintulu LNG complex's production capacity to 16 million tons per annum. A third LNG plant will be constructed and is scheduled to be completed by 2001, which will increase the country's LNG production capacity to 23 million tons per annum.

PGU Project

On the Peninsular Malaysia, the Peninsular Gas Utilization (PGU) project was instrumental in launching the country into the gas era. Started in 1984, the PGU project comprises a trans-peninsula gas transmission pipeline system linked to PETRONAS' gas processing plants (GPPs) and related facilities, which derives its feed gas from the gas fields offshore Terengganu.

At its completion by the end of 1990's, the project, which is being implemented in three stages, will have a gas processing capacity of up to 2 billion standard cubic feet per day. Stage 1 was completed in 1984. It comprises a GPP with a capacity of 250 million standard cubic feet per day (mmscfd), an export terminal, a 32km main pipeline and a gas reticulation system for Kertih township. The main pipeline runs from the GPP to the export terminal, power and industrial end-users in the east coast of Peninsular Malaysia. Stage 2, completed in 1992, comprises three additional GPPs with a processing capacity of 250 mmscfd each, a 680km trans-peninsular main pipeline and related facilities. The trans-peninsular main pipeline connects the western and southern parts of Peninsular Malaysia and Singapore. Stage 3, to be completed by 1998, involves the extension of pipeline northwards along the west coast of Peninsular Malaysia to the Thai border, with the construction of a 450 km main pipeline, two new GPPs which will have a processing capacity of 500 mmscfd each, and related facilities.

Petrochemical

The implementation of the PGU project has opened up gas-based petrochemical manufacturing as a new business area for PETRONAS. PETRONAS entered into joint ventures with several multinational corporations to undertake an ethylene/polyethylene integrated project in Kertih, Terengganu. The production capacity of the ethylene plant is 320,000 tons per annum and that of the polyethylene plant is 200,000 tons per annum. PETRONAS also owns and operates a methyl tertiary butyl ether (MTBE)/propylene plant in Kuantan, Pahang, which has a capacity of 300,000 tons per annum of MTBE and 80,000 tons per annum of propylene. It is also a major partner in a joint venture polypropylene plant, which has a production capacity of 80,000 tons per annum and is located adjacent to the MTBE/propylene plant.

In association with its ASEAN counterparts, PETRONAS established the ASEAN Bintulu Fertilizer (ABF) complex in Sarawak. The complex has the capacity to produce 470,000 tons per annum of ammonia and 660,000 tons per annum of granulated urea. PETRONAS is setting up a second fertilizer plant in Kedah, which produces 375,000 tons per annum of ammonia, 67,000 tons per annum of methanol and 5,700 tons per annum formaldehyde.

Other petrochemical projects being implemented by PETRONAS include a 200,000 ton-per-annum ethylbenzen and styrene monomer plant in Pasir Gudang, Johor, and a 660,000 ton-per-annum methanol plant in Labuan.

3) Coal

The country's coal reserves totaled about 970 million tons at the end of 1996, as shown in Table 5-15. Sarawak had 720 million tons of reserves accounting for 74 percent of the country's total, and Sabah's reserves accounted for 24 percent. Peninsular Malaysia had only small reserves.

Table 5-15 Coal Reserves

(As of December 31, 1996)

Unit: Million tonnes

	Measured	Indicated	Inferred	Total
Peninsular Malaysia	-	-	17.00	17.00
Sarawak	200.98	129.09	388.74	718.81
Sabah	4.80	1.50	231.70	238.00
Total	205.78	130.59	637.44	973.81

Source: National Energy Balance Malaysia (1980-1996),
Ministry of Energy, Telecommunication and Posts, Malaysia

In the year 1996, 243,000 tons of coal, corresponding to about 170,000 TOE, was produced in the country. For coal and coke supply, Malaysia depends heavily on importation. Its consumption of coal and coke was 1,677,000 TOE in 1996, of which about 1,540,000 TOE, over 90 percent of total consumption, was covered by imported coal and coke. Coal and coke consumption for electricity generation accounted for 57 percent of total consumption and that for industry accounted for 43 percent.

4) Hydropower

With an annual rainfall averaging 2,500 mm and favorable topographical conditions, Malaysia is well endowed with hydropower resources and is considered to have a technical potential (i.e. before consideration of economic, ecological and environmental factors) of about 123,000 gigawatt-hours (GWh) per year, as shown on Table 5-16. However, the locations of hydropower resources do not parallel with those of population and electricity demand centers.

Table 5-16 Hydroelectric Power Potential

(As of December 31, 1996)

	Capacity (MW)	Energy Output (GWh)
Peninsular Malaysia	4,000	16,000
Sarawak	20,000	87,000
Sabah	5,000	20,000
Total	29,000	123,000

Source: National Energy Balance Malaysia (1980-1996),
Ministry of Energy, Telecommunication and Posts, Malaysia

Hydroelectric power generated in Malaysia in 1996 totaled 5,150 GWh, which is about 4 percent of its technical potential, as shown on Table 5-17. Hydroelectric power generation accounted for 25 percent of total electricity generation in Sarawak, 23.8 percent in Sabah, 12.9 percent in Peninsular Malaysia, and 14.3 percent in the whole country.

Table 5-17 Hydroelectric Power Generation in 1996

	Hydroelectric Generation (GWh)	Share of Hydroelectric (%)	Total Generation
Peninsular Malaysia	4,130	12.9	31,959
Sarawak	570	25.0	2,276
Sabah	450	23.8	1,891
Total	5,150	14.3	36,126

Source: Statistics of Electricity Supply Industry in Malaysia, 1997 edition

Department of Electricity and Gas Supply, Malaysia

5) Electricity

The Central Electricity Board (CEB) was established in 1949 to undertake generation, transmission and distribution of electricity in most parts of the then Malaysia (the present Peninsular Malaysia). When Malaysia was formed in 1963 with the inclusion of Sabah and Sarawak on Borneo Island, the Sabah Electricity Board (SEB) was established for electricity supply in the State of Sabah and Sarawak Electricity Supply Corporation (SESCO) was established for the same purpose in the State of Sarawak. CEB was renamed as the National Electricity Board (NEB) in 1965. In 1990, NEB was corporatized as Tenaga Nasional Berhad (TNB), bringing the electricity supply industry in the country into the privatization era. Besides the above three main utilities, 15 independent power producers (IPP) licenses have been issued until the end of 1996 as a result of privatization.

Electricity generation capacities of the three major utilities were: 7,621 MW for TNB, 707 MW for SEB and 593 MW for SESCO in 1996, IPP having a total generation capacity of 3,121 MW. The major three utilities' electricity generations are shown in Table 5-18 by type of energy. In the case of TNB, the major energy source for electricity generation was gas, which covered over 40 percent of electricity generation, and the second energy source was oil. SEB's electricity was generated mainly from diesel, gas and hydropower. Gas covered nearly 60 percent of electricity generation for SESCO.

Table 5-18 Generation Mix of Major Three Electricity Supply Companies in 1996

Unit: GWh

Source of Fuel	TNB		SEB		SESCO	
	Capacity, GWh	Share %	Capacity, GWh	Share %	Capacity, GWh	Share %
Hydro	4,130	12.9	450	23.8	570	25.0
Gas	13,917	43.6	506	26.7	1,268	55.7
Coal	4,177	13.1	-	-	-	-
Oil	9,086	28.4	-	-	249	11.0
Distillate	324	1.0	-	-	-	-
Diesel	325	1.0	746	39.5	189	8.3
Others	-	-	189	10.0	-	-
Total	31,959	100.0	1,891	100.0	2,276	100.0

Source: Statistics of Electricity Supply Industry in Malaysia, 1997 edition

Department of Electricity and Gas Supply Malaysia

TNB's transmission system lines had a total length of 12,000 km long in 1996, consisting of three different voltage levels, i.e. 275 kV, 132 kV and 66 kV. Voltage levels of transmission lines for SEB were 132 kV and 66 kV, and those for SESCO were 275 kV and 132 kV. The total length of SEB and SESCO transmission lines was about 600 km each in 1996.

6) Commercial Energy Supply by Source

Figure 5-3 shows the commercial energy supply by source during the period from 1980 to 1996. In term of natural gas supply, a deduction has been made for the quantity of gas flared, re-injected into gas fields and used for production purposes as well as use for LNG production. In 1996, commercial energy supply increased up to 35.6 million TOE, that is four times as much as the supply in 1980, 9.4 million TOE.

Crude oil continued to be the largest supply source and the amount of natural gas supply increased rapidly. Dependence on crude oil and petroleum products continued to decline, except for the period from 1995 to 1996, as shown in Table 5-19. The share of crude oil and petroleum products in the total supply decreased from 87.8 percent in 1980 to 57.2 percent in 1996, while that of natural gas increased from 7.4 percent to 34.6 percent during the same period. This change indicates the success of the four-fuel diversification policy.

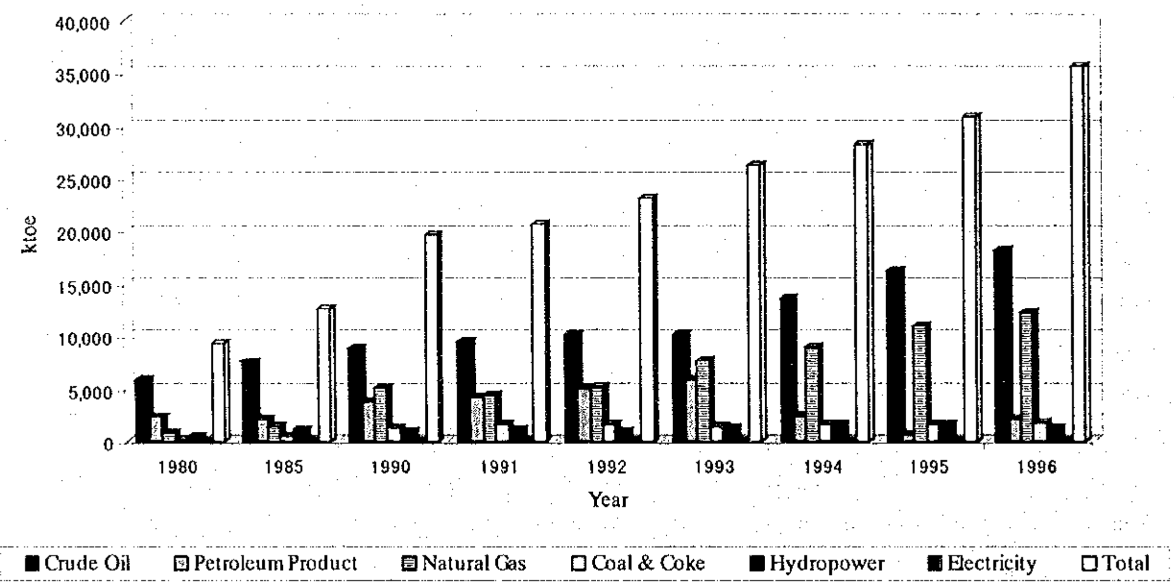


Figure 5-3 Commercial Energy Supply by Source

Table 5-19 Commercial Energy Supply by Source

	1980		1985		1990		1995		1996	
	kTOE	%	kTOE	%	kTOE	%	kTOE	%	kTOE	%
Crude Oil	5,901	63.0	7,579	60.2	8,783	44.7	16,159	52.3	18,255	51.3
Petroleum Product	2,323	24.8	2,131	16.9	3,651	18.6	610	2.0	2,099	5.9
Natural Gas	697	7.4	1,487	11.8	4,991	25.4	10,974	35.5	12,289	34.6
Coal & Coke	53	0.6	362	2.9	1,326	6.7	1,612	5.2	1,677	4.7
Hydropower	383	4.1	1,019	8.1	915	4.7	1,540	5.0	1,243	3.5
Electricity	7	0.1	5	0.0	-5	0.0	-2	0.0	-1	0.0
Total	9,364	100.0	12,583	100.0	19,661	100.0	30,893	100.0	35,562	100.0

(2) Energy Demand

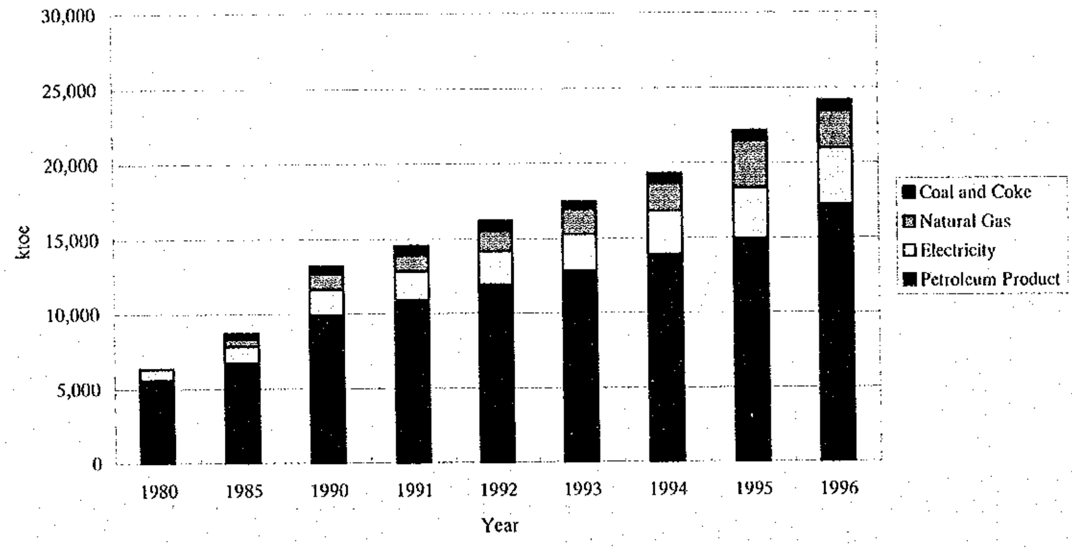
During the period from 1990 to 1996, the final consumption of commercial energy in Malaysia grew rapidly from 13.2 million TOE to 24.4 million TOE at an average annual rate of 10.6 percent, as shown in Table 5-20. This average annual growth rate is higher than that of GDP for the same period, i.e. 8.7 percent. Electricity consumption grew at a higher annual growth rate of 14.1 percent during the period. Consequently, energy intensity per GDP increased during the period at an average annual rate of 1.8 percent for final consumption of commercial energy and 5.0 percent for electricity consumption.

Table 5-20 Selected Economic and Energy Indicators (1990-1996)

	1990	1991	1992	1993	1994	1995	1996	Growth
GDP (Million RM 1978)	79	86	93	101	110	120	131	8.7%
Population (Million)	18	19	19	20	20	21	21	3.0%
Primary Energy (Mill. TOE)	20	21	23	26	28	31	36	10.4%
Final Energy (Mill. TOE)	13	15	16	17	19	22	24	10.6%
Electricity (Mill. TOE)	2	2	2	2	3	3	4	14.1%
Electricity (TWh)	20	22	26	28	34	39	44	14.1%
Average Annual Growth Rate (%)								
GDP		8.6%	7.8%	8.3%	9.2%	9.5%	8.6%	8.7%
Primary Energy		4.8%	11.9%	14.0%	7.4%	9.4%	15.3%	10.5%
Final Energy		10.2%	11.2%	7.9%	10.4%	14.9%	9.0%	10.6%
Electricity		12.2%	15.2%	10.5%	19.7%	15.1%	11.9%	14.1%
Per Capita								
GDP (RM 1978)	4,468	4,645	4,877	5,143	5,465	5,815	6,171	5.5%
Primary Energy (kTOE)	1,107	1,111	1,211	1,344	1,404	1,493	1,682	7.2%
Final Energy (kTOE)	744	785	850	893	959	1,071	1,142	7.4%
Electricity (kWh)	1,123	1,206	1,354	1,455	1,694	1,896	2,074	10.8%
Energy Intensity								
Primary Energy (TOE/1978 Mill. RM)	248	239	248	261	257	257	273	1.6%
Final Energy (TOE/1978 Mill. RM)	167	169	174	174	175	184	185	1.8%
Electricity (TOE/1978 Mill. RM)	22	22	24	24	27	28	29	5.0%
Electricity (MWh/1978 Mill. RM)	251	260	278	283	310	326	336	5.0%

Source: National Energy Balance Malaysia (1980-1996), Ministry of Energy, Telecommunications and Posts, Malaysia

In terms of energy mix, petroleum products made up the largest proportion of energy for final energy use throughout the period between 1980 and 1996, as shown in Figure 5-4. However, the share of petroleum products in total energy use decreased, while that of electricity and natural gas increased. Changes in the share of the four kinds of energy is shown in Table 5-21. The share of petroleum products decreased from 86.9 percent to 71.1 percent during the period. In the same period, the share of electricity increased from 11.7 percent to 15.6 percent, and that of natural gas increased as well from 0.5 percent to 10.2 percent. The changes are considered to be a result of the successful implementation of the four-fuel diversification policy.



Source: Study Team from National Energy Balance Malaysia (1980-1996), Ministry of Energy, Telecommunication and Posts, Malaysia

Figure 5-4 Final Energy Use by Type of Energy

Table 5-21 Final Energy Use by Type of Energy, 1980-1996

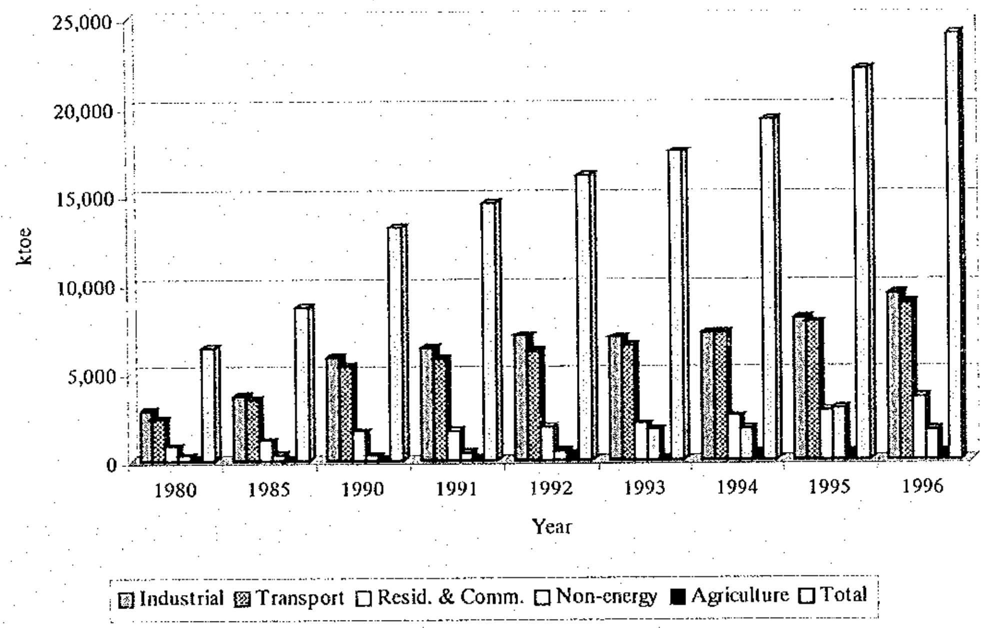
	1980		1985		1990		1995		1996	
	kTOE	%	kTOE	%	kTOE	%	kTOE	%	kTOE	%
Petroleum Product	5,550	86.9	6,756	77.5	9,896	74.9	14,930	67.4	17,189	71.1
Electricity	747	11.7	1,079	12.4	1,715	13.0	3,375	15.2	3,777	15.6
Natural Gas	35	0.5	515	5.9	1,093	8.3	3,147	14.2	2,474	10.2
Coal and Coke	53	0.8	362	4.2	513	3.9	712	3.2	727	3.0
Total	6,385	100.0	8,712	100.0	13,217	100.0	22,164	100.0	24,167	100.0
Growth Rate			6.4%		8.7%		10.9%		9.0%	

Source: National Energy Balance Malaysia (1980-1996), Ministry of Energy, Telecommunications and Posts, Malaysia

For the final energy use by sector, the industrial sector, which includes manufacturing, mining and construction, continued to be the largest energy-consuming sector, followed by the transport sector, as shown in Figure 5-5. Excepting those two sectors, energy use in the residential and commercial sector increased rapidly at an average annual rate of 13.7 percent from 1980 to 1996, and that in non-energy use[2] increased more rapidly at 34.2 percent. The industrial, transport,

[2]Use of products resulting from a transformation process (i.e. bitumen, lubricants, greases) for non-energy purposes or use of energy products (such as natural gas) as industrial feedstock

residential and commercial, non-energy and agriculture[3] sectors accounted for 39 percent, 37 percent, 15 percent, 7 percent and 2 percent, respectively in 1996, as shown in Table 5-22.



Source: Study Team from National Energy Balance Malaysia (1980-1996)

Ministry of Energy, Telecommunication and Posts, Malaysia

Figure 5-5 Final Energy Use by Sector

Table 5-22 Final Energy Use by Sector, 1980-1996

Sector	1980		1985		1990		1995		1996		Growth
	kTOE	%	KTOE	%	kTOE	%	kTOE	%	kTOE	%	90/96
Industrial	2,870	45%	3,726	43%	5,885	45%	8,060	36%	9,443	39%	8.2%
Transport	2,398	38%	3,477	40%	5,387	41%	7,827	35%	8,951	37%	8.8%
Resid. & Comm.	826	13%	1,123	13%	1,646	12%	2,837	13%	3,557	15%	13.7%
Non-energy	291	5%	386	4%	299	2%	2,994	14%	1,744	7%	34.2%
Agriculture	0	0%	0	0%	0	0%	446	2%	472	2%	
Total	6,385	100%	8,712	100%	13,217	100%	22,164	100%	24,167	100%	10.6%

Source: National Energy Balance Malaysia (1980-1996), Ministry of Energy, Telecommunication and Posts, Malaysia

There are some differences between the share of final energy uses in Table 5-22 obtained from

[3] This sector covers agriculture, forestry and fishing.

data of Ministry of Energy, Telecommunication and Posts, Malaysia (METP), and those shown in Table 5-7, obtained from IEA data. Differences are particularly large for shares of industry and non-energy uses in 1995. These differences are caused by the different categories of natural gas used as petrochemical raw material. It was categorized as part of the industrial sector by IEA, but as part of non-energy use by METP. The volume of natural gas used in 1995 for petrochemical feedstock was about 1,008,000 TOE, which accounted for about 5 percent of total final energy use in Malaysia. From this volume of natural gas for petrochemical feedstock, it is obvious that the difference of the industry's share between 41 percent obtained from IEA data, and 36 percent obtained from METP data, was caused by natural gas for petrochemical feedstock. There is not a large difference in the industry's shares in 1985 by the two data sources, since the gas-based petrochemical industry had not yet started in Malaysia in that year.

(3) Energy Prices

Table 5-23 shows the TNB tariff rate that has been effective since May 1 1997.

Table 5-23 Tenaga Nasional Berhad Tariff Rate (Effective since May 1 1997)

	Tariff Category	Unit	Rate
1.	**Tariff A- Domestic Tariff**		
	For the first 200 units per month	Sen/kWh	21.8
	For the next 800 units per month	Sen/kWh	25.8
	For each additional units per month	Sen/kWh	27.8
2.	**Tariff B- Low Voltage Commercial Tariff**		
	For all units	Sen/kWh	28.8
3.	**Tariff C1-Medium Voltage General Commercial Tariff**		
	For each kilowatt of maximum demand charge per month	RM/kW	17.30
	For all units	Sen/kWh	20.8
4.	**Tariff C2-Medium Voltage Peak/Off-Peak Commercial Tariff**		
	For each kilowatt of maximum demand per month during the Peak Period	RM/kW	25.70
	For all unit during the Peak Period	Sen/kWh	20.8
	For all units during the Off-Peak Period	Sen/kWh	12.8
5.	**Tariff D-Low Voltage Industrial Tariff**		
	For all units	Sen/kWh	25.8
	Special for customers who qualify		
	For all units	Sen/kWh	23.8
6.	**Tariff E1-Medium Voltage General Industrial Tariff**		
	For each kilowatt of maximum demand per month	RM/kW	17.30
	For all units	Sen/kWh	19.8
	Special for customers who qualify		
	For each kilowatt of maximum demand per month	RM/kW	13.20
	For all units	Sen/kWh	18.8

	Tariff Category	Unit	Rate
7.	**Tariff E2-Medium Voltage Peak/Off-Peak Industrial Tariff**		
	For each kilowatt of maximum demand per month during the Peak Period	RM/kW	21.70
	For all units during the Peak Period	Sen/kWh	20.8
	For all units during the Off-Peak Period	Sen/kWh	12.8
	Special for customers who qualify		
	For each kilowatt of maximum demand per month during the Peak Period	RM/kWh	18.40
	For all units during the Peak Period	Sen/kWh	18.8
	For all units during the Off-Peak Period	Sen/kWh	10.8
8.	**Tariff E3-High Voltage Peak/Off-Peak Industrial Tariff**		
	For each kilowatt of maximum demand per month during the Peak Period	RM/kW	20.80
	For all units during the Peak Period	Sen/kWh	19.8
	For all units during the Off-Peak Period	Sen/kWh	11.8
	Special for customers who qualify		
	For each kilowatt of maximum demand per month during the Peak Period	RM/kW	16.20
	For all units during the Peak Period	Sen/kWh	17.8
	For all units during the Off-Peak Period	Sen/kWh	9.8
9.	**Tariff-Low Voltage Mining Tariff**		
	For all units	Sen/kWh	21.8
10.	**Tariff F1-Medium Voltage General Mining Tariff**		
	For each kilowatt of maximum demand per month	RM/kW	12.00
	For all units	Sen/kWh	17.8
11.	**Tariff F2-Medium Voltage Peak/Off-Peak Mining Tariff**		
	For each kilowatt of maximum demand per month during the Peak Period	RM/kW	17.00
	For all units during the Peak Period	Sen/kWh	17.8
	For all units during the Off-peak Period	Sen/kWh	9.8
12.	**Tariff G-Public & Street Lighting Tariff**		
	For all units (including maintenance)	Sen/kWh	17.3
	For all units (excluding maintenance)	Sen/kWh	10.8
13.	**Tariff G1-Neon Light & Floodlight Tariff**		
	For all units	Sen/kWh	11.8

Notes:

1) Supply voltage : "Low Voltage" below 6,600 volts; "Medium Voltage" from 6,600 volts to 66,000 volts; "High Voltage" 132,000 volts and above
2) "Kilowatt of maximum demand" for any month shall be deemed to be twice the largest number of kilowatt-hours supplied during any consecutive thirty minutes in that month.
3) "Unit" means one kilowatt-hour.
4) "Peak" period means the period between 0800 hours and 2200 hours. "Off-peak" period means the period between 2200 hours and 0800 hours.

Electricity prices of Malaysia's three utilities are compared with those of foreign countries in Table 5-24. The electricity tariff of various countries may consist of a portion linked with the quantities delivered, portions dependent on diurnal patterns of use, power factor, etc., as well as a fixed charge component. Therefore, it is not practical to obtain an average unit price from the tariff systems. It has been obtained by the IEA either from utilities as the average revenue per unit delivered or from users as the average expenditure per unit purchased. In this report, average unit prices were obtained for Malaysia's three utilities by dividing their electricity sales revenue by their total units sold.

Among Malaysia's three utilities, TNB sold electricity to users at the lowest price and SESCO did so at the highest price. It is difficult to compare Malaysia's prices with foreign prices, because separate values for industry and household cannot be obtained for Malaysia. However, it is clear that electricity was been delivered to users at much lower prices in Malaysia than in Japan.

Table 5-24 Comparison of Electricity Prices

Unit: US cent/kWh

	1993	1994	1995	1996
Electricity Prices for All Users in Malaysia				
TNB	7.3	7.1	7.9	8.3
SEB	9.0	10.1	10.2	9.8
SESCO	8.1	10.8	11.2	11.6
Electricity Prices for Industry				
Japan	16.3	17.2	18.5	15.7
Germany	8.9	8.9	10	8.6
France	5.5	5.3	6	5.7
United States	4.9	4.7	4.7	4.6
United Kingdom	6.8	6.7	6.8	6.5
Electricity Prices for Households				
Japan	23.0	25.0	26.9	23.0
Germany	16.9	17.8	20.3	18.0
France	14.6	15	16.7	16.4
United States	8.3	8.4	8.4	8.4
United Kingdom	11.6	12.2	12.7	12.5

Source: Based on Statistics of Electricity Supply Industry in Malaysia, 1997 edition, Department of Electricity & Gas Supply Malaysia; IEA Statistics Energy Prices and Taxes, Second Quarter 1997

Chapter 6 Policy and Plans for Promotion of Energy Efficiency

In this chapter, the policy and plans for the promotion of energy efficiency considering commercial and industrial sectors are studied.

6-1 Policy and Institution for Promotion of Energy Efficiency

6-1-1 Malaysia's Energy Policy

Malaysia's energy policies have evolved over the years since the early 1970s after the 1973 world oil crisis. Subsequent to the passing of the Petroleum Development Act (PDA), the National Petroleum Policy was formulated in 1975. The policy aims at regulating the oil and gas industry to fulfill the country's economic development needs.

(1) National Energy Policy Objectives

In 1979, energy policy principles were broadly defined in terms of three policy objectives. These policy objectives were instrumental in guiding the formulation of five-year development plans. These are:

1. The Supply Objective: To ensure the provision of adequate, secure and cost-effective energy supply through developing indigenous energy resources, both non-renewable and renewable energy sources using minimum-cost options, and diversification of supply sources both from within and outside the country;
2. The Utilization Objective: To promote the efficient utilization of energy and the elimination of wasteful and non-productive patterns of energy consumption; and
3. The Environment Objective: To minimize the negative impacts of energy production, transportation, conversion, utilization and consumption on the environment.

(2) Four-Fuel Strategy

In 1981, the Government adopted the four-fuel strategy, complementing the national depletion policy, aimed at ensuring reliable and steady supply. This strategy was, effectively, designed to reduce the country's over-dependence on oil as an energy source. The strategy aims for a supply mix of oil, natural gas, hydropower and coal in energy use. As much as possible, local resources of these fuels will be used to enhance steady supply. Though diversification away from oil has been significant, at best it has only moved towards natural gas. However, when viewed in terms of the supply policy objective of developing indigenous energy resources, as well as the environmental objective, the gas option has been the most logical and obvious way to move forward.

(3) Energy Efficiency Regulation

The Energy Efficiency Regulation is currently being formulated and will be focusing on the designation of large consumers, appointment of energy managers and equipment labeling.

The Government is conscious of the need to work with the industry to promote energy efficiency measures in order to reduce inefficient and wasteful use of energy in industrial facilities. To this end, a number of industrial energy efficiency initiatives are being planned and these include an energy auditing program, an energy service companies support program and a technology demonstration program.

6-1-2 Organization of Public Energy Sector

Organization of the public energy sector is illustrated in Figure 6-1. Among them, the Economic Panning Unit (EPU), Ministry of Energy, Telecommunications and Posts (MECM) and the Department of Electricity and Gas Supply (JBE&G), which are the bodies closely related to the policy for the promotion of energy efficiency, are explained in this section. In addition, the Malaysian Energy Center (PTM) was established in 1998 and is studied in Section 6-2-2.

(1) Economic Planning Unit (EPU)

The Economic Planning Unit of the Prime Minister's Department is the central planning agency of the Government, responsible for formulating policies and strategies for medium-and long-term economic development.

The EPU consists of three divisions, namely:

1. The Macro Planning Division
2. The Sectorial Planning Division
3. The Macroeconomic and Evaluation Division

The major functions of EPU are as follows:

1. Formulate policies and strategies for socio-economic development.
2. Prepare medium and long-term plans.

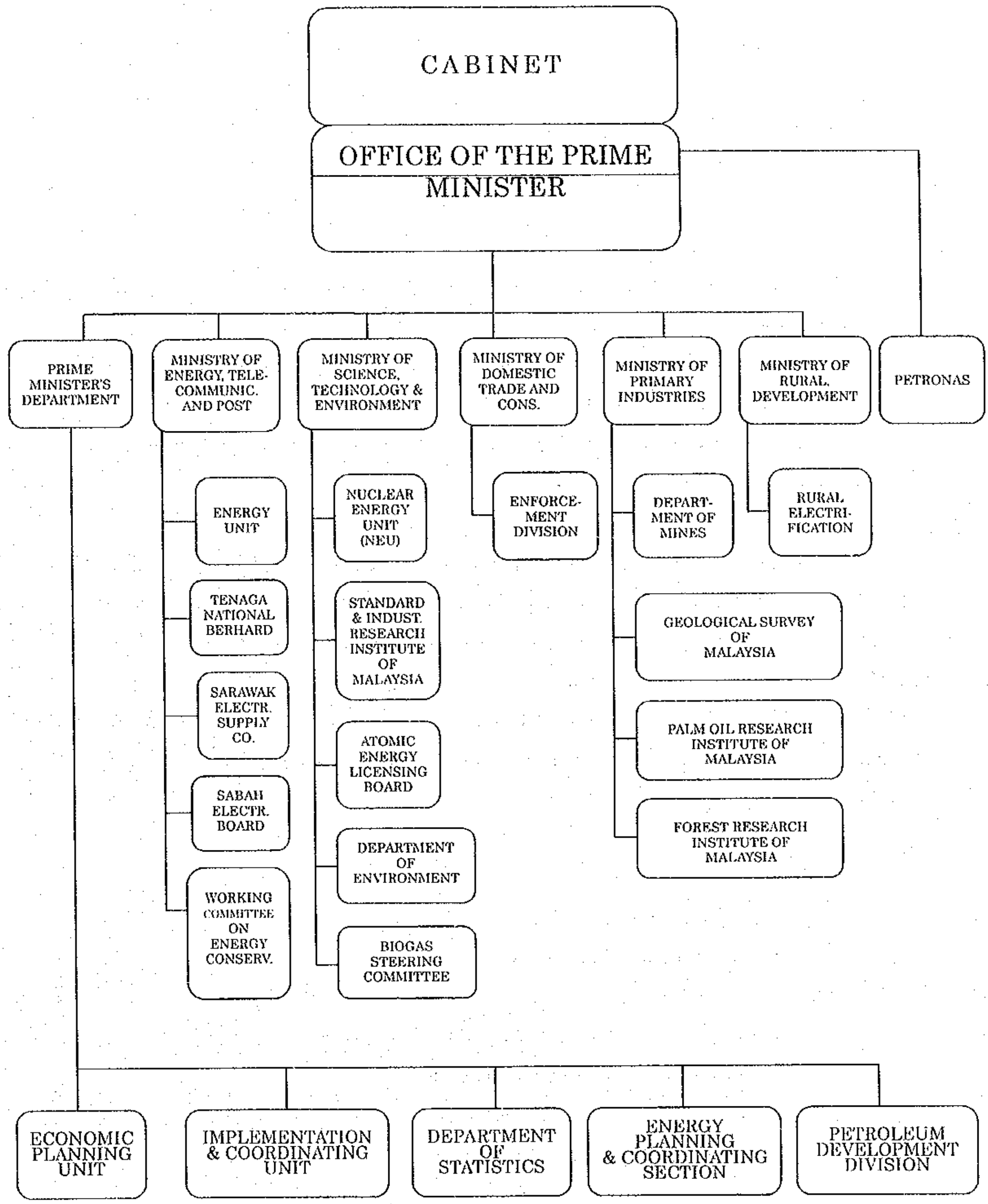


Figure 6-1 Organization of the Public Energy Sector

3. Prepare development programmes and projects budget.
4. Monitor and evaluate the achievement of development programmes and projects.
5. Advise Government on economic issues and initiate and undertake necessary economic research.
6. Plan and coordinate privatization programme and evaluate its achievement.
7. Monitor and evaluate investment activities

Energy Section of EPU:

The EPU has an energy section, one of 7 sections of the sectorial planning division. The section is responsible for:

1. Planning and formulating policies and strategies for the development of the energy sectors.
2. Ensuring the provision of adequate and high quality energy infrastructure facilities.
3. Providing allocation for the development of the programmes and projects and evaluate their achievements.

(2) The Ministry of Energy, Communications and Multimedia, Malaysia (MECM)

The objective of the Ministry is to expedite the attainment of the status of an industrialized country by promoting and regulating the growth of industries in the field of energy supply, telecommunications and postal services.

This Ministry was first established in 1978, with the Department of Telecoms, the Postal Services Department and the National Electricity Board placed under its supervision.

The Ministry is organized as follows:

1. Two divisions in the Ministry:
    - (a) the Administration and Finance Division
    - (b) the Planning and Policy Division
2. Three Regulatory Departments:
    - (a) the Department of Electricity and Gas Supply
    - (b) the Department of Telecommunications and
    - (c) the Postal Services Department
3. The Sabah Electricity Board, a statutory body.
4. Three Government-controlled private companies, namely:
    - (a) Tenaga Nasional Berhad
    - (b) Telekom Malaysia Berhad, and
    - (c) Pos Malaysia Berhad

(3) The Department of Electricity and Gas Supply (JBE&G)

The Department was established in 1990, under the Electricity Supply Act 1990. The objective of the department is to ensure the supply of electricity at reasonable prices; the licensing of electrical installation; and the control of electrical installation. The organization of JBE&G is summarized below.

1) JBE&G

The Department consists of following divisions:

1. Gas Regulation and Supply
2. Electricity Regulation
   (a) Licensing and Registration Unit
   (b) Enforcement and Regulation Unit
   (c) Tariff Control and Competition Unit
3. Electricity Inspectorate
   (a) Competency Examinations Unit
   (b) Standard and Safety Unit
4. Administration and Finance

2) Energy Efficiency Activities by JBE&G

1. Proposed Energy Efficiency Regulations

To ensure those activities for energy efficiency can be carried out more effectively, the Department of Electricity and Gas Supply has formulated the Energy Efficiency Regulation and submitted it to the Ministry of Energy, Telecommunications and Posts for approval.

2. Energy Efficiency Programmes and Activities Carried Out by the Department of Electricity and Gas Supply

The Government has allotted a sum of RM5 million to the Department of Electricity and Gas Supply to carry out an Energy Efficiency Programme under the Seventh Malaysia Plan. The first year of implementation of this programme was 1997.

In 1997, a number of activities were carried out by the Department, as follows:

(a) Seminars Conducted by the Department

Five energy efficiency seminars were organized by the Department. About 90 to 180 participants from all sectors, such as professionals, trade associations, non-government organizations, schoolteachers, etc., attended the seminars. In the seminars, topics such as the proposed Energy Efficiency Regulation, the need to carry out energy efficiency activities and various practical measures to implement them were presented and discussed.

(b) Workshops Jointly Organized by the Department and Other Agencies

In cooperation with the concerned organizations, seminars on 'Electrical Appliance Labeling' and 'Advances in Alternative and Renewable Energy' were organized.

(c) Exhibitions

The Department participated in various exhibitions where the concept of energy efficiency was promoted through posters, pamphlets, stickers, bookmarks, calendars, touch-screen computer information system and discussions with exhibition attendees.

(d) Energy Audits

The Department, jointly with the Japan External Trade Organization (JETRO), carried out energy audits of food industries in the country in 1996 and textile industries in the country in 1997. These energy audits were followed by seminars during which the findings of the audits were presented and discussed with industries and relevant government agencies.

(e) Material Prepared by the Department

Video clips on energy efficiency for the domestic, commercial and industrial sectors have been produced. This will be used for energy efficiency campaigns during seminars, exhibitions and through the mass media. Pamphlets on practical ways to implement energy efficiency have been prepared. In addition to this, posters, car stickers, book marks and calendars, with the aim of promoting energy efficiency activities, have been for distribution to the general public. A touch-screen computer information system was developed to provide information on energy efficiency activities and the proposed Energy Efficiency Regulation.

(f) Co-generation

Co-generation, an efficient form of energy conversion process, is being promoted by the Department. About 30 licenses have been issued or are being considered for major co-generation projects.

(4) Other Major Organizations Related to Public Energy Sector

Other major organizations related to the public energy sector are listed below.

1. Ministry of Science, Technology & Environment
2. Ministry of Domestic Trade and Construction

3. Ministry of Primary Industries
4. Ministry of Rural Development
5. PETRONAS

(5) Analysis (Effectiveness of the Malaysian Organizational Structure)

A study on energy efficiency in IEA member countries by the International Energy Agency concluded that: "In governments, there is a need for a strong central efficiency policy group headed by a senior official who forms part of the top management of the Energy Department or a related group; there should also be effective interdepartmental coordination of efficiency activities. Strong political leadership and bureaucratic commitment are, however, the key to the success of government efficiency activities."

The strong coordination organization based on mandate system is necessary to coordinate among government and private organizations to promote energy efficiency. It is advisable that a coordination board headed by EPU and participated in by MECM as a key member be created to coordinate the energy efficiency activities of government ministries and agencies, to undertake policy and various studies, to provide information net-work, to develop technology, to train engineers, to create awareness for the smooth promotion of energy efficiency. The coordination board must have authority over the actions taken in other ministries and institutions.

6-1-3 Policy and Institution

(1) Laws, Regulations and Systems for the Promotion of energy efficiency

1) Current situations

Today, no laws or regulations to promote energy efficiency are being enforced in Malaysia. To ensure those activities for energy efficiency can be carried out more effectively, JBE&G has formulated new energy efficiency regulations and submitted it to MECM for approval to include them in the Electricity Supply Act in 1997. This was mainly for electricity. Among the provisions of the regulations are:

- the need for a number of electrical appliances used in the domestic sector to meet certain standards of energy efficiency before they can be imported, advertised, exhibited or sold in the country. The preliminary list of such appliances includes:

Table 6-1 Preliminary List of Appliances to meet Standards

- ballasts for fluorescent lamps
- box fans, stand fans, table fans and wall fans with blade diameter not exceeding 41 cm
- ceiling fans with blade diameter not exceeding 115 cm
- refrigerators of total internal capacity not exceeding 750 litters
- Room air conditioners with total input power not exceeding 3 kW

- the need for certain types of electrical appliances to be labeled with regard to their energy efficiency. The preliminary list of such appliances included is shown in Table 6-2.

Table 6-2 Preliminary List of Appliances to be Labeled

- Ballasts for discharge lamps other than fluorescent lamps
- Washing machines of maximum load capacity not exceeding 7 kg
- Freezers of total capacity not exceeding 160 litters
- Lamps
- Step-down transformers for extra-low voltage halogen lamps
- Thermal storage water heaters of capacity not exceeding 150 litters
- Television sets
- Video monitors
- Vacuum cleaners with input power not exceeding 2 kW

- the need for installation, that consume more than a certain level of electrical energy to appoint a person to be responsible for energy efficiency activities in the installation, and to report these activities to the Director General of Electricity and Gas Supply. The installations will be those with an average monthly electricity consumption, taken over a period of twelve months, exceeding 360,000 kWh, or roughly those with a maximum demand of 1 MW.

2) Analysis

A law on which nationwide energy efficiency measures can be based is still needed in order to execute energy efficiency programs in an integrated manner. It is necessary for the government to express its commitment to energy efficiency, and to formulate a law on which its various measures are to be based.

As mentioned above, no energy efficiency promotion law is enforced yet in Malaysia, though a new draft of regulations has been prepared by JBE&G, and is expected to effect in 1999 or 2000. In order to ensure that the activities for energy efficiency can be carried out more effectively, early enforcement of the regulations is expected.

Regulations cover an energy managed entity system, appointment of energy efficiency officers, criteria of qualification of energy manager and several standards of electrical appliances. Regulations include reporting duties of record concerning the promotion of energy efficiency to JBE&G, but do not cover energy efficiency standards and guidelines for the promotion of energy efficiency measures for factories and buildings. Moreover, regulations involve penalties but without incentives. Regulations are mainly for electricity, hence it is expected to expand the scope of the regulations not mainly for electricity but also for fuels including preparation of standards for judgement for the promotion of energy efficiency. In addition, regulations for machinery such as electrical appliances, vehicle and office equipment will be needed for the further promotion of energy efficiency..

(a) For industrial sector

a) Energy managed entity system

For the promotion of energy efficiency, the urgent establishment of an energy-managed factory designation system is recommended. According to the draft of regulations prepared by JBE&G, entities that consume a large volume of energy, for example consuming 360,000 kWh per month or more, are designated as energy-managed entities and are urged to effectively carry out energy efficiency programs, and furthermore are held responsible for reporting their energy supply and consumption every year. This will help the designated factories to recognize their energy consumption; to analyze their energy consumption process-by-process; and to understand the causes of fluctuations in energy consumption. As a result, this will lead them to take effective measures to save energy. At the same time, MECM, JBE&G and PTM will be able to analyze the energy data thus made available to it, and to use these data in formulating its policy for the industrial sector. It is also expected to expand the scope of the regulations to energy in all forms.

b) Energy manager system

It is important to establish this system as soon as possible, and also important for a designated factory to have an energy manager and to enable these managers to play a key role in promoting energy efficiency. The energy manager is expected to fulfill the following roles as described in the regulations prepared by JBE&G.

1. To investigate potential improvements of efficient use of energy in the company and

to examine the causes of the inefficiencies;

2. To investigate complaints by the owner or management relating to the efficient use of equipment;
3. To carry out inspections in accordance to these regulations;
4 To represent the owner or management in consultations with JBE&G; and
5. To submit annual reports in matters relating to energy efficiency of the specified entity to JBE&G on or before 3lst. December of each year.

A system of designating energy-managed entities and energy managers will greatly contribute to nationwide energy efficiency measures especially for the industrial sector.

c) Qualification system of energy manager

An energy managed factory will be obligated to appoint an energy manager. Introduction of a state-approved qualification system for energy managers is needed in order to expedite deployment of necessary managers at every energy-managed entity.

- Energy Manager Certificate:

The Malaysian Government is advised to establish short-term courses to provide training on energy management subjects to the personnel to be assigned by the plants, and/or shall issue authorization to the training organizations to arrange these courses. The Governmental body that is responsible for the promotion of energy efficiency should study to issue certificates after the examinations at the end of the said courses. In order to expedite deployment of energy manager it would be advisable to introduce state approved qualification system for energy managers, such as giving certificates to graduates of technology courses, and engineers with years of promotion of energy efficient experience.

- Energy Efficiency Classes in Universities:

When an engineer who has received a semester of energy efficiency education during education at a university applies to JBE&G with the necessary documents, he/she may be issued with the certificate of energy manager.

d) Organizing energy managers

In order to maintain and improve the quality of energy managers, it is necessary to organize them, provide them with updated technical information on energy saving and train them in energy saving technology through a training course. Qualified energy managers shall be registered after energy managers are posted to entities at energy-managed entities. JBE&G

or PTM should undertake the task of improving their quality and regulating the qualified energy managers.

At an organizational level, it is possible to provide them with information obtained by energy audits and foreign information on energy saving, as well as to communicate government measures to them and to give specialized technical education. This group of energy managers also can perform as auditors or consultants.

e) Award for energy efficiency

To increase business interest in energy efficiency, awards should be given to individual engineers or groups of employees or entities, which have achieved excellent results in promoting energy efficiency. It is considered necessary for state organization to publicly commend entities that have achieved excellent results in energy efficiency and that have made constant efforts in energy management, as well as manufacturers who have developed highly effective energy efficiency equipment during the year. This system will lead to the boosted morale of people engaged in energy efficiency.

f) Standards and guidelines

Energy efficiency standards and guidelines, showing quantitative targets for the energy efficiency-improving measures, should be prepared. The standards may help entity staff to conduct energy efficiency measures and may help business operators to manage positive efforts for streamlining energy use at each entities, and in doing so, choose more effective solutions adapted to the given conditions.

With the assistance of the experts concerned, MECM and JBE&G are strongly expected to take the initiative preparing these standards such as:

1. Control to lower the air ratio and the excess oxygen content in exhaust gas for the purpose of fuel combustion control in furnaces.
2. Control to raise the waste heat recovery rate up to the standard value, for the purpose of effective recovery and utilization of waste heat in waste heat recovery equipment
3. Control to prevent the loss of heat that occurs as radiation, convection and conduction
4. Control to realize the effective operation control of combined heat and power generation and streamlining in the conversion of heat to power or the reverse
5. Control to prevent electricity loss due to resistance, etc. and to keep the power factor at an adequate level at the electricity-receiving end.

The study team recommends that these standards be reviewed every ten years to adjust to the changes in technology, energy situation and so on.

(b) For commercial sector

In addition to measures for the promotion of energy efficiency for the industrial sector described above, followings are for the commercial sector.

Such measures as the insulation of buildings are highly effective for the promotion of energy efficiency. Thus, the formulation of regulations is recommended and provides for the following rules for the promotion of energy efficiency in buildings.

a) Standards and Guidelines

In order to ensure appropriate and effective implementation, the ministry concerned shall stipulate and announce items to which building owners should refer as guidelines in making decisions concerning which specific measures to take.

b) Obligations of building owners

Any person who intends to construct a building must take appropriate measures for prevention of heat loss through external walls, windows, etc. and for efficient utilization of energy for building facilities such as air conditioners, ventilation systems, lighting, water heaters and elevators, keeping in mind the basic policies, in an effort to contribute to the efficient energy use in the building.

c) Guidance and advice

The ministry concerned may give insulation and other construction material manufacturers necessary guidance and advice for improving the insulation properties of their construction materials in order to ensure the improved quality of insulation materials, which constitute a basic element in improving the total insulation capability of buildings.

d) Instructions for specific buildings

Furthermore, if the concerned ministry deems that any building (not for dwelling) of 2,000 m2 or more in total floor area is notably lacking in the measures undertaken for rationalization of energy use in terms of the standards to be referred to, he/she can give necessary instructions to the building owner the matters concerning design and construction work, and if the building owner does not comply, the ministry makes announcement to that effect.

3) Japanese law for rational use of energy

The study team reviewed the legislative situations in Japan. In accordance with the recommendations posted in 1977 by the promotion of energy efficiency subcommittee of the Advisory Committee for Energy of Japan, the promotion of energy efficiency law was formulated mainly through the Ministry of International Trade and Industry (MITI). The law establishes a basic legal system for the promotion of energy efficiency measures in Japan. The law was enacted and became effective in 1979.

The promotion of energy efficiency law enacted in 1979 is the basis for current the promotion of energy efficiency policy. The aim of the law is to reduce the growth of energy demand through increasing energy efficiency without unfavorably influencing economic growth. The law authorizes MITI to develop voluntary standards for streamlining energy use in factories, to require large factories to develop energy management systems, to develop voluntary fuel efficiency standards for automobiles, and efficiency standards for certain appliances.

In recent years, a change in the law became necessary in the light of drastic changes in the economic and social surroundings pertaining to energy matter and growing concern over the impact of mass energy consumption on the environment. The law was partially revised in 1993 and 1998 so as to establish a stable and adequate energy supply-demand structure capable of responding to the above changes through an expansion of measures to save energy.

The study team reviewed the legislative situations in Japan due to the request from MECM, which are attached in the Appendix.

(2) Incentives

The legal and administrative incentives, which can be applied to promoting energy efficiency, are recommended. The most popular legal incentives are tax credits and tax exemptions. The administrative incentives are soft loan, etc.

1) Tax

Tax incentives are not available in Malaysia.

The major investment incentive measures are as follows:

1. Customs Duty Exemption
2. Investment Allowance
3. Tax Reduction, Duty Exemption

2) Loans

Soft loans for the promotion of energy efficiency are not available in Malaysia.

3) Analysis

To increase the effectiveness of incentives for the promotion of energy efficiency such as the tax reduction and exemption, and loan incentives, it would be useful to formulate an incentive package such as tax credits and exemption, and soft loans.

4) Japanese incentive system for the promotion of energy efficiency

For the reference by the request from MECM, the Japanese incentive system for the promotion of energy efficiency are summarized in the followings:

(a) Tax System for Promotion of Investment in Reformation of Energy Supply and Demand Structure

Where a business operator acquires equipment, which contributes to efficient energy use and applies it to his/her business within a year, he/she can choose either of the following:

a) Tax exemption equivalent to 7% of the equipment acquisition cost (which should be not more than 20% of the income tax or corporate tax payable.)

b) Special depreciation of 30% of the equipment acquisition cost in the year of acquisition, in addition to ordinary depreciation.

・ Energy efficiency equipment

Equipment for general industries:	97 units
Equipment for small and medium enterprises:	95 units

Recognized by the Minister of International Trade and Industry in discussion with the Minister of Finance.

(b) Certification System for Equipment which Promotes Reform of Energy Supply and Demand

The certification system for equipment which promotes reform of energy supply and demand is shown in Figure 6-2.

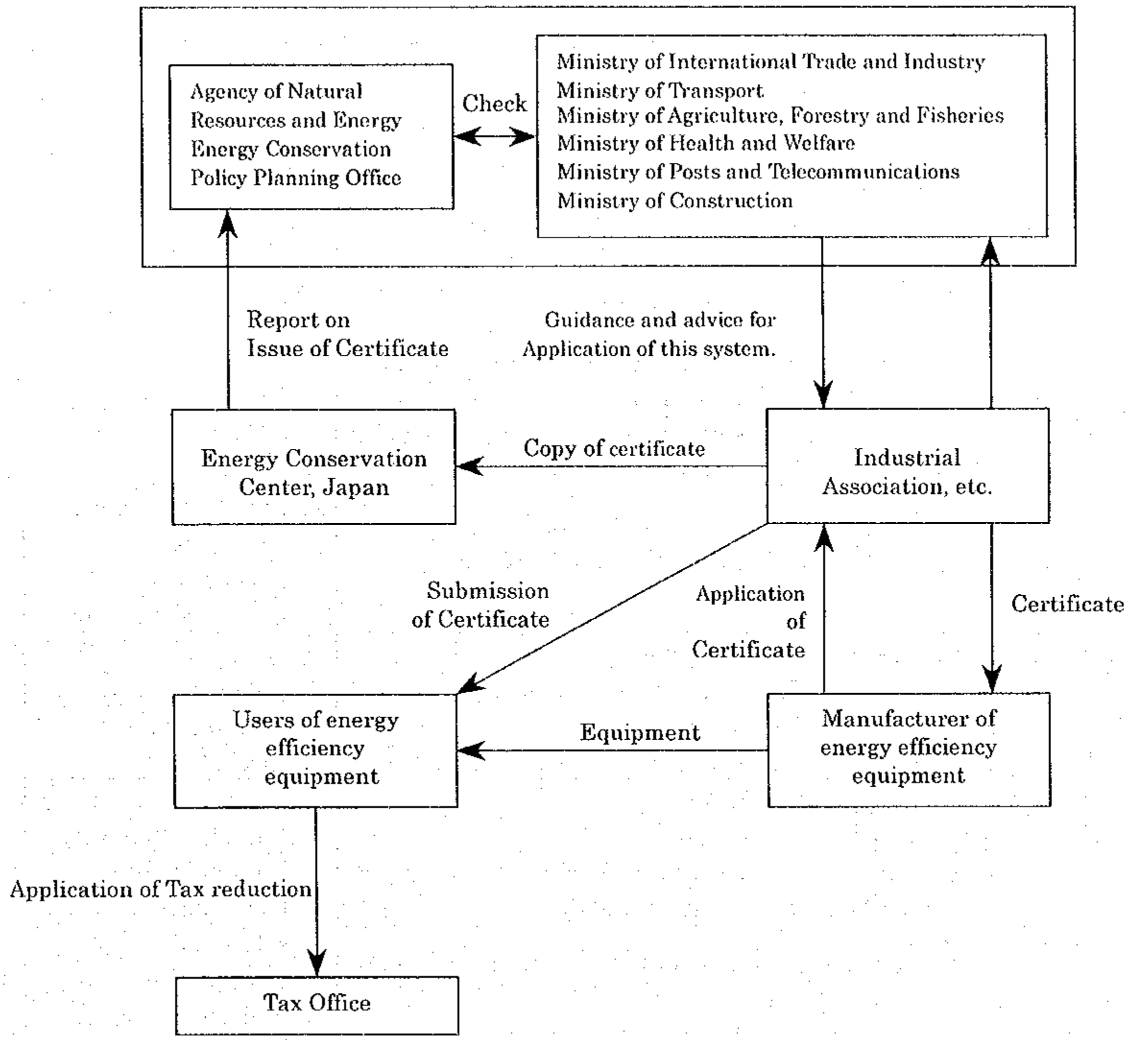


Figure 6-2 Certification System

(c) Financial Assistance for Rational Use of Energy

Financial assistance for rational use of energy in Japan is listed in Table 6-3. The interest rates of loans in the table are relatively low.

Table 6-3 Financial Assistance for Rational Use of Energy in Japan

	Loan Limit
Japan Development Bank Loans for efficient use energy Loans for promoting the introduction of equipment recognized for industry-level efficient energy utilization Loans for promoting the introduction of equipment recognized for business-level efficient energy utilization	Part of 113 billion yen appropriate for advanced energy use
Loans for regional environment-friendly energy facilities	Part of 800 billion yen appropriated for environment protective measures
Hokkaido-Tohoku Development Corporation Loans for promoting the introduction of equipment recognized for business-level efficient energy utilization Loans for regional environment-friendly energy facilities	Part of 69 billion yen appropriated specially
Smaller Business Finance Corporation Loan for promotion of efficient energy use Loans for promoting the introduction of equipment recognized for industry-level efficient energy utilization Loans for promoting the replacement of old type general purpose energy consuming equipment	Part of 200 billion yen appropriated for loans concerned with safety and environment protective measures
People's Finance Corporation Loans for promotion of efficient energy use Loans for promoting the introduction of equipment recognized for business-level efficient energy utilization Loans for promoting the replacement of old type general purpose energy consuming equipment	Part of 40 billion yen appropriated for loans concerned with safety and environment protective measures
Okinawa Development Finance Corporation Loans for promoting the introduction of equipment recognized for business-level efficient energy utilization Loans for promoting the introduction of equipment recognized for business-level efficient energy utilization Loans for promoting the replacement of old type general purpose energy consuming equipment	Part of 73.1 billion yen appropriated as industrial development fund

(3) Energy Pricing Policy

1) Pricing

The pricing mechanism for setting prices of major energy products such as petroleum products is that Government determines the prices. Electricity prices are submitted by TNB, reviewed by the minister of MECM and finally approved by the cabinet. The gas prices have been controlled by EPU. Coal prices are determined by importers. For the reference, the electricity prices in Malaysia, Japan European countries and the U.S. are summarized in Table 6-4.

Table 6-4 Comparison of Electricity Prices

Unit: US cent/kWh

	1993	1994	1995	1996
Electricity Prices for All Users in Malaysia				
TNB	7.3	7.1	7.9	8.3
SEB	9.0	10.1	10.2	9.8
SESCO	8.1	10.8	11.2	11.6
Electricity Prices for Industry				
Japan	16.3	17.2	18.5	15.7
Germany	8.9	8.9	10	8.6
France	5.5	5.3	6	5.7
United States	4.9	4.7	4.7	4.6
United Kingdom	6.8	6.7	6.8	6.5
Electricity Prices for Households				
Japan	23.0	25.0	26.9	23.0
Germany	16.9	17.8	20.3	18.0
France	14.6	15	16.7	16.4
United States	8.3	8.4	8.4	8.4
United Kingdom	11.6	12.2	12.7	12.5

Source: Based on Statistics of Electricity Supply Industry in Malaysia, 1997 edition, Department of Electricity & Gas Supply Malaysia; IEA Statistics Energy Prices and Taxes, Second Quarter 1997

2) Analysis

It is obvious that the relation between product price and demand is a trade-off. Accordingly, from the promotion of energy efficiency view, an energy price increase causes a decrease of energy consumption.

In particular, an energy price rise is effective in promoting the promotion of energy efficiency in manufacturing industries. The managers of manufacturing industries are sensitive to energy price rises, since they are keenly aware of the increase of production cost of their product.

Since energy is convenient to tax and demand is relatively inelastic against price as mentioned above, energy tax is adopted as a measure to raise government revenue, permitting the raising of revenues without significant destruction of the tax base. Using energy taxes to influence the energy consumption pattern is fairly straightforward.

However, an energy price increase greatly influences the whole economy of the nation. In industry, it causes decreased product competitiveness especially in the international market. Accordingly, an energy price policy should be carefully treated and harmonized, considering effects on social issues, industry, trade, etc. On the other hand, there are negative impacts on the governmental finance and the promotion of energy efficiency in case of keeping energy price cheap by means of giving subsidiary.

The study team considers that the free market price mechanism for energy products, consisting of the production cost and reasonable profit, is appropriate.

(4) Others

It would be advisable for MECM to coordinate and arrange a study to enhance ESCOs, which are private entities. The further activation of ESCOs is one option to promote developments in the efficient use of energy. The function of an ESCO would be to carry out energy audits, assist arrangement of finance and modification of facilities and to operate for the benefit of various entities. These activities would be carried out through the allocation of profits obtained by the promotion of energy efficiency between entities and ESCOs.

6-2 Plans for Training of Energy Managers and PTM for Promotion of Energy Efficiency

6-2-1 Training of Energy Managers for Promotion of Energy Efficiency

In order to facilitate energy efficiency promotion, the cultivation of talented individuals to engage in the promotion of energy efficiency becomes necessary for talented individuals to engage in the promotion of energy efficiency, the training is necessary of energy manages for each entity, and talented individuals to train those managers. This paragraph outlines the human resource training plan in relation to the training of energy managers.

The objective of the human resource training is to foster talented individuals who possess the planning sense, knowledge and experience necessary to promote energy efficiency.

In order to achieve this objective, we will consider the following strategies.

1. Preparation of a system
2. Preparation of a training institution
3. Establishment of a training plan
4. Preparation of a qualification system
5. Creation of a schedule

(1) Preparation of System

In the case of training that emphasizes the training of energy managers, the establishment of training system for the promotion of energy efficiency is underway in Malaysia. In the case of experience gained through energy diagnoses of each enterprise on the other hand, it is also a fact that no systematic measure is being prepared in respect to the promotion of energy efficiency activities. The training targeted by this plan does not merely refer to the acquisition of skills; it involves the cultivation of attributes that are conductive to the promotion of energy efficiency in the course of each company's daily activities. To that end, it is considered that the employment of an energy manager system to provide opportunities to not only acquire theory and technology concerning energy, but also to lean about the promotion of energy efficiency diagnosis and promotion methods, would be effective.

(2) Preparation of Training Institution

It is thought that JBE&G, which formulated the draft of promotion of energy efficiency regulations focusing on the electricity sector, should assume responsibility for the training in the short-term, and that in the long term, an organ like PTM, that strives to implement the promotion of energy efficiency measures not only for electricity, but for the full spectrum of the promotion of energy efficiency including heat energy, should supervise training. However, in order to maintain consistency with an overall plan for the promotion of energy efficiency, it is thought that a promotion of Energy Efficiency Promotion Board headed by such organization like EPU should undertake coordination.

If one takes into consideration levels of expertise and experience, however, the utilization of private training functions in Malaysia that are already experienced in energy manager training, and the use of university education functions, are also conceivable options.

(3) Training Plan for Energy Manager

This plan concerns the training of talented individuals involved in the promotion of energy efficiency through a qualification course that is consequent upon the systemization of energy managers. In other words, it consists of the education of engineers and students in regard to the promotion of energy efficiency.

1) Procedure

It is considered the following methods for training engineers and manager.

(a) Energy Manager Courses:

It is recommended that short term courses be established to train personnel to be assigned by the institutions or plants on energy management subjects, and to train the personnel to be a trainer in the future.

(b) Preparation of Training Materials:

Materials for training should be prepared based on the contents of training. It is recommended that existing materials be utilized, or materials that are commonly used in English speaking countries such as the U.S., U.K. or Australia.

(c) Scope of the Course:

An announcement containing the scope, fee, certificate of proficiency issuance, cancellation of this proficiency, and examination rules should be prepared by the Governmental body that is responsible for the promotion of energy efficiency.

(d) Type s of Courses:

a) Industrial Energy Manager's Training Course

This course is designed for technical personnel in the manufacturing sector.

b) Building Energy Manager's Training Course

This course is designed for technical personnel in the building or commercial sector.

(e) Training Items:

The contents of training for energy managers are described in Table 6-5. The contents are divided into three: training in various techniques in energy management; in various energy management theories; and a project assignment.

Table 6-5 Content

<table>
<tr><th>Industrial Stream</th><th>Building Stream</th></tr>
<tr><td>1. Energy in Malaysia
2. Energy Use
- Energy bills
- Power factor & Load factor and their impact on electricity costs.
- Measurement of energy use
- Energy management systems
- Energy used and opportunities for improvement
3. Technologies to Improve Energy Use
- A range of exciting new technologies
4. Energy Use Theory
- Effective lighting
- Refrigeration
- High efficiency motors and variable speed drives
- Boilers
- Process heating and waste heat recovery
- Co-generation and steam turbines
- Compressed air
5. Financial Analysis of Projects
6. Company Energy Management Program
7. Energy Audit Process
8. Case Studies in Energy Use Improvement</td><td>1. Energy in Malaysia
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- Building envelope
- Air conditioning
- Water heating
- General office equipment
5. Financial Analysis of Projects
6. Company Energy Management Program
7. Energy Audit Process
8. Case Studies in Energy Use Improvement</td></tr>
<tr><td colspan="2">9. Heat control
1) Foundations of thermodynamics
2) Foundations of biography heat
3) Foundations of heat switchboard
4) A flow of a fluid
5) Fuel and combustion
6) Utilization mentioned above
7) Heating materials
10. Electricity management
1) Electricity management of the strange supply of electric power facility
2) Electricity management of a motor
3) Electricity management of a blower / a compressor
4) Electricity management of a pump
5) Electricity management of electricity heat facility
6) Electricity management of illumination facility
7) Electricity management of air conditioning facility</td></tr>
<tr><td colspan="2">11. Presenting of participant project reports
12. Overview of participant projects
13. Gaining management support
14. A company Energy Management Policy
15. Involving people in energy efficiency
16. Presenting proposals</td></tr>
</table>

(f) Qualification of Energy Managers

The energy manager has an important role for promotion of energy efficiency, and it is necessary to have knowledge and experience in energy-related matters. Therefore, an official qualification of energy manager is also necessary. There may be some ways to qualify energy managers officially, and typical ways for qualification are as follows:

1. Graduates from college or universities, who have completed an energy-related course such as heat transfer or electricity, and have more than three years' experience of promotion for energy efficiency in an entity
2. Persons who have the certification of Professional Engineer (PE) or a doctoral degree in an energy-related course
3. Participants in a seminar for qualification as an energy manager, who have more than three years' experience of promotion for energy efficiency in an entity
4. Participants in a seminar for qualification as an energy manager, who pass an examination of certification at the end of the seminar
5. Persons who pass an examination of certification as an energy manager

The necessity of examination to gain qualification as an energy manager should be carefully evaluated by energy-related organizations in Malaysia. A likely method of qualification is to utilize items 1 to 3 above at the initial stage, and reevaluate the examination method, reflecting the results or performance during the initial stage.

For example, there are a lot of examinations of qualification in relation to energy efficiency in Japan:

1. Registered consulting engineer (automatically regarded as an energy manager)
2. Energy manager (heat and electricity)
3. Boiler operating manager (there are 4 ranks)
4. Qualified electricity engineer (there are 4 ranks)
5. Pollution controlling manager (gas, water, noise, vibration)

(4) Certificates

1) Energy Efficiency Class in Universities:

When engineers who have received a credit of energy efficiency education during their education at a university applies to JBE&G with the necessary documents, they may be issued a certificate of Energy Manager.

2) Energy Management Training Certificate of Attendance

An energy management training certificate of attendance shall be awarded to all participants who completed the training program for the early stage of the system. In case of this system, the governmental body that is responsible to the promotion of energy efficiency should issue certificates following the final examinations of the said courses. Both certificates shall be endorsed by JBE&G for the early stage of the system.

(5) Schedule

In order to disseminate this plan widely in Malaysia, its execution in combination with the energy manager system is desired JBE&G is (currently) advancing a plan to position energy managers in each company; we therefore advise that the executed as a short-term project.

1) Preparation of a system (the year 2000)
2) Preparation of a training organ (the year 2000)
3) Establishment of the human resource training plan (the year 2000)
4) Preparation of a qualification system (the year 2000)
5) Enforcement of plan (2001 onward)

6-2-2 Plan of the Energy Efficiency Promotion Division of the Malaysian Energy Center

PTM was newly established in 1998 as a technical arm of MECM and just starting its activities for the promotion for energy efficiency.

Study team entitled prepared documents entitled 'Energy Efficiency Promotion Division of PTM' as a preliminary discussion memorandum. During the third field survey, team members discussed utilization of the discussion memorandum with the CEO of PTM. As a result, the following organizational demarcation of activities regarding Promotion of Energy Efficiency is clarified at present.

Scope of Implementation for PTM:

1. Promotion of energy efficiency campaign
2. Research activities
3. Energy data base
4. Seminars for energy efficiency
5. Technical development
6. Energy audits
7. Publication

Scope of Implementation for Others (JBE&G, Universities and Others):

1. Education and training programs on energy efficiency
2. Energy manager's qualification
3. Energy management lessons for university students

Though JICA study team recognizes the current situation of the Energy Efficiency Promotion Division of PTM (hereinafter termed 'the Division'), the following items still remain as important issues:

1. Decentralization of activities for energy efficiency will be inefficient in the future
2. Though energy management should be on the basis of thermal and electrical energy, the current activity is too concentrated on electricity.

The recommended institutional plan of the Division is also described in this section.

(1) Scope of the Implementation

For the promotion of energy efficiency, various kinds of measures should be taken. Responsibility for some if these measures should be taken by an active organization, which is financially sponsored, well organized and consists of well-trained officers and engineers. The Division is advised to organize this as a division of PTM in order to promote energy efficiency in Malaysia.

Major and recommended activities for promotion of energy efficiency by the Division are classified into the following items:

1. Enlightenment of awareness for energy efficiency
2. Activities of research and study for energy efficiency
3. Education and training programs for energy efficiency
4. Technical development for energy efficiency
5. Publication activities for energy efficiency
6. Organization of energy managers for energy efficiency

And outline of each activity is described below as the scope of the implementation by the Division.

1) Scope of the implementation for the promotion of energy efficiency by the Division

(a) Promotion of energy efficiency awareness

1. Energy efficiency and conservation campaigns
2. Exhibition for effective use of energy
3. Training instructors for energy efficiency
4. Poster contest of energy efficiency
5. Essay contest of energy efficiency
6. Preparation and distribution of posters and brochures about energy efficiency
7. Promotion of energy efficiency advertisements

Promotion of public campaign for energy efficiency:
The promotion of a public campaign for energy efficiency is recommended to promote energy efficiency awareness. The establishment of an Energy Week is also recommended. During the energy week, exhibitions and conferences consisting of promoting energy efficiency programs and promoting energy efficiency implementation and technical discussions will be programmed.

Exhibition for effective use of energy:
To increase public awareness of energy efficiency promotion, promotion of energy efficiency exhibitions should be held regularly. It is important to hold exhibitions to introduce promotion of energy efficient equipment, and give explanations on the domestic and international energy situation. Public interest in exhibitions will be increased if they are held at about the same time of year, regularly every year. The effectiveness of such exhibitions will be further enhanced if the above-mentioned seminars and meetings for publication of successful examples are held concurrently.

(b) Research and study activities for energy efficiency

1. Research and studies for establishment of an energy data base
2. Research and studies on promotion of energy-efficient measures

Establishment of energy database:
Within this project, the development of a computer model is recommended to forecast energy consumption in industry, commercial buildings and the transport sector.
In addition, in order to effectively provide entities with technical information on promotion of energy efficiency, it is necessary to establish a system by which the current situation and future forecasts in technology in various areas can be accurately grasped. And whereby such information can be used effectively. For this purpose it is recommended that the Division promotes permanent cooperative relations with overseas organizations for promotion of energy

efficiency. More information on promotion of energy efficiency is expected to be gathered through the exchange of information with foreign countries in this way.

(c) Education and training programs for the promotion of energy efficiency

1. Dissemination of energy efficiency technology
2. Training of candidates for energy managers
3. Technical training course

a) Dissemination of energy efficiency technology

Seminars on technical information:

It is particularly important to disseminate technical information on promotion of energy efficiency through periodical and occasional seminars. The Division is advised to give seminars on various energy efficiency promotion topics such as energy management, heat insulation, combustion, and efficient use of electric and steam systems, for the technical personnel of entities.

One option to provide seminars is a Training Bus Program. In the programs, seminar notes and technical manuals are provided for the participants.

Generally speaking, large-scale factories have high technical levels of their own and are active in collecting technical information. There may exist a shortage of engineers and technology at medium- and small-scale factories and in the commercial sector. Managers and staff members are not sufficiently aware of the need for promotion of energy efficiency; they are concerned more about production, operation and cost. In order to supplement medium- and small-scale factories' and the commercial sector's activities, it is important to hold promotion of energy efficiency seminars for those in charge of energy management at entities that are not designated as energy-managed entities.

b) Seminars to qualify energy managers

Energy-managed entities will be obligated to appoint energy managers in order to promote energy efficiency at the entities.

The Division is advised to hold seminars for granting the qualification of energy manager to the participants. One idea for a seminar outline is as follows:

1. Scope: theoretical information, measuring equipment, practical studies, computer programs of calculation
2. Candidates: maximum 20 persons for every course
3. Duration: not less than 2 weeks
4. Certificate: examination for the certification will be held at the end of the

course and PTM will issue the certificates.

5. Course fee: Participants shall pay.
6. Authorized organization will arrange the course, the Division will control the course.

In order to expedite deployment of energy managers, it would be advisable to introduce a State-approved qualification system for energy managers, such as issuing certificates to graduates of technology courses and entity engineers with years of experience in the promotion of energy efficiency.

c) Energy management lessons for university students

The Division is advised to plan to hold energy management lessons at university engineering faculties for engineering students for half a year. Besides theoretical knowledge, would also be conducted practical studies. However, education itself would be conducted by universities or related institutes, and the Division is advised to join programming of the curriculum and coordinate practical studies outside of the universities.

(d) Technical development for energy efficiency

1. Consultation
2. Studies and technology development of energy efficiency

(e) Energy audits

Energy audits provide data and information on energy consumption, energy balance, problems of energy use, measures for the improvement of energy efficiency of entities and recommendations for the promotion of energy efficiency. It is essential to conduct energy audits to formulate plans for the promotion of energy efficiency of entities. It would be advisable for the Division to conduct energy audits, fully utilizing related institutions like SIRIM.

a) Paid energy audits

Paid energy audits at large entities should be carried out where costly experts from outside are needed for precise, high level diagnosis and guidance.

b) Simplified energy audits

It would be advisable for the Division to conduct simplified energy audits at a large number of medium- and small-scale factories and commercial buildings, which may have no engineer, specialized in energy efficient technology. In this case, an energy audit should be carried out in such a manner as simply to identify points to be improved, and to enable them to find ways to advance to the next step, thereby stimulating the entity's engineers and management to become interested in promotion of energy efficiency.

c) Energy audits by Energy Bus Program

The Energy Bus Program aims to create promotion of energy efficiency awareness, identify energy saving potential and help to establish energy management in an entity. The program includes:

1. A pre-visit,
2. A visit to the entity (gathering data and taking measurements),
3. Analysis of results,
4. Report preparation.

(f) Publication activities for energy efficiency

1. Magazines
2. Statistical data
3. Books
4. Technical books

The main objective of publication is to provide technical Information for engineers, managers and students in relation to energy efficiency.

a) Publication of magazines for promotion for energy efficiency

The purpose of publishing a magazine for promotion of energy efficiency is to provide information to energy-related personnel, and to provide an opportunity for the exchange of information. In order to promote energy efficiency, it is necessary to constantly provide technical information on promotion of energy efficiency to management and engineers, and to contribute toward increasing their awareness of promotion for energy efficiency by showing them successful cases of promotion of energy efficiency and energy-efficient equipment.

At present, sufficient information on promotion of energy efficiency is not provided to managers and engineers. Provision of the latest information would serve to upgrade the technical levels of entities and to stimulate them in their promotion of energy efficiency activities.

b) Hand book of energy efficiency

The study team recommends that the Division publishes a hand book, 'Promotion of Energy Efficiency Reference Book', illustrating statistics, standards and other technical data, in order to enable staff members of entities to easily access the needed information while they conduct promotion of energy efficiency activities at their entities.

(g) Organizing energy managers for energy efficiency

The study team recommends that the Division organizes qualified energy manages for energy efficiency.

(2) Organization and Personnel Allocation of the Division

1) Current organization of PTM

The current organizational chart is shown in the Figure 6-3. Though details of the job scope for each section are yet to be clarified, PTM currently consists of the following sections.

1. Administration & Finance
2. Energy Data Modeling and Consultancy Services
3. Energy Efficiency Outreach Services
4. Emerging Energy Technology R&D Management Services

The total number of posts in the organizational chart is 18 (eighteen) and the total number of staff, as of October 17, 1998, is 10 (ten).

2) Plan for organization and personnel allocation of the Division

When the Scope of the Implementation by the Division is fulfilled, the organization and personnel allocation in each section, reorganizing the job scope, will be as follows. And the planned organizational chart is shown in the Figure 6-4. It is advisable for personnel to hold several posts.

(a) Public Relations and Publication Section (Section A)

a) Main activities
1. Energy efficiency and conservation campaigns
2. Exhibition for effective use of energy
3. Training instructors for energy efficiency
4. Poster and essay contest of energy efficiency
5. Preparation and distribution of posters and brochures for energy efficiency
6. Promotion of energy efficiency advertisements
7. Publication of magazines, statistical data, books and technical books

b) Personnel allocation

Head:	1
Unit secretary:	1

Coordinator:	1
Researcher	1
Staff:	3
(Total):	(7)

(A special task force is necessary when preparing statistical data and technical books)

(b) Research Section (Section B)

a) Main activities

1. Research and studies for establishment of an energy data base
2. Research and studies of promotion of an energy-efficient measures
3. Dissemination of technology

b) Personnel allocation

Head:	1
Unit secretary:	1
Coordinator:	1
System engineer:	1
Researcher:	1
Staff:	3
(Total):	(8)

(A special task force is necessary to develop and formulate an energy database)

(c) Technical and Training Section (Section C)

a) Main activities

1. Consultation
2. Studies and technology development of energy efficiency
3. Communication and facilitation of activities of energy managers
4. Training of candidates for energy managers
5. Qualification of energy managers
6. Technical training course

b) Personnel allocation

Head:	1
Unit secretary:	1
Coordinator:	1
Researcher:	1

Instructor:	2 (heat & electricity)
Staff:	3
(Total):	(9)

(3) Necessary Resources for the Division

On the basis of the Scope of Implementation, and the Plan for Organization and Personnel Allocation of the Division, the necessary resources of manpower, equipment and facilities for the Division are planned as follows.

1) Manpower

Planned personnel allocation is as follows. It is recommendable to hold additional posts when the work volume is not sufficient enough.

Position	section A	Section B	section C	Total
Head	1	1	1	3
Unit secretary	1	1	1	3
Coordinator	1	1	1	3
System engineer		1		1
Researcher	1	1	1	3
Instructor			2	2
Staff	3	3	3	9
Total	7	8	9	24

2) Equipment and facilities

An outline of necessary equipment and facilities is planned as follows:

Training bus:	1 set with audio and video set
Energy bus:	1 set
Measuring equipment:	Basically utilizing measuring equipment provided by JICA
Equipment for analysis:	Elementary analysis, gas chromatograph and others (Mainly for analysis of fuel and waste gas)
Laboratory:	For technology development and analysis
Computer system for energy database:	1 set with software

PTM is now planning introduction of the GEF program by UNDP to facilitate and develop activities of the organization. And the combination and introduction of other technical cooperation with overseas organizations should be pursued.

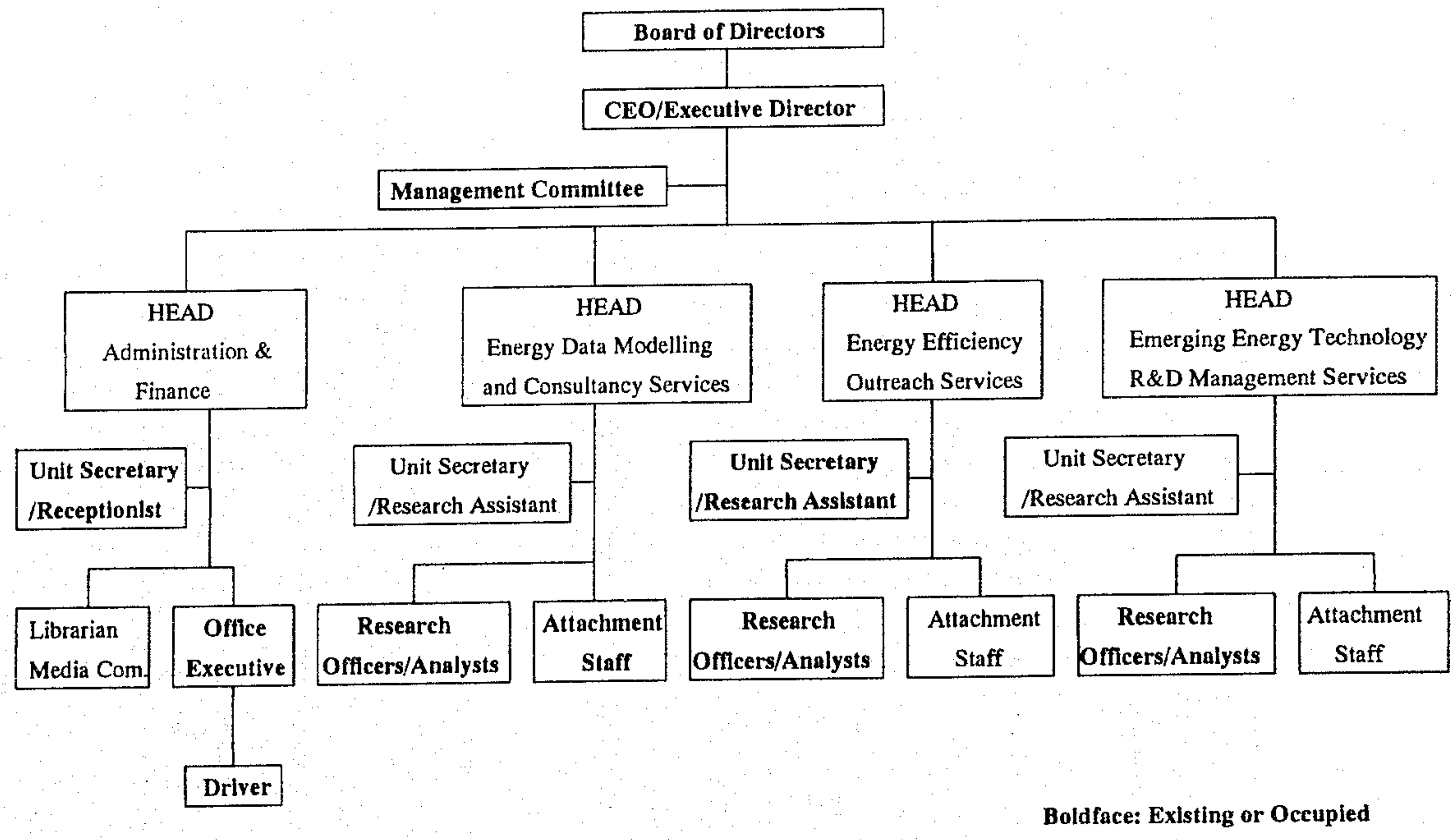

Figure 6-3 **Current Organization of PTM (as on 17/10/1998)**

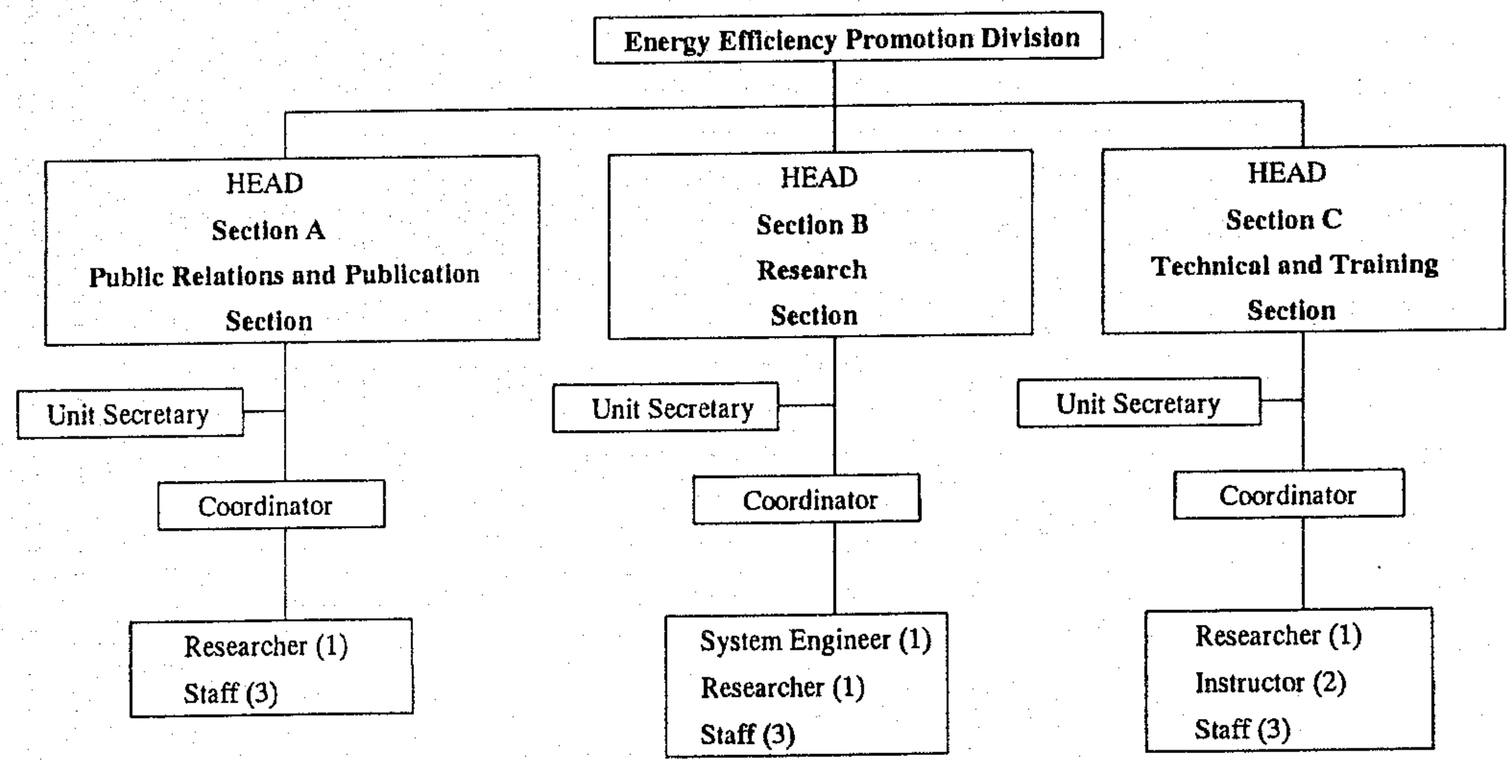

Figure 6-4 **Organizational Plan of Energy Efficiency Promotion Division**