GOVERNMENT OF MALAYSIA

IN CO-OPERATION WITH

THE ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC, THE UNITED NATIONS DEVELOPMENT PROGRAMME AND THE GOVERNMENT OF FRANCE

SECTORAL ENERGY DEMAND IN MALAYSIA

NOVEMBER 1989

REGIONAL ENERGY DEVELOPMENT PROGRAMME (RAS/86/136)

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PREFACE

To further strengthen energy demand analysis capabilities, the Malaysian Government had taken the opportunity offered to participate in Sub-activity P-1.1 on Sectoral Energy Demand Studies implemented within phase III (1987-1989) of the Regional Energy Development Programme (REDP) of the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP). An in-country core group was formed with officers drawn from various Government Ministeries and Agencies, namely, Economic Planning Unit (EPU) in the Prime Minister's Department, Ministry of Energy, Telecommunications and Posts (METP), Ministry of Transport (MOT) and the National Electricity Board (NEB). The team started work in February 1988 and the project culminated in a National Seminar held in Kuala Lumpur on the 10th. of August, 1989.

This publication is a combination of efforts of the team members, ESCAP and the P-1.1 Central Consultants at the Asian Institute of Technology (AIT). Particular work is accredited as follows:-

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Chapters 5, 6 -
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The team members wish to express its gratitude to the United Nations Development Programme and ESCAP for the opportunity to participate in the P-1.1. Special thanks and acknowledgement go to Dr. F. Harahap, Senior Coordinator of REDP and Dr. A. Ounali, Regional Advisor on Energy Statistics, ESCAP for their continued guidance throughout the study and to the P-1.1. Central Consultant's Team at AIT, namely, Dr. B. Chateau, Dr. B. Lapillonne, Mr. D. Bosseboeuf, Ms. Deepa Patel Krishnamoorthy, for their patience and help. The team also acknowledge with thanks the assistance extended by the UNDP office in Kuala Lumpur especially Mr. Micheal van Hulten, Mr. David Thorup, Mrs. Mimi Hew and also to all ministries and agencies who have helped us in one way or another, whose input and cooperation enabled this study to proceed.

REDP P.1 PROJECT;
SECTORAL ENERGY DEMAND STUDY
MALAYSIA

TABLE OF CONTENTS

SECTORAL ENERGY DEMAND

5. RESIDENTIAL SECTOR

6. SERVICE/COMMERCIAL SECTOR

7. TRANSPORT SECTOR

8. INDUSTRIAL SECTOR

9. AGRICULTURE SECTOR

LIST OF TABLES

EXECUTIVE SUMMARY

REDP P - 1.1
SECTORAL ENERGY DEMAND STUDY IN MALAYSIA
1988 -1989
EXECUTIVE SUMMARY

I. INTRODUCTION

1.1 Malaysia expressed its interest to participate in the REDP subactivity P-1.1: Sectoral Energy Demand Analysis in mid 1986. Subsequently, a multi-agency core team was formed to work on the project which effectively started in February 1988. The Study programme was initially laid out over a one year span and subsequently was extended to April 1989. This project continues the efforts by the Government of Malaysia to enhance and institutionalise integrated energy planning. The first effort was initiated in 1983 by the commissioning of the National Energy Planning Study (NEPS). It was recognised then, the role of energy as a driving force of the economy and hence the need to give greater emphasis on in-depth energy planning as an integral part of overall macro economic planning. Consequent to NEPS, the Energy Planning and Coordination Section (EPCS) was setup in 1987 in the Economic Planning Unit (EPU) of the Prime Minister's Department, the Government's central planning agency. A training programme was launched in 1988 to improve and strengthen energy planning capabilities of energy planners and this REDP P-1.1 project was timed to run in parallel to complement the programme. The National Electricity Board (NEB) had in the meantime undertaken a study on energy and electricity demand using the MAED (Model for Analysis of Energy Demand) under a technical cooperation with the IAEA in 1986.

1.2 The main objective of the Project/Study is to enhance and strengthen capabilities in sectoral energy demand analysis in Malaysia. This is to be achieved by the core team working on

- o past evolution analysis of energy consumption trends and factors influencing them.
- o forecasting of energy demand using the MEDEE-S model.

Consequent of above main activities are the following:-

- o establishment of computerised energy database for information analysis and projections.
- o conduct of surveys to fill in information gaps.

1.3 Conduct of the Study was coordinated by the Energy Planning and Coordination Section (EPCS), Economic Planning Unit, Prime Minister's Department. The core group was splited to undertake the project on a sectoral basis as follows:-

- o Database and Modeling (EPCS)
- o Industry Sector (METP)
- o Transport Sector (MOT)
- o Household and Service Sector (NEB)
- o Agriculture Sector (EPCS)

A leader was appointed to head and coordinate each of these sectors which then produced their workplan/ schedule based on the objectives as explained in para 1.2. This setup was used to diseminate knowledge on energy demand analysis planning throughout the various branches of the Government's planning machinery. Officers were nominated to participate in the project and these people act as referral points for consultations and coordination. The member agencies in the core team are Economic Planning Unit of the Prime Minister's Department, Ministry of Energy, Telecoms and Posts (METP), Ministry of Transport (MOT) and the National Electricity Board (NEB).

2. ENERGY DEMAND TRENDS

2.1 Data Situation

Basically, the data problems can be broadly broken down into two categories, viz:-

- o Lack or non-existance of data information.
- o Reliability of available information.

The first type of problem can be solved by conducting research and surveys subject to availabiliity ofresoures. As for reliability, a common check is by cross comparison with data from other countries e.g. on efficiencies, intensities etc.

The data collected and assembled by the various sectoral study groups was compiled with a database management package DBA/VOID (provided by ESCAP/AIT) at EPCS. This compilation has largely been done on DBA/VOID as planned, notably for the manufacturing, transport and agriculture sectors. However, the residential/service sector's data were compiled on LOTUS, that being the perference of the study group.

Compilation of data was done over a much longer period than initially envisaged due to the rather scattered nature of the required information. There are notable and serious gaps in the database which the core team has identified in the course of their work. One major problem area is in the allocation of diesel oil between industry and transport sector. These gaps will require much effort and finance to bridge and the participating agencies will endeavour to fill these gaps in the near future.

The data compiled for the industrial sector is rather 'voluminous' with energy demand information established to 5-digit ISIC code and various fuel types for 1978, 1979, 1983, and 1985. Data on gross output and value-added were also available. However, this rather indepth and disaggregated data were found to be inconsistent for quite a number of sectors. These doubts on the reliability had rendered analysis rather difficult and projecting on this database in such cases is of dubious benefits.

Compilation of data for the transport sector was done for road, rail and air subsectors. There were also serious gaps in the database especially for the road transport sector with respect to operational fleet. This has been recognised by the various agencies concerned and efforts are being channelled to close these gaps. A limited service station survey was launched over a 2-month period in an attempt to source information on the road fleet's unit consumption and annual mileage in the Kuala Lumpur/Petaling Jaya area, the largest urban centre in Malaysia.

The data for the household/service sector was compiled mainly from the National Electricity Board who possesses comprehensive and indepth information on this sector, particularly with regard to electricity. Comprehensive data on conventional fuels by end-use is still lacking and the study team utilised existing surveys/studies to derive estimates. Detailed fossil energy consumption data is unavailable.

Past years data on energy demand in the apriculture subsector is scarce and a hypothetical approach was used to develop an indication of energy consumption pattern in 3 main subsectors, viz, crops, fishing and forestry. The secondary database thus formed from the limited primary information available is largely estimated.

2.2 Overall Energy Demand

Figure 1 summaries the energy consumption by the four main sectors studied. Energy supply/ demand and GDP growth trends are shown in Figure 2. Final use of energy by fuel type for are shown in figures 3 and 4. Study results showed the transport sector to be the major energy consumer with about 51% in 1983 and 53% share in 1985. Next came the industrial sector with some 22% share followed by agriculture at around 12% and finally the residential/service sector with about 14%.

Energy demand in the industrial sector is expected to grow in response to the rapid industrialisation in Malaysia. In the transport sector, road transport is expected to continue to play a dominant role in the near and medium term with road freight projected to grow at 4% p.a. and passengers at around 2.5% p.a. for bus traffic and between 2.3% to 5.3% p.a. for cars and taxi flows. A huge share of 95.5% of total passenger movement was by road in 1986. This trend would continue with investment for road transport increasing in the coming years.

In terms of fuel usage, petroleum products is the major form of energy used overall. Diesel oil is dominant in the industrial sector supplying some 48% of energy needs with the remainder shared by gas, fuel oil and electricity in roughly equal proportions. The transport sector main fuel is motor gasolene accounting for about 58% of energy consumption with diesel oil at about 31%.

Total energy consumption for the nation is expected to grow at around 6% p.a. overall during the next few years.

2.3 Sectoral Energy Demand Trends

2.3.1 Industrial Sector

Analysis of collected data showed that the industrial sector's energy consumption grew at about 4% p.a. for the period 1978-1985, totaling approximately 77 PJ in 1985. Manufacturing accounts for 64% of this energy cousumption making it by far the largest consumer. Mining and construction each had a share of about 17% and 18% respectively.

Major fuels consumed are fuel oil, diesel oil and electricity, each having a share in 1985 of 44%, 20% and 20% respectively in the manufacturing subsector. Together these fuels accounted for 85% of total energy demand.

In 1985, the manufacturing subsector accounted for almost 50% of industrial value added followed by mining with a 34.4% share and construction at 15.7%. The manufacturing subsector's value added grew by about 2% over the analysis period (1975 - 1985) and growth rates of 7.5%, 12.8% and 18.0% were registered for 1986, 1987 and 1988 respectively. This strong performance is expected to sustain for the near term and this should see energy consumption increase in concert.

Energy intensity for the manufacturing sector has declined from 6 TJ/M$ in 1978 to about 5.7TJ/M$ in 1985. That for construction sector remained stable over the same period while the mining sector showed a large drop of about 56% in energy intensity compared to 1978. The drop in the case of mining was due mainly to the substantial decline in tin production over this period.

2.3.2 Transport Sector

2.3.2.1 Road

An operational road fleet was generated on judgemental basis based on a global fleet figure available for Peninsular Malaysia. This then formed the basis of a secondry database for further analysis into the road fleet. The methodology and hypothesis represents a first start to sectoral energy demand analysis of the road transport sector.

Analysis of historical data (1978-87) showed that the road fleet has been growing at a rate of 10.3% p.a. with the gasoline fleet increasing at 10.3% p.a. and the diesel fleet at 9.3% p.a. Gasoline consumption grew from 1281 Mliter in 1978 to 3196 Mliter in 1987, representing a growth rate of 10.7%.The diesel oil consuption groth rates was 11.5 % p.a for the same period. Vehicle ownership increased from 0.63 vehicles per household in 1978 to 1.10 in 1987. It appears that the increase in ownership is moving towards some sort of plateau.

Motorcycles form the bulk of the road fleet population holding a share of about 58% in 1987, a slight decrease compared to the 60% share recorded for 1978. Next came the gasoline cars maintaining a share of around 32% throughout the 80's. In total, the gasoline fleet holds a 93% share, being quite stable for the period 1978-1987. The diesel fleet makes up the balance of 7%. The gasoline road fleet has largely remain stable throughout the 80's and there appears to be no structural change, consistent with the stable fleet unit consumption over this period.

Meanwhile, the diesel road fleet has shown improvement in fuel consumption efficiency, estimated at 15% improvement since 1978. Structural change within the diesel road fleet is estimated to contribute about 10% towards the efficiency improvement.

Analysis in the road transport sector has produced rather large mismatches with energy balance figures in the case of diesel oil consumption, the study results being substantially more than the energy balance. This area obviously requires further work particularly on the identification of operational road fleet by vehicle type and the usage of small trucks inclusive of vans and 4-wheel drives. The unit consumption and annual mileage for these vehicles is suspect.

2.3.2.2 Rail

Traffic and fuel consumption data compiled for the Malaysian railways sector has shown a rather small increase in activity with overall traffic in GTKH growing at about 2.7% per annum. The corresponding figures for freight and passengers are 2.6% per annum and 2.9% per annum respectively.

Energy consumption (diesel) has been growing at about 3% per annum for the period 1975-1987. In terms for energy intensities, there has been very little change over this period.

2.3.2.3 Air Transport.

In absolute terms, passenger traffic for Malaysia increased from 1.9 million in 1976 to 7.8 million in 1985, representing an average annual increase of 13%. Freight traffic increased from 40.7 million tons in 1976 to 364.0 million ton in 1987 registering an average annual increase of 21%. Jet fuel consumption has increased from 209 KTOE in 1978 to 434 KTOE in 1987 showing an average increase of 8.5% p.a. Malaysian Airline System (MAS), the national carrier, purchased more than 50% of the jet fuel consumption in Malaysia. The jet fuel consumption per passenger ratio has been decreasing steadily over the period 1977 - 1987.

2.3.3 Residential and Services Sector

2.3.3.1 Residential Sector

Energy use in the residential sector is mainly for cooking, lighting, hot water, air-conditioning and operation of electrical appliances. Electricity is a major commercial residential fuel and other fuels used by this sector are kerosene, LPG/gas, charcoal and firewood which are mostly used as cooking fuels. Analysis of past trends showed that electricity consumption per capita exhibited an almost linear growth from 1978 to 1987. A similar trend is seen for consumption per household but at a sharper gradient.

Based on the predetermined development scenarios up to year 2010 it was found that total commercial final energy demand of the sector is expected to increase from 21109 TJ in 1985 to 32480 TJ and 41675 TJ in the year 2000 and 2010 respectively. This represents an average annual growth rate of 2.91% p.a. for the period 1985 - 2000 and 2.75% p.a. for the period 1985 - 2010. This corresponds to a commerical energy demand/household income elasticity of 1.006 for the period 1985 - 2000 and 1.005 for the period 1985 - 2000, while for electricity the same elasticity value for the period considered are 1.043 and 1.037. Electricity demand is expected to increase at a more rapid rate than that of other commerical energy and this increase should be slightly dampened in the long term due to saturation effect.

In terms of conventional thermal fuel share, LPG is projected to increase its contribution from 31.5% in 1985 to 44.7% and 53.5% in the 2000 and 2010 respectively. Gas will also increase its share rapidly from 3.2% in 1985 to 12.2% in 2010. Kerosene is expected to reduce to its share drastically from 55.5% in 1985 to 26.7% in 2000 and 12.5% in the year 2010. This scenario of fuel share forecast appears plausible and consistent with the future energy resource option in Malaysia, whereby its large domestic natural gas reserve will sustain the increase of gas/LPG utilisation. Kerosene after the year 2000, will become increasingly costly as Malaysia moves towards being a net importer of oil.

Electricity demand in the sector is projected to increase from 9558 TJ in 1985 to 29764 TJ and 45410 TJ in the year 2000 and 2010. The corresponding share of electricity to total final commercial energy will then be 32.1% in 1985, 47.8% in 2000 and 52.1% in 2010.

Consumption per electrified dwelling is expected to increase from 1145kwh in 1985 to 1902kwh and 2107kwh in the year 2000 and 2010 respectively. Residential sector consumption per capita increases from

169kwh in 1985 to 364kwh and 445kwh in the year 2000 and 2010.

Based on a predetermined constant 1983 fuel prices and an assumed constant fuel escalation rate, total electricity expenses share in total conventional energy expense in the sector is projected from 64% in 1985 to about 79% in the year 2010. The elasticity of energy expenses to GDP is expected to decrease from 2.10 in year 2000 to 1.31 in the year 2010.

Future energy demand in the household sector is strongly dependent on various variables. The accuracy of forecast is thus dependent on how precise these parameters are projected. From the plausible scenario simulated, electricity and to a lesser extent LPG/gas will continue to grow in importance in satisfying future energy requirements in Malaysian homes.

The projection results of energy demand in this sector points towards a favourable situation till year 2010 where significant reduction in kerosene usage is seen with substitution by LPG and gas for cooking. A disturbing result seen is that of increase consumption of charcoal implying deforestation trends. This however could be controlled with penetration of natural gas and LPG as cooking fuels to the rural areas.

2.3.3.2 Service Sector

Although there is a comparative lack of information on energy use in the service/commercial sector. Past trend analysis revealed that electricity consumption in the services sector increased from 1720 Gwh in 1978 to 4076 Gwh in 1987 with consumers doubling during the period. The highest growth of energy demand was found to be in the Government offices, educational institutions, offices and multipurpose buildings sub-sector, registering a growth factor of 3.57 over the 1978-87 period. It was observed that 85% of the total energy consumed in the commercial and public sector is in the form of electricity. The balance of 15% is covered by other fuels such as diesel, LPG and gas which are mainly used for water heating and cooking. Development scenarios on NEB's 1988/89 load forecasts was used for projections of energy consumption in this sector. Using the MEDEE-S model.,results indicates that total energy consumption in this sector would reach 48430TJ in year 2000 and 76282TJ in year 2010.

2.3.4 Agriculture Sector

Results of the analysis on the secondary database established, showed that there has been a steady increase in energy demand over the period 1978 - 1988. Total energy consumption grew from a figure of 38,896 TJ in 1978 to 48240 TJ in 1988, an overall increase of 24% representing a growth rate of about 2.2% per annum.

Diesel oil is the largest source of energy, supplying in 1988, some 90% of the total energy consumed by the sector. The fishing subsector is the largest energy consumer, taking an estimated 70% of the diesel oil consumed in the agriculture sector while the crops and forestry subsectors each accounted for about 19% and 11% respectively.

3. CONCLUSION

3.1 The REDP P-1.1 project has brought together a diverse and multi-disciplinary team, tackling the common problem of energy demand analysis. This enable each planner to experience and gain insight into the many different facets of energy demand and brought more awareness of the various linkages of other sectors to their own specific field. Previous attempts at energy demand analysis were mainly carried out with substantial external consultancy inputs. This P-1.1 project represents one of the few attempts of local planners defining and executing the work largely by themselves. A better appreciation of the forces at work by planners is one of the major achievements of the study in Malaysia.

3.2 Forecasting work though not fully explored under this project has registered with participants the importance of scenario building. The MEDEE-S has met with good reviews and shall be continued to be used. This area needs further strengthening and will be focused upon in future exercises.

3.3 Data has been identified as the major problem in the study. This is not surprising as sectoral energy demand analysis was not institutionalised in previous National Planning Curricula which means that data collection and compilation for energy planning where available is in alot of cases more by accident that by design. As integrated energy planning builds up its role, data collection will become formalise and become part of the national planning network. This awareness has heightened with the national seminar held at the end of the project which provided the project study team the opportunity to explain the data needs and roles of different agencies in integrated energy planning.

3.4 Energy issues is gaining more prominence in the Malaysian energy scene. The growing awareness of environmental protection and its close links to conservation will feature strongly in the future. Although, study results has not identified any major conservation opportunities, the project brought to the attention of national energy planners the usefulness and importance of energy demand analysis to identify and assess conservation opportunities. With the Malaysian Government's more to utilised its indigeneous resources more e.g. gas, coal and hydropower, market and demand analysis will play an important role in policy making and development of strategies.

3.5 Malaysia is embarking on its Sixth Plan (1991 - 1995) soon and the Government's planning machinery is being geared towards its formulation together with it's next Objective Perspective Plan (OPP) for 1991 - 2000. Sectoral energy demand studies are required to input data to formulate future plans. An energy database project sponsored by UNDP incorporating some energy supply/demand analysis will start of by end of 1989. Meantime, the National Electricity Board is coordinating a project team on energy supply/demand analysis and projections under technical cooperation with the International Atomic Energy Agency (IAEA) using the ENPEP (Energy and Power Planning Evaluation Program) software package. The Asia Pacific Development Cente (APDC) is also launching a national project over the next two years on energy database, energy supply/ demand analysis, energy economy and environmental considerations. This APDC project is scheduled to start in January, 1990.

CHAPTER 1

INTRODUCTION

1.1 THE NEED FOR ENERGY PLANNING

The future development of Malaysia's energy sector is closely related to the economic development of the country. The specific role of energy in its various forms as a production factor, its importance as a consumption good and export/import commodity underlines the fact that sustained economic growth and balanced socio-economic development of the country are dependent to a large extent on an adequate development of the national energy sector. Thus, energy sector development planning is an integral part of economic development planning.

Energy sector development related planning efforts, policy formulation and decision making are geared to meet the prime target of

- o supply of energy in its final forms sufficient to support the achievement of socio-economic goals set for Malaysia's future.

This implies supply of energy in terms of quantities and costs adequate to encourage the development of industrial, agricultural and service sectors and to improve the standard of living of the population.

Economic planning is well-established in Malaysia. Five-year plans, perspective plans covering a long term period as well as sector specific development plans are prepared either regularly or as required. However, in the past, energy planning has not been carried out in such a depth and detail as required for a concept of integrated economic planning which should incorporate energy planning. The National Energy Planning Study (NEPS), in 1985 was the first exercise at comprehensive energy planning.

Considering Malaysia's energy situation which is characterized by a heavy dependence on oil to satisfy the energy needs of the country and considering the past and planned future strong economic growth and the corresponding energy requirements, it is imperative to put higher emphasis on energy planning in the context of future economic planning. In particular, the fact that Malaysia has her own energy resources, which have to be utilized in an optimal way, and the fact that energy development and supply projects are capital-intensive, and generally require long lead times for planning and implementation, stress the need for long term planning and decision making in order to avoid sub-optimal use of natural as well as financial resources.

1.2. BACKGROUND

At the second workshop on Regional Energy Development Programme (REDP) Activity A-4 held in June 1986, Malaysia expressed its interest to participate in the REDP subactivity P-1.1: Sectoral Energy Demand Analysis. Seven other countries, namely Thailand, China, Korea, Nepal, Indonesia, India and the Maldives eventually participated in this project. The REDP sub activity P-1.1, funded by UNDP is implemented under the auspices of the Economic and Social Commission for Asia and the Pacific (ESCAP). The focal point of REDP subactivity P-1.1 in Malaysia is the Economic Planning Unit (EPU) in the Prime Minister's Department.

Efforts by the Malaysian Government to undertake an integrated energy planning were initiated with the commissioning of the National Energy Planning Study (NEPS) in November 1983. The Study was undertaken in recognition of the need to give greater emphasis on in-depth energy planning and as an integral part of overall macro economic planning. The NEPS, completed in October 1985 analysed the past and current energy trends and evaluated future energy demand and supply scenarios as well as the long term development strategies and options of the energy sector. A series of energy supply scenarios were developed with the view of meeting forecasted energy demand by minimising costs of energy development as well as maximising energy export potentials. Related energy conservation, diversification as well as energy self-reliance were also considered.

The National Electricity Board (NEB) had also undertaken an Energy and Electricity Demand study using the Model for Analysis of Energy Demand (MAED). The study was undertaken under a technical cooperation project with the International Atomic Energy Agency (IAEA). However, the scope of the study was rather limited. Since the MAED Model was developed by the IAEA from the MEDEE-II model to provide electricity demand forecasts for its Wien Automatic System Planning (WASP) model, the use of the model has been restricted to electric utilities.

1.3 SCOPE AND OBJECTIVE OF THE STUDY

The main objective of the study is to enhance capabilities in integrated energy planning with special focus and emphasis on methodology, tools and their application for sectoral energy demand analysis. The results of the analysis are envisaged to provide useful inputs towards the formulation of policy recomendation and decisions. The Study was initially envisaged to provide:

(a) an analysis of past energy consumption patterns and factors influencing them such as the economic and demographic growth, technological development and Government policies;

(b) development of a methodology for forecasting various energy demand scenarios in the long term within the context of overall socio-economic development;

(c) the formulation of energy demand management policy recommendations, encompassing issues on energy savings, alternative fuel, energy efficiency, pricing, institutional arrangements and resource allocations.

The implementation of the Sectoral Energy Demand Analysis was planned to comprise the following activities :-

A. *Information Analysis and Energy Data Base* - Review of existing information required by the selected methodology of MEDEE-S. Compilation and computerisation of available data and information as well as analysis of past and existing work pertaining to energy demand. The coverage of the study includes all energy consuming sectors, however, with greater emphasis on the transport and manufacturing sectors, being the two largest sectors (constituting more than 70%) of the total energy demand in the country.

B. *Energy Survey* - A limited transport survey and a mail survey for the manufacturing sector were to be conducted during the study.

C. *Computerisation of the Data Base* - Computerisation of the data base and model/calculation codes. Computerisation of database was to be done with the help of a database management package provided by the Asian Institute of Technology (AIT).

D. *Energy Demand Analysis* - Analysis of past energy consumption pattern and factors influencing

CHAPTER 1

INTRODUCTION

them. This then help the development of future energy demand scenarios, both for the medium and long term as well as a comparative analysis of the past and future trends in energy consumption.

E. *Energy Conservation and Inter Fuel Substitution Analysis* - This comprise a detailed analysis of major issues in energy conservation and availability of alternative fuel, including an assessment of pricing, regulation, incentives and fiscal measures in the country.

F. *Reference Energy Demand Scenario* - Assessment of likely energy demand paths in the long term in relation to socio-economic development and energy supply to develop the reference energy demand scenario for purpose of policy recommendations.

The EPCS in the EPU is be to the focal point for this REDP - subactivity P-1.1. In order to enable wider participation of key agencies related to energy planning, the EPCS established a core group comprising 12 officials from the EPU, Ministry of Energy, Telecommunication and Posts (METP), Ministry of Transport (MOT) and the National Electricity Board (NEB). Other relevant members were coopted when necessary. The following officers made up the core group :-

(i) **Economic Planning Unit**

1) Mr. Kho Chin Seng
(Project Coordinator)

2) Mdm. Leong So Seh

3) Mr. Mohd Irwan Serigar Abdullah

4) Mr. Zailani Ismail

5) Ms. Noraini Ismail

6) Mr. Ahmad Kassim

7) Mr. Mohd. Yazi Md. Zin

ii) Ministry of Energy, Telecommunications and Posts

1) Mrs. Noraini Hashim
2) Mr. Letchumanan Ramatha

iii) Ministry of Transport

1) Mdm. Siew Kuan Wai

iv) National Electricity Board

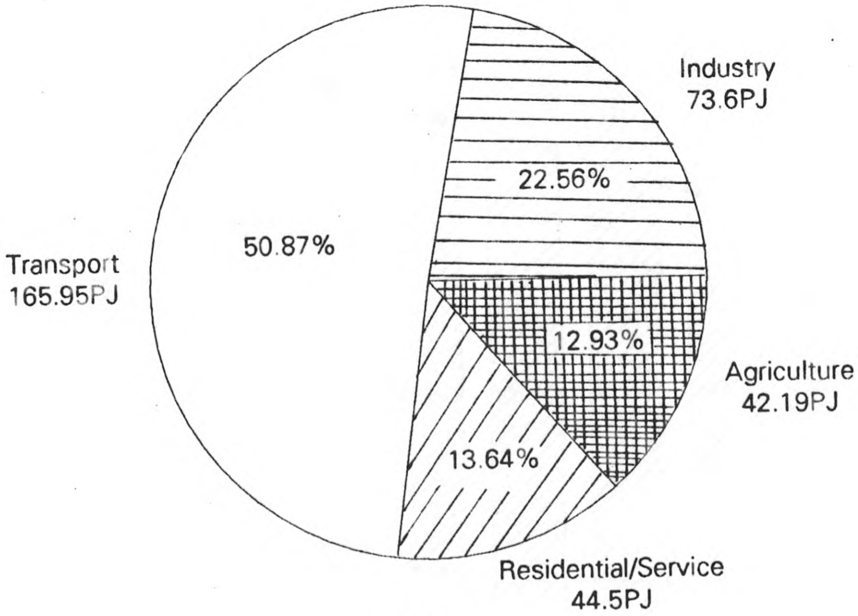
1) Dr. Mohd Zam Zam Jaafar

2) Mr. Loo Kok Seng

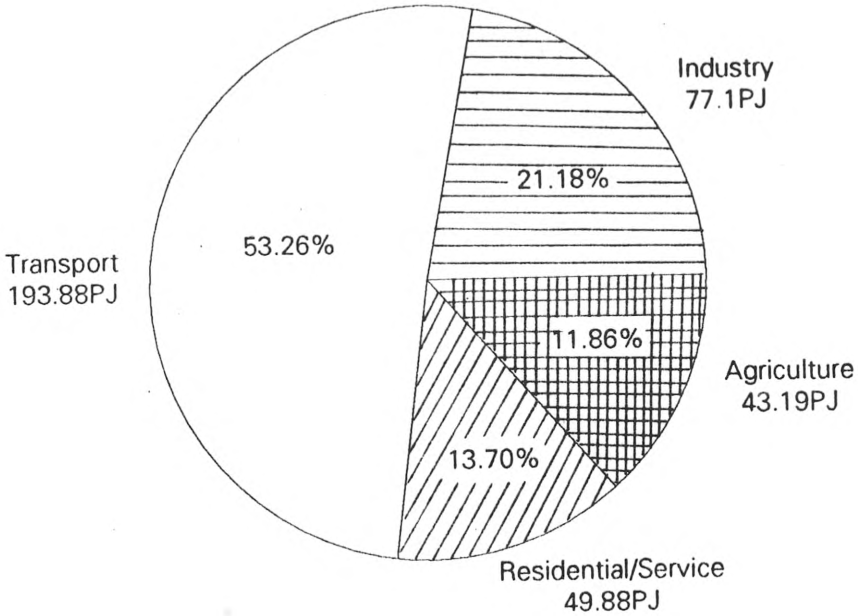
The overall execution of the study was monitored by a steering committee, established under the chairmanship of the EPU with members comprising primarily from the core group. The committee help ensure that findings and results of the study are consistent and within the broad framework of national objectives and strategies, both at the sectoral and overall socio-economic development of the country.

Figure 1

OVERALL ENERGY DEMAND



1983



1985

Figure 2

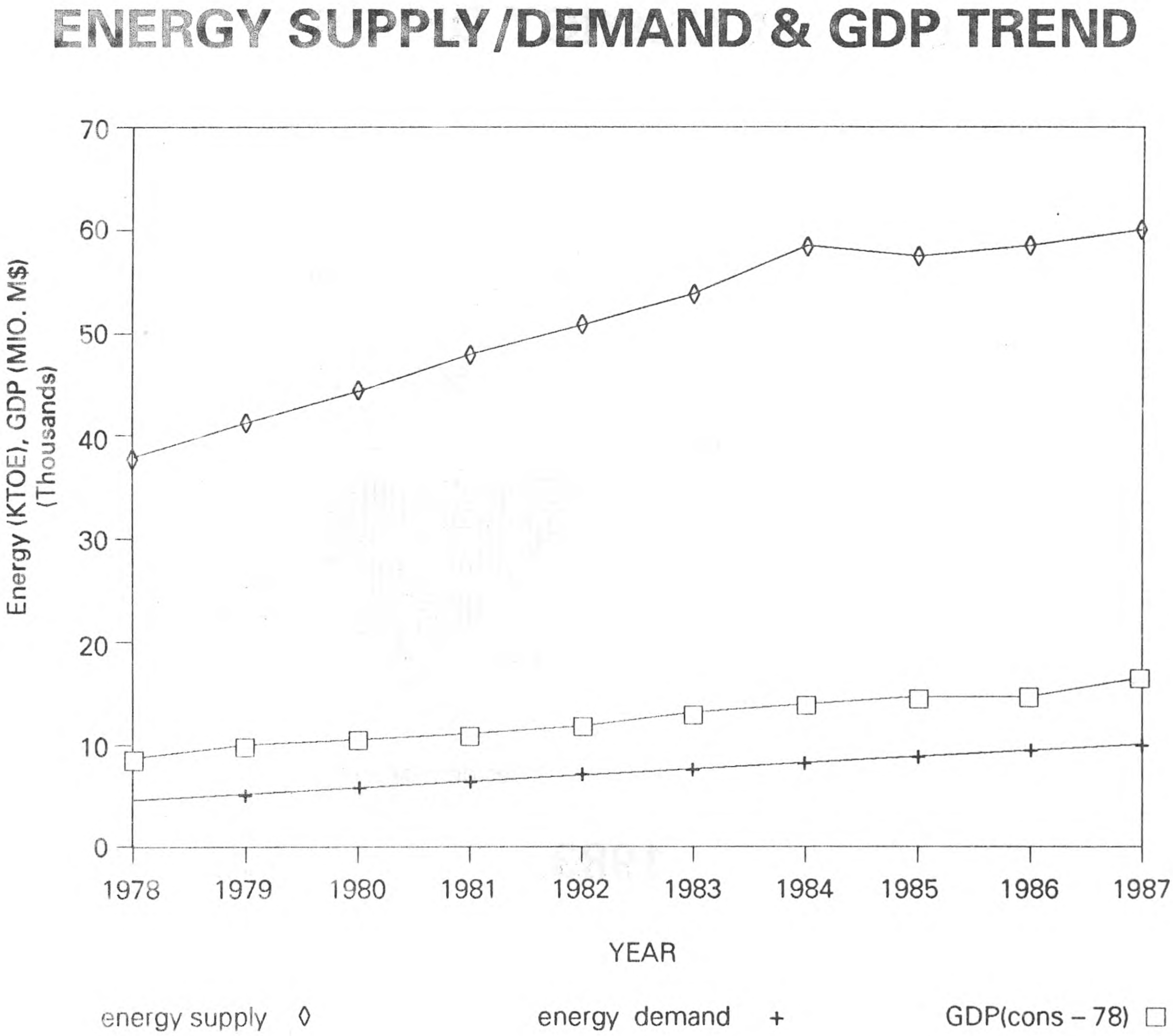

ENERGY SUPPLY/DEMAND & GDP TREND
Energy (KTOE), GDP (MIO. M$)
(Thousands)
70
60
50
40
30
20
10
0
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
YEAR
energy supply ◊
energy demand +
GDP(cons – 78) □

Figure 3

FINAL USE OF ENERGY (KTOE)

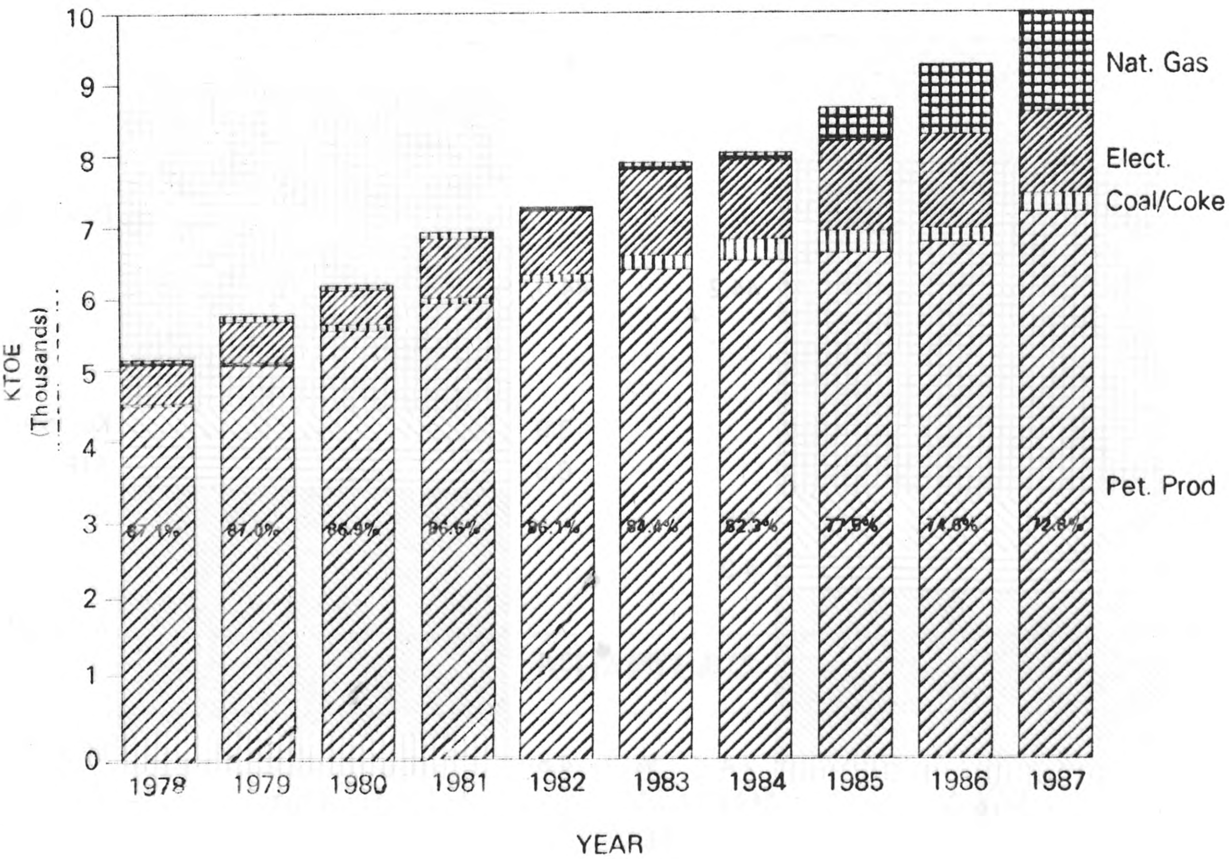
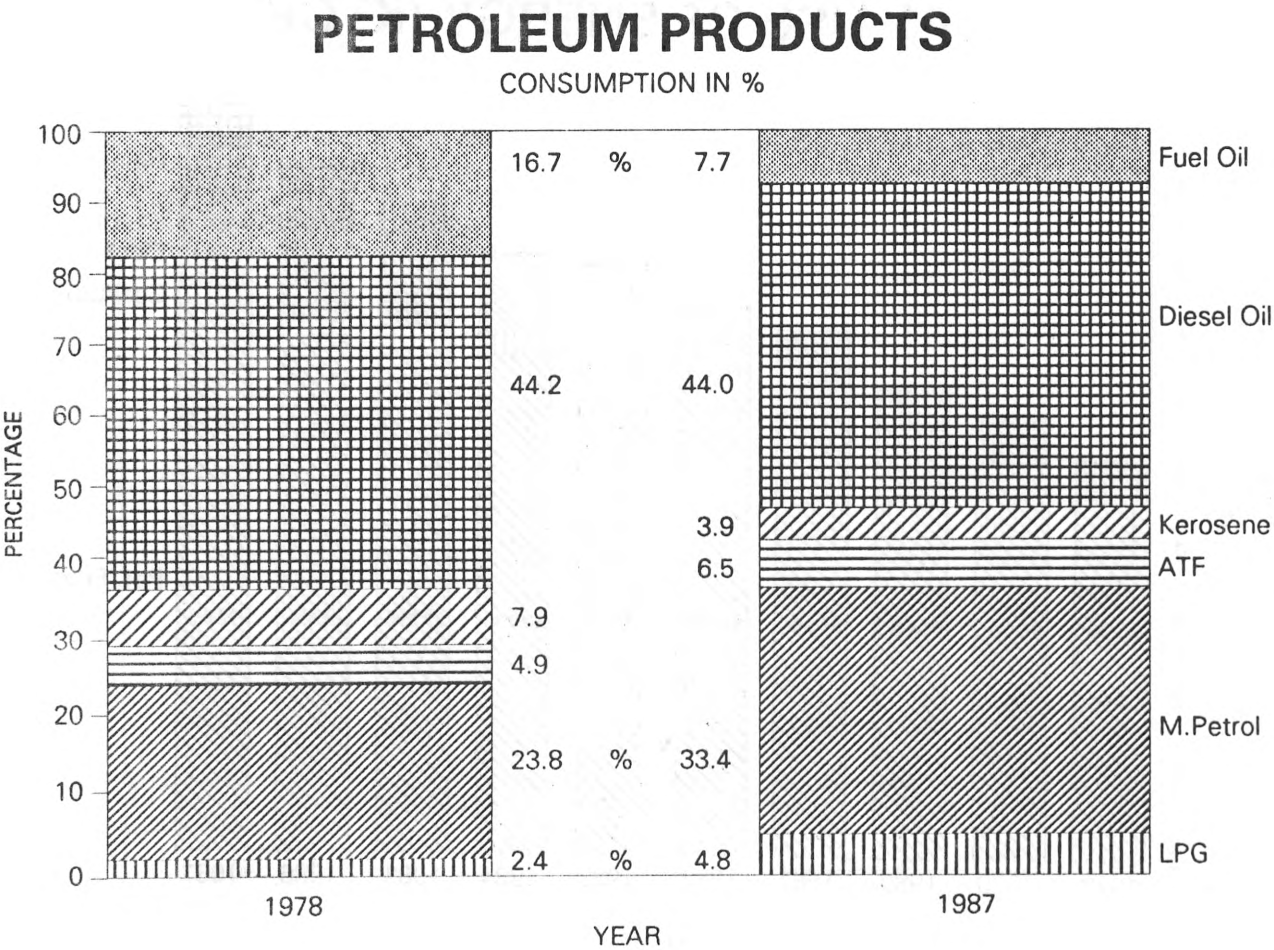


Figure 4



PETROLEUM PRODUCTS
CONSUMPTION IN %
100
90
80
70
60
50
40
30
20
10
0
PERCENTAGE
16.7
%
7.7
44.2
44.0
3.9
6.5
7.9
4.9
23.8
%
33.4
2.4
%
4.8
Fuel Oil
Diesel Oil
Kerosene
ATF
M.Petrol
LPG
1978
1987
YEAR

CHAPTER 2

BACKGROUND INFORMATION ON MALAYSIA

CHAPTER 2

BACKGROUND INFORMATION ON MALAYSIA

2.1 GEOGRAPHY AND CLIMATE

2.1.1 GENERAL

The Federation of Malaysia is composed of eleven states in Peninsular Malaysia which forms the south-eastern extremity of the Eurasian land mass to which it is connected by the Isthmus of Kra. The city of Kuala Lumpur, which is the national centre of administration and commerce, constitutes a separate Federal Territory. The remaining two states of Malaysia, namely Sarawak and Sabah, are located on the north-west region of the Island of Borneo. Malaysia is close to the equator between latitudes 1°N and 7°N. Therefore the climate, being equatorial, is hot and wet resulting in the presence extensive rain forest.

2.1.2 PENINSULAR MALAYSIA

2.1.2.1 Physical Features

A mountain range dominates the central region of Peninsular Malaysia. It runs from the southern tip of Southern Thailand right down to the border of the southern most state of Johor. Most of the ranges are composed of granite rocks covered with dense equatorial forecasts and contains peaks around 2,000 m. The major rivers and streams and their tributaries run parallel as well as tranversely to the strutural grain of the peninsula.

The coastal plain of Peninsular Malaysia is generally covered by recent alluvial deposits and supports large tracts of mangrove swamps. The coastal plain width varies significantly along the entire coastline ranging from 2 km to 45 km. However the average coastal plain strip is within 20 to 30 km wide.

The western coastal plain of Peninsular Malaysia has an irregular shoreline with small and narrow beach ridges. In contrast, the eastern shoreline possess extensive straight coastal stretches with well-developed beach ridges.

2.1.2.2 Climate

In general, the climate of Peninsular Malaysia is characterised by a uniform temperature, high-relative humidity, abundant but seasonal rainfall, little wind and intermittent sunshine and cloud. However, individual regions experience considerable variations in climate.The Peninsula in particular can be divided into at least two distinct, but poorly defined, climatic regions based on monsoon influences. Areas east of the main range are affected by the north-east monsoons which bring heavy rainfalls from October to March each year and areas west of the central mountain range are sheltered from the south-west monsoon by mountain ranges in the Island of Sumatra and generally do not experience prolonged intense rainfalls.

2.1.2.3 Temperature

The annual temperature pattern based on monthly data, indicates that slightly higher temperature occurs during March to May each year. There is only a slight variation between the warmest and the coldest month. The average annual temperature in the lowlands in about 26.5°C while the temperature ranges of approximately 1.1 and 2.5°C are experienced within the east and west coast respectively. Towards Kedah and Perlis average temperatures are about half a degree higher that the normal average, and temperature ranges of the order of 1.8°C are experienced. The average temperature decreases with altitude, conforming to an adiabatic lapse rate of about 6oC per 1,000 m. The maximum shade temperature ever recorded in Peninsular Malaysia is 39.4°C.

2.1.2.4 Humidity

The average monthly relative humidity varies with the prevalent monsoon season, being high on relatively wet months. Higher values tend to occur during periods on heavy rainfall. The average relative humidity in the lowlands is about 83.9% while the interior hills experience slightly higher relative humidities which indicate greater convective influences in these areas.

2.1.2.5 Rainfall

Rainfall in Peninsular Malaysia is affected by the monsoons and by altitudes. The highest rainfall occurs along the coastal mountain ranges which intercepts the moisture laden monsoonal winds. Maximum annual rainfalls of the order of 3,750 mm occur the Taiping, Dungun and Mersing regions. Relatively low rainfalls are experienced in the Tampin, Hulu Perak and North Perlis regions. On the average, annual rainfalls of about 2,000 to 3,000 mm occur within the peninsula. The north-east monsoon brings heavy rainfalls to the east coast areas where about 50% of the average annual rainfall is precipitated between November to Jannuary. In contrast very little rainfall occurs in these areas during February to April and it is not unusual for this region to experience little or not rainfall for up to two months at a stretch. In the Central Highland region, the annual rainfall pattern is similar to that of the west coast with peak rainfall occuring during inter-monsoonal seasons , i.e. April to May and October to November. Monthly totals are characterised by large differences that can occur between individual months. Coastal influences tend to even out daily rainfall distributions. However, in inland areas, daily rainfall is normally associated with convective thunderstorm activity during the mid-afternoon.

2.1.2.6 Wind

Wind characteristics are also influenced by the prevalent monsoon seasons. The north-east monsoon which occurs between November and April produces strong winds along the east coast, the intensity and persistence of which is very nearly matched by winds generated by the south-west monsoon along the west coast and in the highland regions. During the monsoons, wind speeds vary between 9 to 18 km/hr with gusts up to 46 km/hr. At least, 27% of each month is calm, with monthly averages ranging from 30% on the coast to 35% in the highlands. Slight differences between inland and coastal areas are due to effects cause by the sea/land interface. Occasionally, squalls up to 50 knots (92.6 km/hr), refered to as "Sumatras", prevail along the west coast areas. The highest gust recorded was 106 km/hr.

2.1.2.7 Thunderstrom

The frequency of thunderstorm is high, the isokeraunic level being between 150 and 200 day per annum.

2.1.3 SARAWAK

2.1.3.1 Physical Features

Topographically, Sarawak can be divided into three parts :

- the coastal area where the land is generally flat;
- the far interior where the mountain ranges form the borderline between Sarawak and the other states in Borneo Island, and
- the hilly areas sandwiches by the two regions mentioned above.

The high mountain ranges of the interior form a watershed along the borders and the numerous rivers of Sarawak originate from these areas. The vegetation is composed mainly of swamps along the coast and virgin jungle in the far interior. In the mid-region of Sarawak secondary forest is found. In the coastal areas farming is fairly intensive. Shifting cultivation left very distinct marks on the forest areas.

2.1.3.2 Climate

The climate of Sarawak is typically tropical with heavy rainfall and constant high temperature producing high humidity. Primary climatological stations are situated in the coastal area only.

2.1.3.3 Temperature

The mean annual temperature is 26°C and the mean daily maximum is about 32°C for the coastal area whereas it is expected to be a few degrees lower in the interior due to its higher altitude. The highest temperature recorded in the 10-year period 1968 - 1977 was 36.5oC in the month of September, 1976.

2.1.3.4 Humidity

The mean annual relative humidity is about 85%.

2.1.3.5 Rainfall

The rainfall of Sarawak varies greatly from area to area and the mean annual rainfall ranges from 2,250 to 6,000 mm. The annual rainfall pattern in the coastal area, especially towards the west of Sarawak is characterised by a wet period from November to March due to the north-east monsoon and a dry period from April to October. This pattern becomes less pronounced towards the interior.

2.1.3.6 Wind

In general, the surface wind does not vary greatly from one part of Sarawak to another and the mean wind speed is about 1.0 m/s (3.6 km/hr).

2.1.3.7 Thunderstorm

Sarawak has a very high occurrance rate of thunderstorms. The highest monthly occurance is around

April and May with a highest annual occurance of 178 in Kuching.

2.1.4 SABAH

2.1.4.1 LOCATION AND GEOGRAPHY

Sabah is one of the 13 states of Malaysia. It occupies the northern part of the island of Borneo. The State of Sabah is bounded on the south by Brunei, Sarawak and Kalimantan Indonesia. Its coastline of about 1440 km long is surrounded by the South Chine Sea on the west to north and by the Sulu and Celebes Seas on the east. Total area of the State of Sabah is 76,115km2 which is a little over half of Peninsular Malaysia. The Capital city of the State of Sabah is Kota Kinabalu. It is situated on the west coast. Sabah is a mountainous country of dense tropical rain forests as well as alluvial and swampy coastal plains. It is intersected by numerous rivers and fertile valley plans. There lie central mountain ranges having occassional peaks of 1,000 to 2,000 m high. Above all, the highest range is the Crocker Range. It culminates at Mount Kinabalu having a peak of 4,101m or 13,455 ft. the highest mountain in South East Asia. Rivers are numerous throughout the country and are of importance for the area, being often used as the means of transportation and communication. Swift streams flow down slopes of the Crocker Range into the South Chine Sea. The longest river in the east coast area is the Kinabatangan river. The Padas river is the longest river in the West Coast area.

2.1.4.2 CLIMATE

Sabah is located in tropical climate zone. It is situated in the midst of South East Asia monsoon area. The northeast monsoon begins in November and last until March, and the South West monsoon prevails from May untill August. Generally speaking, the southwest monsoon brings rainy season to the west coast and the Northeast monsoon to the east coast.

2.2 MALAYSIA ECONOMY 1970 - 1990

2.2.1 1970 - 1985 PERIOD

Malaysia launched the Overall Perspective Plan (OPP) in 1971 with the main objective of achieving national unity through the adoption of a two pronged New Economic Policy (NEP). The NEP was designed to eradicate poverty irrespective of race, and to restructure society in order to eliminate the identification of race with economic function and geographical location. The country is now in the fourth phase of the OPP which is due to end in 1990. The real Gross Domestic Product (GDP) was targetted to grow at 8.0 per cent per annum over the OPP period, 1971-1990. Despite the setbacks of the oil crises of 1972-1973 and in 1979, the economy managed to register a rate growth of 7.6 per cent per annum during the first ten years of the OPP.

However since 1980, economic development were less favourable mainly due to the prolonged international economic recession beginning in late 1979. Following these the economic growth during 1981-1985 period slackened to 5.8 per cent per annum compared to the relatively high growth rates experience in the 1970's.

The growth of GDP over the period 1971-1985 was 7.0 per cent per annum, where real GDP in 1978 prices tripled from $21,548 million in 1970 to $59,344 million in 1985. The growth rates achieved in Malaysia were relatively high for a developing country and its performance compared favourablely with some of the developed economies. The high economic growth of this 15 year period was accompanied by a structural tranformation of the economy gradually shifting from low productive and subsistence activities to high productive and modern activities. In terms of sectoral output, significant changes in the composition of production took place with a rising contribution of the manufacturing, contruction, and banking and finance sectors, and a declining role of the agriculture sector. The manufacturing sector expanded from 13.9 per cent of GDP in 1979 to 19.1 per cent 1985, while that of agricultural sector declined from 29.0 per cent to 20.3 per cent during the same period.

Within sectors, structural changes took place in terms of contribution of various sub-sectors, in the agriculture sector, palm oil and cocoa increased their shares, while that of rubber and paddy continued to decline. The electrical and electronic equipment, petroleum products and textiles subsectors increased in the share of the manufacturing sector, while rubber and wood products subsectors remained unchanged. In the mining sector, the share of tin decline from 78.0 per cent in 1971 to 21.0 per cent in 1985, whereas the contribution of petroleum (in 1970 prices) increased from 17.0 per cent to 69.0 per cent.

2.2.2 1985 - 1988 PERIOD

As the world experienced a severe economic recession in 1985, the domestic economy also immediately took a downturn. With export volume stagnating and commodity prices moving downward, the overall income fell. Overall output declined for the first time since independence, where the country experienced a negative GDP growth rate of - 1.0 per cent in 1985. The sectors which performed badly were the mining, manufacturing, construction and commercial sectors.

However in the following years the economic situation improved considerally with a GDP growth rate of 7.6 per cent in 1988. The sectors which performed better compared to 1985 were the manufacturing, mining and the services sectors. The construction sector however continued to decline in terms of contribution to the total GDP.

2.2.3 PROSPECTS 1989 - 1990 PERIOD

While the world economic outlook seems to be plagued with prolonged uncertainties, the domestic economy is somewhat more promising. In the next two years, GDP is expected to grow at 6.5 per cent per annum. The momentum of output expansions will be from the secondary and tertiary sectors whilst the primary sector will experience sustained growth. The manufacturing sector is expected to over take the Agriculture sector as the leading contributor to the national output with 26.1 per cent as against the agriculture sector 20.00 per cent in 1990, compared to 1985 where the agricultural sector was leading with 20.8 per cent and manufacturing sector with only 19.7 per cent.

2.3 POPULATION

2.3.1 Malaysia was estimated to have a total population of 17.1 million in 1988 compared with 15.9 million in 1985, with an average growth rate of 2.6 percent per annum. The Peninsular Malaysia accounts for 81.9% of the total population in 1988, with the remainder 9.7% residing in Sarawak and 8.4% in Sabah. Malaysia continued to have a young population, where in 1988 the median age of the population was about 21 years. Distribution by different ethnic group of the Peninsular Population shows that in 1988, 57.6% are Malays, 31.8% Chinese, 10.0% Indian and 0.6% Others. Malaysia's total population is expected to reach 18.0 million by 1990, with an average annual growth rate of 2.5 percent, which is the highest among the ASEAN countries.

2.3.2 LABOUR FORCE AND EMPLOYMENT

The size of labour force was 6.0 million in 1985 and increased to 6.6 million in 1988. The labour force growth rate was at about 3.1% during the period 1986 - 88. The total employment grew at a rate of 2.6 percent per annum during the same period. The total employment in 1988 stood at 6.1 million, with unemployment accounting for more than 0.5 million or an unemployment rate of 8.1%. The agriculture sector still leads in terms of total employment by sector accounting for 31.2% in 1988 followed by the wholesale and retail trade, hotels and restaurants sector 17.9% and the manufacturing sector 16.4%. But during the period 1986 - 88, the majority of the 458,000 new jobs generated were in the services, manufacturing and agriculture sectors respectively. By 1990 the total labour force is expected to reach 7.0 million, employment to about 6.5 million with unemployment rate declining to 7.7 percent.

CHAPTER 3

ENERGY SITUATION IN MALAYSIA - AN OVERVIEW

CHAPTER 3

ENERGY SITUATION IN MALAYSIA-AN OVERVIEW

3.1 Past Energy Consumption and Supply

Availability of reliable data on past energy consumption and supply is a prerequisite for projecting future energy demand and supply development. In general, energy supply data are to be disaggregated according to the particular types of energy supplied. Furthermore, energy supply is divided into primary and secondary supply:

- Primary supply of energy refers to inland availability of energy that has not undergone a conversion process in the country.
- Secondary supply of energy refers to supply of energy from conversion processes excluding losses and own use of the conversion processes.

Energy delivered to final users is called final use energy. In this chapter, energy consumption basically refers to energy used at the final use level. The degree of disaggregation of final use data depends on data availability as well as desired application purposes. Apart from energy consumption at the final use level, energy is used or lost in energy conversion processes, to transmit electric power etc. These issues are dealt with when aspects of conversion and transmission of energy are considered.

To obtain a clear and consistent picture of energy supply and consumption, data on all pertinent energy flows have to be compiled and evaluated. The most common framework used for systematic compilation and accounting of all relevant energy supply and consumption data is the energy balance format. In the following paragraphs 3.2 and 3.3 the past energy supply and consumption development is summarized on the basis of the prepared energy balances.

3.2 Energy Balances 1978-1987

The compilation of energy balances for the years 1978-1987 is conducted by the Ministry of Energy, Telecommunication and Posts (METP). The METP energy balances focused on commercial energy only. The disaggregation level of final use of energy according to economic sectors as given in the METP balances was not sufficient for the study purposes. In addition to the information available from METP, other information had to be evaluated to achieve the desired sectoral disaggregation.

3.2.1 Summary of Past Development of Energy Supply and Consumption

In the following, the official Malaysian energy balance information is summarized to highlight the development of energy supply and consumption for various energy carriers for the period 1978 to 1987.

3.2.1.1 Primary Supply of Energy

For the assessment of primary supply of energy, the following items are taken into account:

- Primary energy production in Malaysia
- Energy imports
- Energy exports
- Bunkers
- Stock change (rise - , fall +)
- Statistical discrepancies.

Table 3.1 summarises total primary energy supply in 1978-1987. The following development is obtained from the table:

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Average annual increase (%)
*Adjusted Primary Supply (KTOE)	8126	8955	9356	9918	10418	11768	12488	13703	13706	14933	-
(PJ)	340	375	391	415	436	492		522	522	625	
Annual Increase %	-	10.2	4.5	6.0	5.0	13.0	6.1	9.7	0.0	9.0	7.0
Crude Oil and Petroleum Products (KTOE)	7021	7682	8224	8866	9165	9715	9405	9710	9283	8999	-
(PJ)	294	321	344	371	383	406	394	406	388	377	
Crude Oil and Petroleum Products Share (%)	86.4	85.8	88.0	89.4	88.0	82.6	75.3	70.9	67.7	60.3	-

* Excluding flared gas

Table 3.1: TOTAL PRIMARY SUPPLY OF ENERGY (in KTOE)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Natural Gas	2021	2515	2237	1881	2368	5735	8715	9629	11164	14002
LNG	0	0	0	0	0	2416	4603	5658	6876	8276
Crude Oil	5847	6065	5901	5784	5435	6750	7721	7579	7549	7274
Total Petroleum Product	1174	1617	2323	3082	3730	2965	1684	2131	1798	1725
(PJ)	49	68	97	129	156	124	70	89	75	72
Coal and Coke	23	33	53	99	93	249	270	362	268	327
Hydropower	244	296	383	403	394	454	913	1019	1070	1212
Electricity	1	9	7	7	6	3	7	5	0	-2
Total (KTOE)	9310	10535	10904	11256	12026	13740	14707	15067	14973	16262
Total (PJ)	390	441	456	471	503	575	615	630	626	680
Flared gas	1184	1580	1548	1338	1608	1972	2219	1364	1267	1329

The average annual increase of primary supply (adjusted as mentioned above) is 7.0%. Crude oil and petroleum products (at primary supply level) have a share of 86.4% in 1978 decreasing to 60.3% in 1987.

Table 3.1 contains energy imports and exports. Table 3.2 summarizes the development of energy imports and exports by energy type.

3.2.1.2 Secondary Supply of Energy

For the assessment of secondary supply of energy, the following items are taken into account:

- Energy conversion
  - Refineries
  - Power stations
- Energy losses and own use for conversion processes
- Statistical discrepancies.

The Tables 3.3 and 3.4 summarize the energy conversion development in refineries and power stations.

3.2.1.3 Refinery Output

Due to the increased share of Malaysian crude oil as refinery feedstock, the effective capacity of the Esso and Shell refineries, which were originally designed for Middle East crude, was reduced. The change of feedstock mix was required to adjust refinery output to changing petroleum product demand, i.e. to get a higher proportion of light and middle distillates at the expense of fuel oil output. The production shares of selected fuels developed as follows (in % of total refinery output, see Table 3.3):

Production Share (%)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Motor Petrol	17.1	17.5	16.4	16.8	18.0	15.7	15.8	15.8	15.6	16.0
ATF	2.7	3.0	3.8	4.0	4.9	4.0	3.4	2.7	4.0	3.7
Kerosene	4.1	4.0	4.1	5.0	5.4	8.3	10.7	9.5	8.8	8.6
Diesel Oil	27.4	28.7	30.7	32.4	36.4	36.4	33.4	31.7	30.7	31.1
Fuel Oil	43.2	41.6	39.6	36.3	29.5	30.3	26.9	25.9	25.0	24.5

TABLE 3..2

PRIMARY SUPPLY OF ENERGY - ENERGY EXPORTS AND IMPORTS (in KTOE)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Export										
Natural Gas	13	9	8	10	11	2418	4603	5658	6788	7751
Crude Oil	9472	2455	11619	10497	12392	14720	17073	17338	19683	18784
Petroleum Products	170	177	132	123	291	976	1676	1949	2257	2425
Total Export	9655	12641	11759	10630	12694	18114	23352	24945	28728	28960
(PJ)	404	529	492	445	531	758	967	1044	1202	1212
Import										
Crude Oil	4303	4508	4038	3622	2587	2709	2690	2302	1976	1578
Petroleum Products	1450	1888	2627	3160	4011	3981	3418	4062	4162	4245
Coal and Coke	23	33	53	99	93	249	270	362	268	327
Electricity	1	9	7	7	6	5	7	5	0	0
Total Import	5777	6438	6725	7338	6697	6944	6385	6731	6406	6150
(PJ)	242	269	281	307	280	291	267	282	268	257
Net Export	3878	6203	5034	3292	5997	11170	16967	18214	22322	22810
(PJ)	162	260	211	138	251	467	710	762	934	954

TABLE 3..3

CONVERSION IN REFINERIES (in KTOE)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Input										
Crude Oil	5847	6065	5901	5784	5435	6750	7721	7579	7549	7274*
(PJ)	245	254	247	242	227	282	323	317	316	304
Share of Imported Oil in %	73.6	74.3	68.4	62.6	47.6	40.1	34.8	30.4	26.2	21.7
Output										
Total Petroleum Products	5735	5922	5693	5453	5275	6556	7608	7530	7845	7940*
(PJ)	240	248	238	228	221	274	318	315	328	332

* inclusive of products due to refinery intake other than crude.

TABLE 3..4

CONVERSION IN POWER STATIONS (in KTOE)

	1978	1989	1980	1981	1982	1983	1984	1985	1986	1987
Input										
Hydropower	244	296	383	403	394	454	913	1019	1070	1212
Diesel Oil	145	247	287	273	333	461	321	345	239	183
Fuel Oil	1842	1930	2059	2097	2358	2370	2351	2174	2213	2086
Natural Oil	21	24	33	36	35	59	81	539	703	818
Total (KTOE	2252	2497	2762	2809	3120	3285	3666	4077	4225	4299
(PJ)	942	104	116	118	131	137	153	170	177	180
Output										
Total Electricity Generated	710	789	864	928	1013	1097	1182	1285	1387	1498
(PJ)	297	33	36	39	42	46	49	54	58	63
Annual Increase (%)	-	11.1	9.5	7.4	9.2	8.3	7.7	8.7	7.9	8.0

3.2.1.4 Electricity Generation

Electricity generation increased at an average annual rate of 8.61% over the period of 1978 to 1987. Hydropower contribution to power generation amounted to 28.2% in 1987 compared to 10.8% in 1978. Fuel oil contributed 48.5% in 1984, and 81.8% in 1978, diesel oil 4.3% in 1987, and 6.4% in 1978. The share of natural gas increased from 0.9% in 1978 to 19% in 1987. The figures for electricity generation contain electricity generated from mining installations and private installations which hold licences from the Chief Electrical Inspectorate. The diesel fuel requirements of these installations are (in PJ):

	1978	1979	1980	1981	1982
Diesel for licensed private power generation	3.48	3.65	3.73	3.99	3.98

Data on other private power generation, e.g. electricity generation in palm oil mills, sugar mills etc., are not available.

3.2.1.5 Final Consumption of Energy

Energy available for final use comprises primary supply plus secondary supply. Primary supply of energy used for transformation has a negative sign in the energy balances as it is not available for final use. In general, data for energy supply and data for energy consumption come from different sources. Inconsistent data or incomplete accounting result in discrepancies between supply and consumption data. These discrepancies are accounted for in the energy balances ("statistical discrepancies"). Table C.5 summarizes final use of energy for 1978 to 1987. Final use of energy increased by an average annual rate of 7.7% (non-commercial energy excluded).

TABLE 3.5

FINAL USE OF ENERGY (in KTOE)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	Average Annual Increase
Total Petroleum Products	4456	5032	5550	6041	6228	6641	6622	6756	6880	7271	5.6
Coal and Coke	23	33	53	99	98	249	270	362	268	327	34.3
Electricity	604	684	747	800	866	935	1019	1079	1164	1253	8.4
Natural Gas	31	33	35	39	46	45	134	515	910	1132	49.1
Total	5114	5782	6385	6979	7233	7870	8045	8712	9222	9983	7.7
(PJ)	214	242	267	292	303	329	337	365	386	418	0.3

The share of petroleum products at the final use level developed as follows (in %):

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Share of Petroleum Products in Total Final Energy	87.1	87.0	86.9	86.6	86.1	84.4	82.3	77.5	74.6	72.8

For selected petroleum products the consumption developed as follows:-

	1978 KTOE	1978 (PJ)	1987 KTOE	1987 (PJ)	Average Annual Increase (%)
LPG	101	4.22	330	3.81	14.1
Motor Petrol	1,010	42.25	2,297	96.11	9.6
ATF	209	8.74	434	18.16	8.5
Kerosene	337	14.10	269	11.25	-2.5
Diesel Oil	1,877	78.53	3,026	126.61	5.4
Fuel Oil	709	29.66	529	22.13	-3.2
!Non-Energy Products	180	7.53	358	149.78	7.9

With regard to non-commercial energy carriers the national consumption of fuelwood and palm oil mill byproducts, which are the main non-commercial energy carriers used, was estimated for the year 1982 under NEPS. NEPS also estimated the utilization of woodwaste from woodwork and finishing industries for own use of these industries, timber residues from sawmills and plymills for own use of these mills, and for palm oil mill byproducts used in palm oil mills for power and process heat generation. On the basis of rubberwood production available for energy purposes, domestic use of rubberwood as fuel (as well as for charcoal preparation) was also estimated under NEPS.

At the final use level, the estimates show that fuelwood and palm oil mill byproducts have a share of about 18%.

However, non-commercial energy carriers has not been monitored nor any attempts at estimates made since then. No attempt has been made in this study to estimated non-commercial energy carriers.

Summary

At the primary supply level, commercial energy supply (flared natural gas excluded) increased at an annual average of 7.0% over the nine years. The share of crude oil and petroleum products varied between 86.4% (1978) and 60.3% (1987). The share of charcoal, fuelwood and palm oil mill byproducts was estimated at 15% in 1982.

At the secondary supply level, electricity generation increased by about 8.65% p.a. over the given period. Refinery output decreased from 5922 KTOE in 1979 to 5275 KTOE in 1982 due to reduced effective refinery capacity because of an increased share of local crude oil for refinery input. The share of imported oil decreased from 73.6% in 1978 to 21.7% in 1987. As a consequence the refinery output share of fuel oil decreased from 43.2% in 1978 to 24.5% in 1987, the share of diesel oil increased from 27.4% in 1978 to 31.1% in 1987.

At the final use level, energy consumption increased by an average annual rate of 7.7%. The share of petroleum products in total final use varied between 87.1% in 1978 and 86.9% in 1980 and 72.8 in 1987.

3.3 Disaggregation of Energy Consumption at Final Use Level

The analysis of past energy consumption by sector and fuel was initially intended to cover a time horizon long enough to explain the past consumption trends either with or without econometric analysis. This did not imply that an econometric approach would provide the key method for energy demand projections but could have been useful to identify correlations between past energy demand and other variables, i.e. as a contribution to understand the past to the extent that it can be explained by econometric regression analysis. The establishment of sufficiently long term series as a prerequisite for this kind of analysis did not prove to be a meaningful undertaking due to the incompleteness and poor quality of consumption data which is increasing the further on one goes back. Further, the time frame of this REDP P-1.1 project did not enable detail analytical work to be done as more time was spent collecting and verifying data than originally estimated.

In the preparation of the energy balances 1978 - 1987 by METP, the officially available data for energy consumption at the final use level was the main area of doubt. For electricity, sales figures for the different consumer classes served by the utilities are available. However, with regard to petroleum products the picture is quite different. Major efforts would have to be made to obtain a fairly consistent breakdown of petroleum product consumption for the different sectors for comprehensive integrated energy analysis is to be meaningful. This is recognised by the REDP P-1.1 team and work will continue to improve the final energy consumption data.

Final Use of Petroleum Products

Data available from government sources gave only broad indications regarding sales of petroleum products to consumers. The breakdown of sales by consumer category was available for the following categories only:

- Retail
- via distributors
- Direct Sales
- Government & Military
- Others.

The energy balances 1978 - 1987 contain a final energy use breakdown based on the mentioned information. The obtained level of disaggregation of final use of petroleum products was not sufficient for the purposes of the REDP P-1.1 Study as energy demand analysis had to be carried out at sectoral level. In addition to data used for the energy balances, the following main sources of information were taken into consideration to obtain a sectoral breakdown of past petroleum consumption:

- Energy Statistics 1970 - 1972, Department of Statistics
- Petroleum product sales figures, Ministry of Trade and Industry
- Industrial Surveys, Department of Statistics
- Yearbook of Transport Statistics, Ministry of Transport
- NEPS

Time series for energy consumption in monetary terms by major sectors, approximately according to the sector classification which was used for the description of GDP by industry of origin for the Five-Year Plan of Malaysia, were available from the Energy Statistics compiled by the Department of Statistics for the years 1970 to 1982. For the industrial sectors the energy consumption data was based on the annual surveys of industries. The source data, however, from where the aggregate figures were derived was not available anymore for the sectors. After 1979, quantity data of energy consumption were dropped from the surveys, so that a valuable source of information of energy use by sub-sector in subsequent years was lost. This survey was however, revived in 1983.

In NEPS, since the energy consumption data were given in monetary terms, an attempt to calculate the energy consumed in quantity units was to apply the well documented prices for petroleum products and electricity. However, the results were not consistent with the energy balances (with regard to totals) nor with sectoral figures from other sources.

As the energy balance figures were based on one set of official sources and were part of a systematic accounting framework, it was decided to take the final energy use totals of the balances as the basis of for analysis in this project.

CHAPTER 4

ENERGY DATABASE AND SURVEYS

CHAPTER 4.

ENERGY DATABASE AND SURVEYS

4.1. Introduction

A centralised and integrated database on energy supply/demand and social economic parameters is a prerequisite for comprehensive energy planning work. There exists some data scattered around different ministries, agencies in a host of studies on related subjects. The EPU possess limited data as found in the National Energy Planning Study (NEPS) completed in 1985. This study utilises energy demand data of 1978 and 1978 which were obtained from the Department of Statistics. In NEPS, these limited information were analyzed and used to help establish the data for base year 1980 which were then used for projection. As was pointed out in NEPS, the need for a comprehensive energy databank is paramount if planning work is to continue. This is recognised by the government who have approved the setting up of the Energy Planning and Coordination Section (EPCS), Economic Planning Unit (EPU), within the Prime Minister's Department's, one of whose duties is to manage the energy database. The EPCS has put the setting up of an energy database as a priority area and substantial funds and effort will be put into this area for 1989 and 1990.

The following paragraphs discussed some of the major deficiencies in the existing data.

4.2. Socio-Economic Data

The EPU possess some social-economic data for major economic sectors and at present has projections only up to 1990. This means that EPCS will have to produce its own macroeconomic forecasts for any projection work beyond 1990. This was done by Consultants in NEPS which is now about 5 years old. However, work on the Sixth Malaysia Plan (1991 - 1995) is to begin soon and probably the next Objective Perspective Plan (1991 - 2000) will be available by end 1990.

Demographic data shall be updated with the advent of the Nation-wide Census scheduled for 1990. EPU is in dialogue with the Department of Statistic and shall work towards gathering data on energy consumption.

4.3. Oil Products

The METP compiles the National Energy Balance which only accounts for commercial energy. The sectoral breakdown in the final consumption are of the following subsectors:-

- Residential & Commercial
- Industrial
- Transport
- Non-energy

The petroleum products final consumption are built up with information received from oil companies who provide data disaggregated into the folowing categories:-

- Direct Sales
- via distributors
- Government/Military
- Others

However, further disaggregation of the data for 1987 was available as follows:_

- o Manufacturing
- o Agriculture and livestock
- o Forestry and logging
- o Fishing
- o Mining and Quarrying
- o Construction
- o Transport
- o Wholesale and Retail, Hotels and Restaurants
- o Finance, Insurance, real estate and Business Services

There is need for better rapport with the oil companies to institute a regular flow and interchange of information. This has been recognised and will be one of the key areas that will be looked into.

4.4. Energy Demand Data

Energy consumption data was compiled by The Department of Statistics published under "Energy Statistics". However, this was discontinued after 1982. The Department of Statistics has since (from 1983) revived the establishment surveys on energy consumption. These data has been introduced into EPCS energy database and analysis has shown rather large fluctuations in some sectors (historically). This indicates inconsistencies and errors which will have to be traced. Substantial work has been done by the team in this respect but due to time and manpower constraints, the team cannot go beyond the source data received from the Department of Statistics. This problem was also encountered during the NEPS where survey data was found to be inconsistent with the energy balance.

Although, there's a wealth of energy consumption data available, down to 5-digit ISIC level, the reliability is doubtful in a number of sectors which render analysis difficult.

4.5 TRANSPORT

This section lists the general characteristics and problem area in the transport sector database. The individual chapters on the different transport modes address the database in greater detail.

4.5.1 Road

The most obvious lack is that there is no information on operational fleet. However, this deficiency is recognised by the Ministry of Transport who has institute procedures to obtain such information. This is easier said than done as the Road Transport Department has only computerized their Kuala Lumpur/Petaling Jaya data. Thus a lot of manual work will have to be done until such time when the whole country is computerized.

As far as energy consumption data is concerned, there are rather large gap in existing data as this area has never been looked into before. There will be a need for surveys to fill in these gaps and procedures established to obtain data on a regular basis.

4.5.2 Rail

This sector has the majority of the required data though there are still deficiencies.

4.5.3 Air

Fuel consumption in terms of domestic and International sectors for the national carrier, Malaysian Airlines is available in time series. However, the passenger and freight traffic breakdown in terms of domestic and international sectors is not available.

4.5.4 Sea

The team has not been able to form a database in this sector. Riverine and coastal transport is of importance in rural areas especially in Sarawak and Sabah. However, expensive surveys over a very, very wide expanse and remote areas would have to be conducted to gather the relevant data. This is at present financially not affordable.

The team has recognised the urgent need to establish an updated and comprehensive energy databank. The various agencies participating in this project know the deficient areas and will endeavour of improve the database in their respective areas of interest. One of the most important result of this project in the identification of data/information gaps and the need for acquisition procedures to overcome these deficiencies.

4.6 The Kuala Lumpur/Petaling Jaya Service Station Survey

4.6.1 Introduction

A limited service station survey was carried out in the Kuala Lumpur/Petaling Jaya area, the largest urban area in Malaysia, upon the recommendation of the Central Consultant of the P-1.1 project. This survey was contracted to Survey Research Malaysia Ltd, a Malaysian survey company in October, 1988. Design of questionaires were carried out jointly by SRM, the EPCS and MOT with the participation of the Central Consultant. The service stations to be surveyed were identified by the EPCS working in close cooperation with the six major oil companies in Malaysia, viz. PETRONAS, SHELL, ESSO, CALTEX, MOBIL and BP. Good cooperation from these oil companies enable high sales service stations to be recruited with a even spread over Kuala Lumpur and Petaling Jaya.

4.6.2 Objectives of the Survey

This survey was obtain indicative information of the following:-

(i) unit consumption of motor vehicles by fuel-type (Petrol, Diesel) and by vehicle-type.

(ii) annual mileage of motor vehicles by vehicle-type.

Data on above are lacking and this survey is designed to provide in a limited way, some indication of fuel consumption and road vehicle utilization trends in the urban area.

4.6.3 Methodology

The information on fuel purchases, vehicle vintage, unit consumption, etc were sourced from a round-the-clock, 24 hours monitor of 8 petrol stations. Each station was monitored for a full 7-day week. The petrol stations were selected to reflect the following coverage:-

- o stations in city centre
- o stations along highways
- o stations in the residential area

The data obtained was compiled, processed and tabulated by SRM. The first tabulations was reviewed by EPCS and the Central Consultant (D. Bosseboeuf) in December, 1988. The comments were incorporated into the final report and final tabulations were was submitted by SRM middle March, 1989.

The field work lasted about two months, during October and November, 1988.

4.6.4 Problems encountered in Survey work

There were some problems during the survey work at the petrol stations and are briefly listed below:-

o Apprehension of petrol station owners that the survey information would be used by competitors. They fear especially that the information would be used against them by the Income Tax Department.

o The private car owners are generally cooperative. The main obstacle come from the taxi drivers/ owners, who again fear that the information would be used for income tax purposes.

The above two problems were the main obstacles against the surveyors and some station owners refused to participate. Hence, time was wasted in sourcing alternative stations. Infact, one station owner refused to let the surveyors had to be recruited. The station owners who cooperated said that their sales went down during the period due to reluctance (mainly from taxis) to refill at their station.

4.7 Number and Type of Vehicles

A total of 73,205 vehicles have been recorded in the 8 petrol stations selected for the study. These recordings were made from the week long monitor in each station, continuously for 24 hours a day. The distribution of these 73,205 vehicles shows a skew towards private passenger cars and motorcycles, which account for the bulk of the vehicles refuelling at the petrol stations. Together with vans for private use, and 4-wheel drives, they account for 87% of the vehicles.

These 87% privtae vehicles are segmented as :

* cars 48%
* motorcycles 35%
* vans for private use 3%
* 4 wheel drives 1%

Taxis and commercial vehicles form another 2% each, while lorries account for 5%. There are another 4% who buy fuel using jerricans. Possibly because buses have their own depots for fuel, they account for only less than 0.5% of the vehicles monitored.

Table 4.1

TOTAL NUMBER OF VEHICLES (PRIVATE VEHICLES AND TAXIS) MONITORED

	TOTAL
Private Vehicles (Any)	63592
- Car	34873
- Van	2466
- 4 Wheel Drive	424
- Motorcycle	25829
Jerrican	2880
Taxis (Any)	1751
- In-town	1097
- Inter-town	654
BASE : All Vehicles	73205

Table 4.2

TOTAL NUMBER OF VEHICLES (BUSES AND COMMERCIAL VANS/LORRIES) MONITORED

	TOTAL
Buses (Any)	279
- Stage	6
- Tour	9
- Express	2
- Minibus	150
- School Bus	90
- Factory Bus	19
- Red Crescent Bus	3
Commercial Vans (Any)	1156
Lorries (Any)	3547
- Less than 2500 kg	3005
- 2501 - 15000 kg	460
- More than 15000 kg	73
- Others	9
BASE : All Vehicles	73205

Table 4.3 :

TOTAL NUMBER OF VEHICLES
(PRIVATE VEHICLES AND TAXIS) MONITORED

	TOTAL
Private Vehicles (Any)	87
- Car	48
- Van	3
- 4-Wheel Drive	1
- Motorcycle	35
Jerrican	4
Taxis (Any)	2
- In-town	1
- Inter-town	1
Buses (Any)	*
Commercial Vans (Any)	2
Lorries (Any)	5
BASE : All Vehicles	73205

4.8 Fuel Purchased

The majority of the fuel purchased is premium petrol, with 95% of the vehicle refuelling this type of petrol. However, analysis at the subgroup level shows marked differences in the type purchased by the private vehicles and those vehicles for public or commercial use. Whilst virtually all private vehicles (99%) buy premium petrol, a substantial proportion of the other vehicle types buys diesel :

	premium petrol	diesel
* taxi	52%	46%
* bus	1%	99%
* cv/lorries	66%	32%

In terms of the station type, there is no difference between the stations. All of them have at least 90% of the vehicles refuelling with premium petrol.

Table 4.4 summarise the volume of fuel purchased from the stations monitored, estimated from actual recordings of the amount purchased at the stations. In total, the estimated amount is 882,602 litres of which:

* petrol accounts for 759,102 litres, or about 86% of the total

* diesel makes up 122,458 litres, or 14% of the total.

These estimates refer to a week's monitor of 7 days a week and 24 hours a day, as all the stations monitored were in 24-hour operation.

Table 4.4 :

TYPE OF FUEL PURCHASED

	TOTAL	VEHICLE TYPE Private Vehicles	Taxi	Bus	Commercial Vans/ Lorries
	%	%	%	%	%
Premium petrol	95	99	52	1	66
Regular petrol	*	*	2	-	2
Diesel	5	*	46	99	32
LPG	*	*	*	-	*
BASE:All Vehicles	73205	63592	1751	279	4703

4.9 Use of Commercial Vehicles and Buses

The majority of the commercial van/lorries monitored in the study were used for carrying industrial and commercial goods (88%). Only 8% were carrying agricultural goods while an estimated 4% are used to transport people. However, the sample size is too small to draw any major conclusions.

Buses in the transportation sector (67%) account for the majority of the buses monitored, while 22% comes under private buses (22%) such as those used for touring purposes. Buses used by the industrial and commercial establishments make up 11% of the buses covered.

Table 4.5

MAIN USE OF LORRIES/COMMERCIAL VANS

	TOTAL	Commercials Vans	LORRIES Less than 2500 kg	2501 - 15000 kg	Above 15000 kg	Others
	%	%	%	%	%	%
Transportation of passengers	4	8	2	2		22
Carrying industrial/commercial goods	88	87	88	90	74	44
Carrying agricultural goods	8	6	9	8	26	11
Don't know	*	*	*	*	-	22
BASE: All lorries/Commercial Vans	4703	1156	3005	460	73	9

Table 4.6

TYPE OF BUSES

	TOTAL	BUSSES Stage bus	Tour bus	Express bus	Mini bus	School bus	Other buses
	%	%	%	%	%	%	%
Private Company	22	33	67	-	11	31	36
Industrial/Commercial Factory	11	33	11	-	-	20	50
Public Transport	67	33	22	100	89	49	14
Don't know	*	*	*	*	1	-	-
BASE: All Busses	279	6	9	2	150	90	22

4.10 Age of Vehicles

Tables 4.7 & 4.8 present the distribution of vehicles by the age of the vehicles. Where possible, the age of the vehicle was established by the driver of the vehicle, at the time of refuel. However, there are some cases where the drivers themselves do not know the age. For all such cases, the age is determined by the year of registration of the vehicle accordinglyto the registration numbers (obtained via the Road Transport Dept).

The analysis in Tables 4.7 & 4.8 is presented separately for petrol vehicles and diesel vehicles. The average age for any petrol vehicle is estimated as **6.4 years, with 41% falling under the 3 to 6 years category.** There are only 15% which are older than **10 years.**

The average age of the commercial vehicles/lorries (4.2 years) estimated as lower than private vehicles or taxis. Taxis have about the same average as the private vehicles, being only slightly higher (6.7 years vs 6.4 years for private vehicles). Close to half of them are between 5 to 8 years.

In comparison, there is more variation of age among diesel vehicles. The average age is 5.6 years at the total level but when analysed against the types of vehicles, the range is as high as 7.3 years for private vehicles and as low 4.7 years for taxis.

*	private vehicles	7.3 years
*	cv/lorries	5.6 years
*	buses	5.5 years
*	taxis	**4.7 years**

Table 4.7:

AGE VEHICLE
ACTUAL REPORTING AND ESTIMATION FROM REGISTRATION NUMBERS - PETROL VEHICLES

	TOTAL	VEHICLE TYPE Private Vehicles	Taxi	Bus	Commercial Vans/ Lorries
	%	%	%	%	%
Less than 1 year	7	4	2	-	3
1 - 2 years	13	14	7	-	13
3 - 4 years	22	22	13	-	25
5 - 6 years	19	20	21	-	19
7 - 8 years	14	15	26	-	16
9 - 10 years	9	9	11	-	9
Above 10 years	15	16	9	-	15
Don't know	*	*	12	-	*
Average	6.4	6.4	6.7	-	4.2
BASE: All Vehicles	69803	63262	944	-	3175

Table 4.8

AGE OF VEHICLE
ACTUAL REPORTING AND ESTIMATION FROM REGISTRATION NUMBERS - DIESEL VEHICLES

	TOTAL	VEHICLE TYPE Private Vehicles	Taxi	Bus	Commercial Vans/ Lorries
	%	%	%	%	%
Less than 1 year	19	6	7	2	6
1 - 2 years	17	8	12	49	21
3 - 4 years	20	17	26	7	25
5 - 6 years	16	19	26	7	17
7 - 8 years	10	16	12	6	12
9 - 10 years	5	15	1	11	6
Above 10 years	9	18	2	18	13
Don't know	3	-	13	-	-
Average	5.6	7.3	4.7	5.5	5.6
BASE: All Vehicles	3775	310	801	279	1527

4.11 Distance Travelled

The reading on the meter was recorded for every vehicle, and the number of cycles the meter has changed was also obtained from the driver of the vehicle. However, there were cases where the meters were spoilt, or the drivers did not know the number of cycles the meters have undergone. For such cases, an estimation formula was provided by EPU (as per recommendation from Central Consultant) and this formula has been used to estimate the total distance travelled by the vehicle.

The estimation formula makes use of the age of the vehicle and the probability that the distance travelled by a vehicle of the following age ranges would be:

- o when the driver has estimated that their meter was overturned
- * cars and motorcycles
  - * + 100,000 kms if the age is 10 years or less
  - * + 200,00 kms if the age is above 10 years
- * vans and small lorries
  - * + 100,000 kms if the age is 8 years or less
  - * + 200,000 kms if the age is above 8 years
- * taxis
  - * + 100,000 kms if the age is 4 years or less
  - * + 200,000 kms if the age is above 4 years

If the number of completed cycle is known and the current reading on the meter can be read, then the age will be computed by:

- * number of cycles x kms per full cycle + the reading in the meter

Tables 4.9 & 4.10 summarise the distribution of vehicles by the average distance travelled in a year. About 4 in 10 petrol driven vehicles travel less than 10,000 kms a year. Although the estimation formula was used, there is still some 22% without an estimation. These are mostly contributed by taxis for which information of the outstation taxi year of registration is not known. The majority of the petrol driven private vehicles (64%) travel less than 30,000 kms a year. The estimation of distance travelled from the SRM Motor Vehicle Index 1988 (MVI) is comparable, with 36% of motorists (driving private passenger cars) falling under the 9,000 kms or less category. The estimate from this monitor shows 43% in the below 10,000 kms segment.

The estimate from the MVI is based on recall from the motorists interviewed, which would have ssome recall error, while that estimated from the station monitor have some assumptions built in, if the number of completed cycles is not known, or the meters were spoilt.

Table 4.9:

ESTIMATED DISTANCE TRAVELLED PER YEAR - PETROL VEHICLES - DISTRIBUTION OF RESULTS

	TOTAL	VEHICLE TYPE Private Vehicles	Taxi	Bus	Commercial Vans/ Lorries
	%	%	%	%	%
Less than 10,000 km	43	46	25	-	36
10,001 - 20,999 km	17	18	8	-	17
21,000 - 30,999 km	8	8	2	-	14
31,000 - 50,000 km	6	6	4	-	13
50,001 & above	4	4	39	-	7
Don't know	22	19	22	-	13
BASE: All Vehicles	69803	63262	944	-	3175

Table 4.10

ESTIMATED DISTANCE TRAVELLED PER YEAR - PETROL VEHICLES -

VEHICLE TYPE	KM PER YEAR SURVEY RESULT
Car	16923
Van (Private)	30647
Van (Command)	27014
4-Wheel Drive	27903
Motorcycle	12617
Taxi (In-town)	51814
Hire-Cars (Inter-town)	55680
Lorries - 2500 kg	23791

Table 4.11:

ESTIMATED DISTANCE TRAVELLED PER YEAR
DIESEL VEHICLES - DISTRIBUTION OF RESULTS

VEHICLE TYPE	TOTAL	Private Vehicles	Taxi	Bus	Commercial Vans/ Lorries
	%	%	%	%	%
Less than 10,000 km	20	33	16	19	26
10,001 - 20,999 km	10	12	14	8	10
21,000 - 30,999 km	5	8	2	6	7
31,000 - 50,000 km	9	13	2	7	15
50,001 & above	20	14	35	19	20
Don't know	36	20	31	41	21
BASE: All Vehicles	3375	310	801	279	1527

Table 4.12

ESTIMATED DISTANCE TRAVELLED PER YEAR
- DIESEL VEHICLES -

VEHICLE TYPE	KM PER YEAR SURVEY RESULT
Car	28182
Van (Private)	26595
Van (Command)	45490
4-Wheel Drive	31856
Motorcycle	-
Taxi (In-town)	62159
Taxi (Intercom)	67593
Lorries - 2500 kg	39378

Table 4.13

AVERAGE MONTHLY MILEAGE COVERED BY CAR DRIVEN MOST REGULARLY NOWADAYS

	1986	1987	1988
	%	%	%
Up to 750 km	NA	36	40
750 - 1500 km	NA	26	29
1501 - 3000 km	NA	17	17
Above 3000 km	NA	5	4
Don't know	NA	15	9
Average	NA	1292	1192
BASE: All Motorist ('000)	NA	1080	1134
Actual No. Of Interviews	NA	985	1046

NA = Not Available Ref: SRM's Motor Vehicle Index (1986 - 1988)

Table 4.14

AVERAGE MILEAGE COVERED BY CUB/SPORT SCOOTER/SCRAMBER OWNED

	1986	1987	1988
	%	%	%
Up to 400 km	38	36	43
401 - 800 km	34	29	25
801 - 1280 km	13	13	13
Above 1280 km	9	8	7
Don't know	6	14	11
Average (km)	628	631	559
BASE: All Cub/Sport/Scrambler	1824	2410	2362
Actual No. Of Interviews	834	850	799

REF: SRM's Motor Vehicle Index (1986 -1988)

4.12. Fuel Consumption

The estimated unit fuel consumption are as below:-

		km/litre (Survey results)
Motorcycles (Petrol)	=	24.4
Private Passenger Car (Petrol)	=	13.1
Private Passenger Car (Diesel)	=	12.9
Private Passenger Car (Petrol)	=	10.9
Private Passenger Car (Diesel) (4-Wheel Drive)	=	11.8
Taxi Cab (town) (Petrol)	=	13.8
Hire Cars (Intertown) (Petrol)	=	13.3
Taxi Cab (town) (Diesel)	=	14.6
Hire Cars (Intertown) (Diesel)	=	14.8
Vans (Petrol)	=	12.6
Vans (Diesel)	=	12.1
Buses (Stage) (Diesel)	=	8.3
Bus (Tour) (Diesel)	=	6.0
Bus (Express) (Diesel)	=	8.0
Bus (Mini) (Diesel)	=	14.2
Bus (School) (Diesel)	=	9.4

Table 4.15:

PETROL CONSUMPTION - NO. OF KMS PER LITRE
- PETROL VEHICLES -

	TOTAL	VEHICLE TYPE		
		Private Vehicles	Taxi	Bus
	%	%	%	%
Up to 10 km	8	9	5	-
11 - 15 km	24	25	31	-
16 - 20 km	3	3	3	-
21 - 25 km	3	3	1	-
26 - 30 km	2	2	1	-
31 - 40 km	3	3	1	-
41 & above	1	1	*	-
Don't know	57	55	58	-
Average kms per litre	15.8	15.9	13.5	-
BASE: All Vehicles Excluding Lorries/ Commercial Vans	66628	63262	944	-

Table 4.16:

PETROL CONSUMPTION - NO. OF KMS PER LITRE
- DIESEL VEHICLES -

	TOTAL	VEHICLE TYPE Private Vehicles	Taxi	Bus
	%	%	%	%
Up to 10 km	5	15	2	9
11 - 15 km	12	15	22	3
16 - 20 km	2	4	3	2
21 - 25 km	1	1	1	1
26 - 30 km	1	1	1	1
31 - 40 km	1	1	1	-
41 & above	*	*	*	-
Don't know	78	62	70	85
Average kms per litre	13.8	13.0	14.7	11.2
BASE: All Vehicles Excluding Lorries/ Commercial Vans	1848	310	801	279

CHAPTER 5

RESIDENTIAL SECTOR

CHAPTER 5.

RESIDENTIAL SECTOR

5.1 INTRODUCTION

Energy demand, in household and commercial sector demand, is strongly dependent on the changes in social factors such as urbanisation rate, improvement in standard of living and variation in human lifestyle and consumer taste. Energy constitutes an element of necessity in modern living, such as uses for air-conditioning, space heating, cooking, specific electrical appliances and lighting. In the commercial sector, energy can be interpreted as an intermediate input, its consumption pattern is quite similar with that of the residential sector. Thus, while the energy demand in other economic sectors such as industrial and transportation sector are highly sensitive to variation in the economic environment, the residential and commercial sector energy demand shows a relatively stable trend. It broadly covers:

- an analysis of past energy consumption pattern and the factors influencing energy demand in the residential/commercial sectoral in Malaysia.

- the development of a plausible model structure and scenarios for forecasting long term residential/ commercial sectoral energy demand within the framework of a consistent overall socio-economic development.

For the latter objective, the MEDEE-S (S for South) model, designed for the developing countries, was utilised to determine the likely long term energy demand paths till the year 2010.

The MEDEE-S model is a PC-Version demand model similar to Module 1 of the MAED model currently residing in the National Electricity Board. In both models, demand is analysed based on the end-use approach which takes into consideration the overall mechanism of how energy demand in various sub-sectors of the economy evolved. In the residential/commercial sector, end-use of energy are identified and exogenous variables (such as sectoral value added, household income, population, household size, rural/urban split, ownership pattern, electrification level, end-use efficiency, etc) are defined based on consistent evolution of economic, technological and social/demographic development.

Finally, the MEDEE-S model projects long term energy demand in terms of conventional fossil fuel (coal, charcoal, kerosene, diesel, gas and LPG), electricity and traditional fuel for the residential/commercial sectors. These are presented for a plausible economic and demographic development scenario.

5.2 HOUSEHOLD SECTOR DEMAND ANALYSIS

In Malaysia, energy in the residential sector is mainly used to satisfy daily requirement such as cooking, lighting, hot water for laundry and bathing, air-conditioning and operation of electrical appliances. Historically, energy consumption data and trend are mostly analysed as a combined entity with the commercial sector; the demarcation is normally not clear and sketchy (8 - 11). Whilst for electricity which is a major commercial residential fuel, data are readily available for the residential sector. Electricity share in total consumption of final commercial energy in the sector has increased from 20.5% in 1978 to 29.6% and 36.0% in 1983 and 1987 respectively. In term of useful energy, the share of electricity becomes even more dominant, about 42.5% in 1983 and 49.5% in 1987.

The requirement for energy by the household were generally for specific essential activities. Kerosene, LPG/Gas, Electricity, charcoal and firewood were used largely as cooking fuels. Other application for energy in the sector are mainly satisfied by electricity. The current increase of energy demand in the sector is mainly attributed to LPG and electricity consumption growth rate in excess of 20% and 8% percent respectively. LPG usage for cooking has great potential as in 1986, only about 25% of household were using LPG. A probable current and future trend as revealed by a detailed study conducted for 1983, is that kerosene use for lighting especially in the rural areas is declining and will be gradually substituted by electricity through the rural d electrification programme. In the middle and high income groups, accelerated substitution of kerosene by LPG for cooking is observed. The strong rural to urban migration is also responsible for increased substitution of other forms of energy by electricity. Gas consumption to household may increase as a result of availability of reticulated gas as opposed to only local gas consumption in certain households in Sarawak in 1983.

From the baseline study, it was observed that 85% of the urban household used electricity as a source of energy and, respectively 36% and 24% of the urban households consumed LPG and kerosene. The percentage of urban households consuming other forms of energy are low that is between 7% to 39% for charcoal, 0.8% to 10% for firewood. For the rural household, between 59% to 96% used electricity and between 60% and 86% used kerosene. Percentage of rural household using firewood were also high, ranging from 4% to 30%. While charcoal utilisation was less significant as reflected by the low percentage of rural household (between 1.9% to 11.3%) using it.

Most studies and surveys on household consumption pattern indicated that there were no significant differences except for variation in terms of predominance and "quantum" of particular energy source being utilised and the overall higher consumption of energy for more end-uses in the urban household.

5.2.1 PAST TRENDS AND DATA ANALYSIS (1978 - 1987)

The analysis of the past trends and data is carried out based on the following indicators;

i. Electricity demand in residential sector
ii. Electrification level
iii. Average electricity consumption per electrified household
vi. Residential sector electricity per value added

(a) ELECTRICITY DEMAND IN RESIDENTAL SECTOR

From Fig.1, a trend of electricity consumption per capita shows an almost linear growth from 1978 to 1987. Similarly for consumption per household, the gradient exhibited is even higher. This trends shows that the electricity demand per consumer in residential sector is gradually improving due to increase in ownership of electrical appliances as a result of increase in income level and as more households become electrified.

(b) ELECTRIFICATION LEVEL

As a whole, the rate of electrification in Peninsular is improving since 1978 especially in rural region in line with the government objectives to improve the living standard of rural households. As shown in Fig.2, electrification level of rural households increases from 34.89% in 1978 to 66.16% in the year 1987. The corresponding increase for urban household is from 71.3% to 90.4% in the year 2010. The average electrification level for Malaysia increases from 46.9% to 76% in the same period.

(c) AVERAGE ELECTRICITY CONSUMPTION PER ELECTRIFIED HOUSEHOLD

As mentioned earlier, the average electricity consumption per electrified household continues to increase annually. The average consumption per elctrified household was 925 kWh in 1978 and 1243 kWh in 1987. The change in the consumption pattern is mainly due to increase in ownership of electrical appliances such air-conditioners, refrigerator etc. The increase in urbanisation rate also contributes to greater utilisation of electricity.

(d) RESIDENTIAL SECTOR ELECTRICITY PER VALUE ADDED

Here, two classifications are identified and analysed;

i. kWh/Gross Domestic Product
ii. kWh/Private Consumption

Fig.4 shows that the consumption per value added increased for all three sectors. Generally, all the two variables tread the same trend, almost linear from 1978 to 1983, a slight drop in 1984 and then increase at a more rapid rate from 1985 to 1987. The trend clearly indicates the growing share of electricity in the total household energy consumption. Electricity consumption has historically increased at a faster rate than value added growth. This trend is likely to continue although it may reach saturation in the longer term.

FIG. 1: ELECTRICITY DEMAND IN RESIDENTIAL SECTOR
(1976-1987)

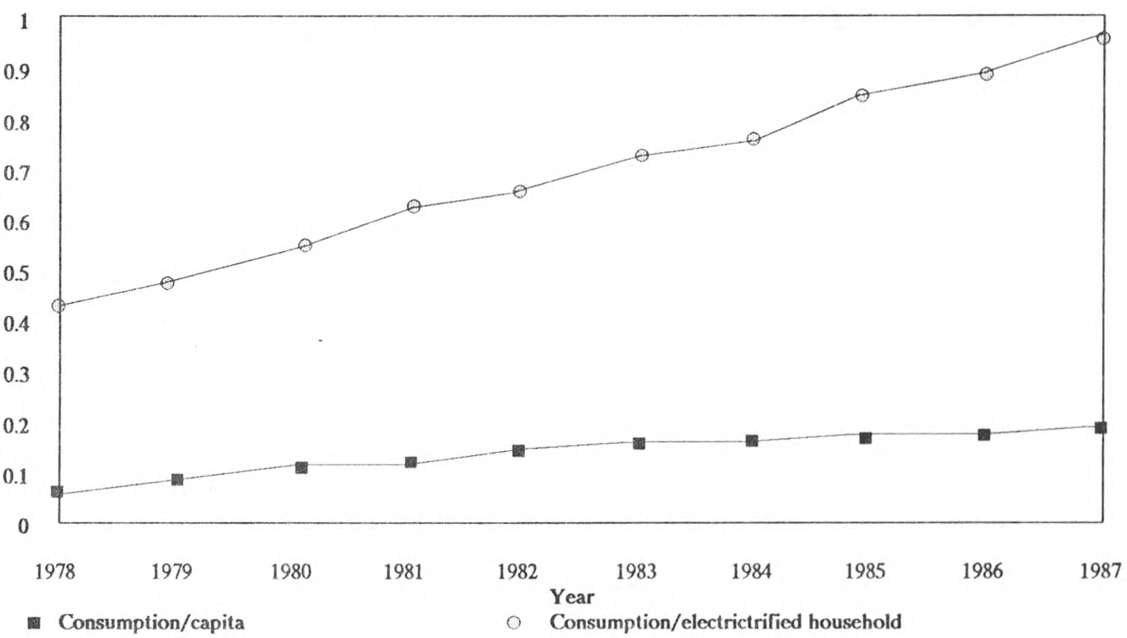


FIG. 2: ELECTRIFICATION LEVEL
(FY1976-FY1987)

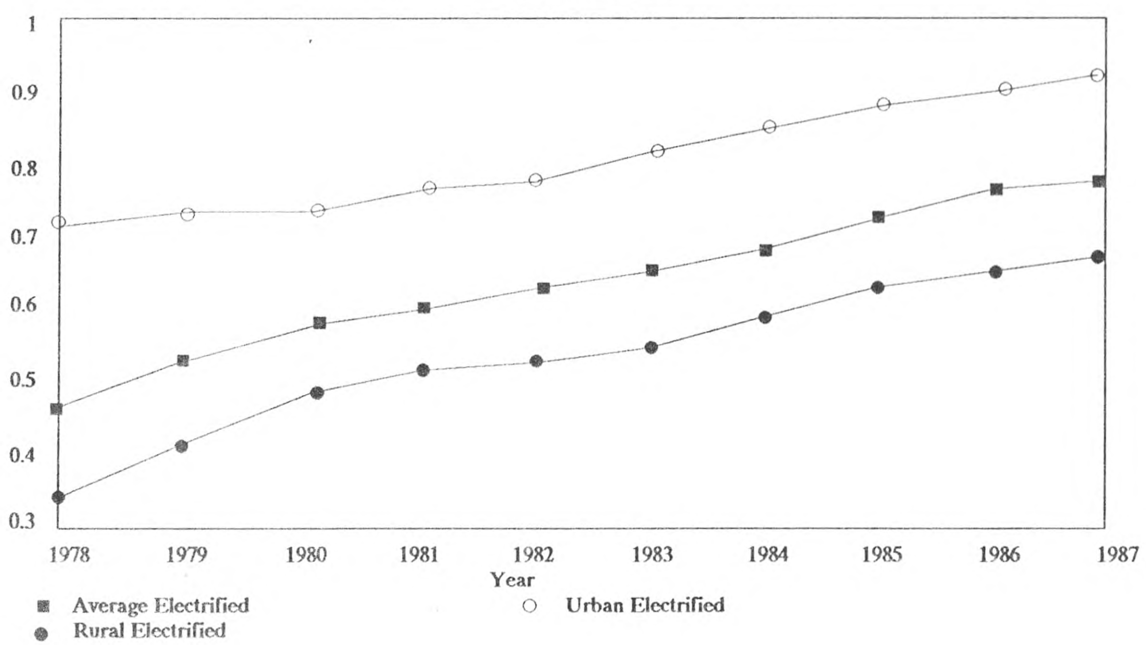


FIG. 3:
ELECTRICITY CONSUMPTION/ELECTRIFIED HOUSEHOLD
(FY1976-FY1987)

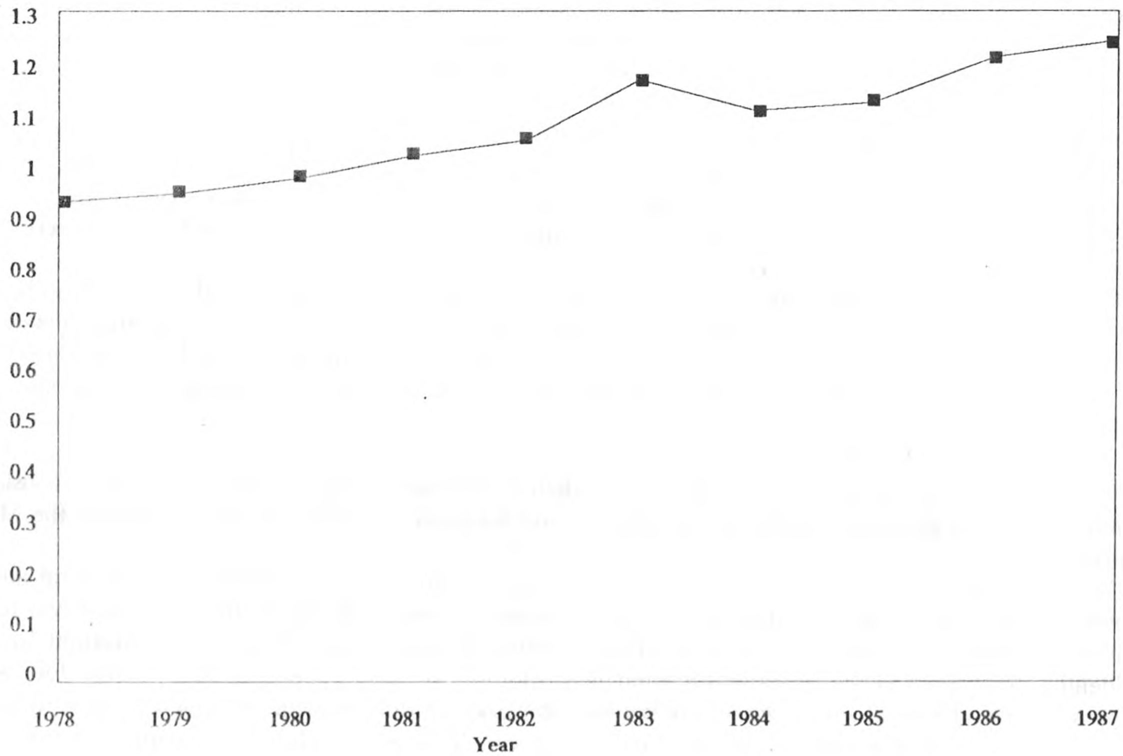
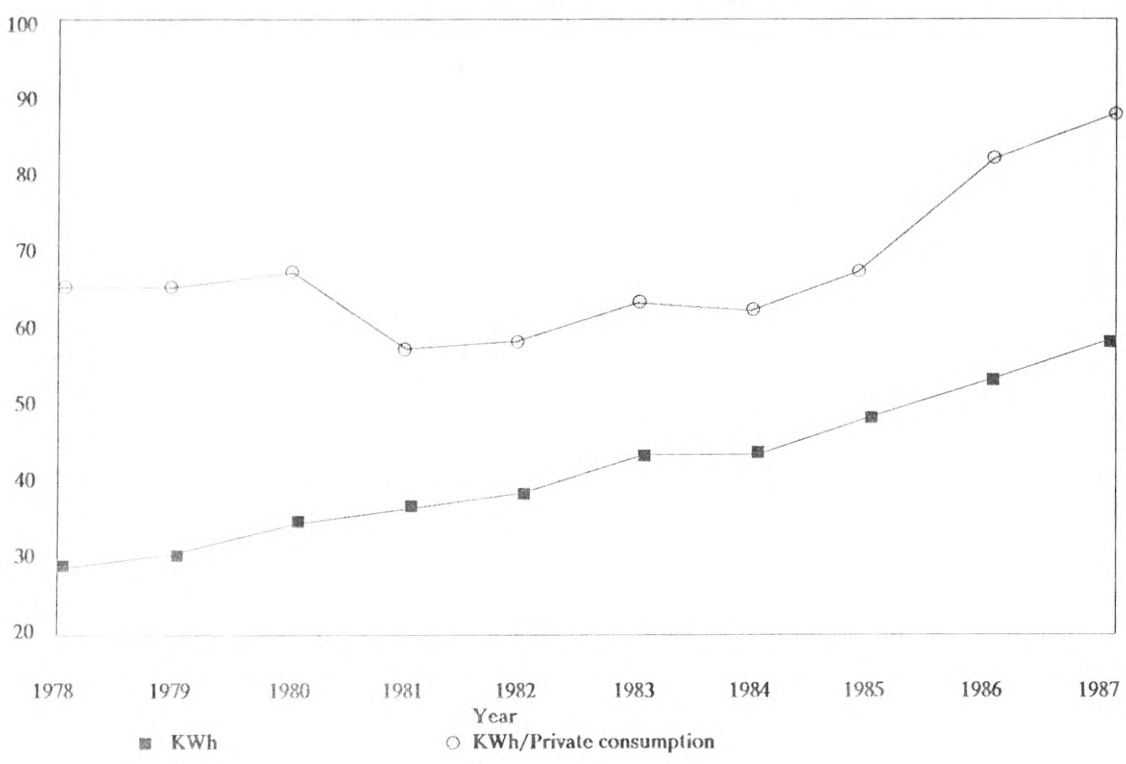


FIG. 4:

ELECTRIFICATION LEVEL
(FY1976-FY1987)



5.2.2 METHODOLOGICAL APPROACH FOR SECTORAL ACCOUNTS AND LONG TERM FORECASTING

As described in the previous section, aggregate demand data of the residential sector in Malaysia are available as a combined entity with the commercial sector in the Energy Balances. Thus, the initial hurdle to overcome in the modelling stage was to isolate the household energy demand. This was partially overcome with the aid of reasonably reliable data provided for electricity consumption and analysis of end-uses of other energy forms.

The modelling aspect of energy consumption in the residential sector takes into account the result of the various phenomena, such as; urbanisation and structural transformation of social classes; substitution among energy forms (electrification level, diffusion of LPG, etc.) and technological changes (emergence of new end-use, equipment efficiency etc.). Thus, the modelling is aimed at predicting the evolution of energy demand by isolating various determining factors affecting demand in the sector.

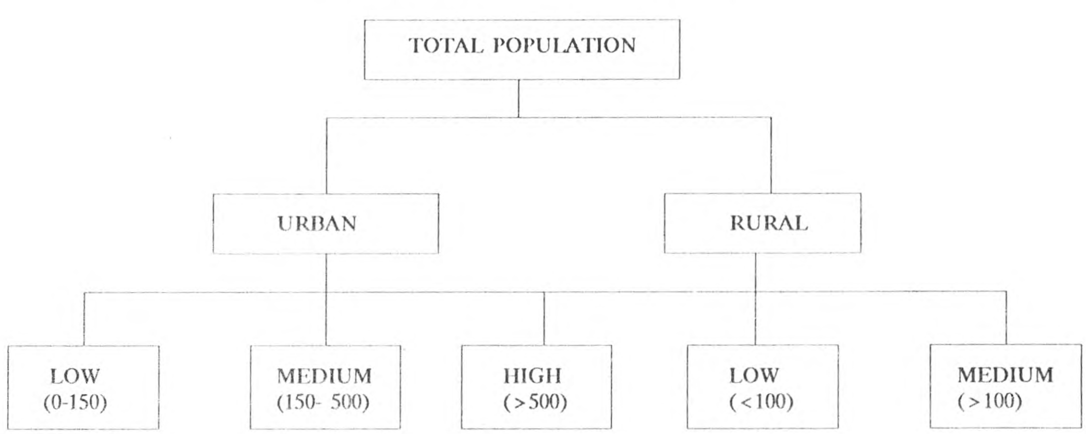
As experienced by many other countries, exact consumption data of residential consumption by end-use were not available directly and this poses a major problem to assess quantitatively the energy demand in this sector. However, these problems were partially circumvented by making inferences from the various energy related surveys [3,4] provided by the electric utilities and other socio-economic reports on household consumption pattern, rural electrification studies [5, 6] and also extracts from the 1970 and 1980 population census [1, 2].

The following paragraphs describe the modelling approach adopted after taking into consideration various constraints and limitation of data availability and the inherent flexible structural input of the MEDEE-S model.

As depicted in Fig. 5, the population of Malaysia is split into rural and urban. The rural and urban household, are then further sub-divided into various consumption bands (three for urban and two for rural) with the proportion of each consumption band inferred from historical data on electricity consumption of NEB residential consumers. The consumption band was adopted instead of income class mainly for two main reasons. Firstly, data on income classes are not available and not well defined. Although analysis by individual income tax group gives an indication of the broad categories of household classes, the demarcation is not clear for each class and does not serve to indicate degree of energy demand in each class. Secondly, the consumption band analysis provides a convenient form and almost certain way of assuming ownership pattern and electrification level for each class of consumers.

As an illustration, by virtue of the fact that data on appliance ownership pattern are available for the whole country or urban/rural household, one can assumed that the high consumption band urban household (namely those in the 150 - 500 kWh/month and > 500 kWh/month classes) posses most of the luxury electrical items, and the remainder of the population owning such equipment could then be easily derived using the national ownership average value. The exact computational procedure for the base year 1983 is shown in Appendix 1. The consumption band is partially related to household income; essentially a high consumption category is one that is affluent and has high energy consumption and vice versa.

FIG.5 : CATEGORIES OF HOUSEHOLD



Note : denotes consumption of electricity in kWh/mth.

Each type of household is then analysed based on the following end-uses of energy;

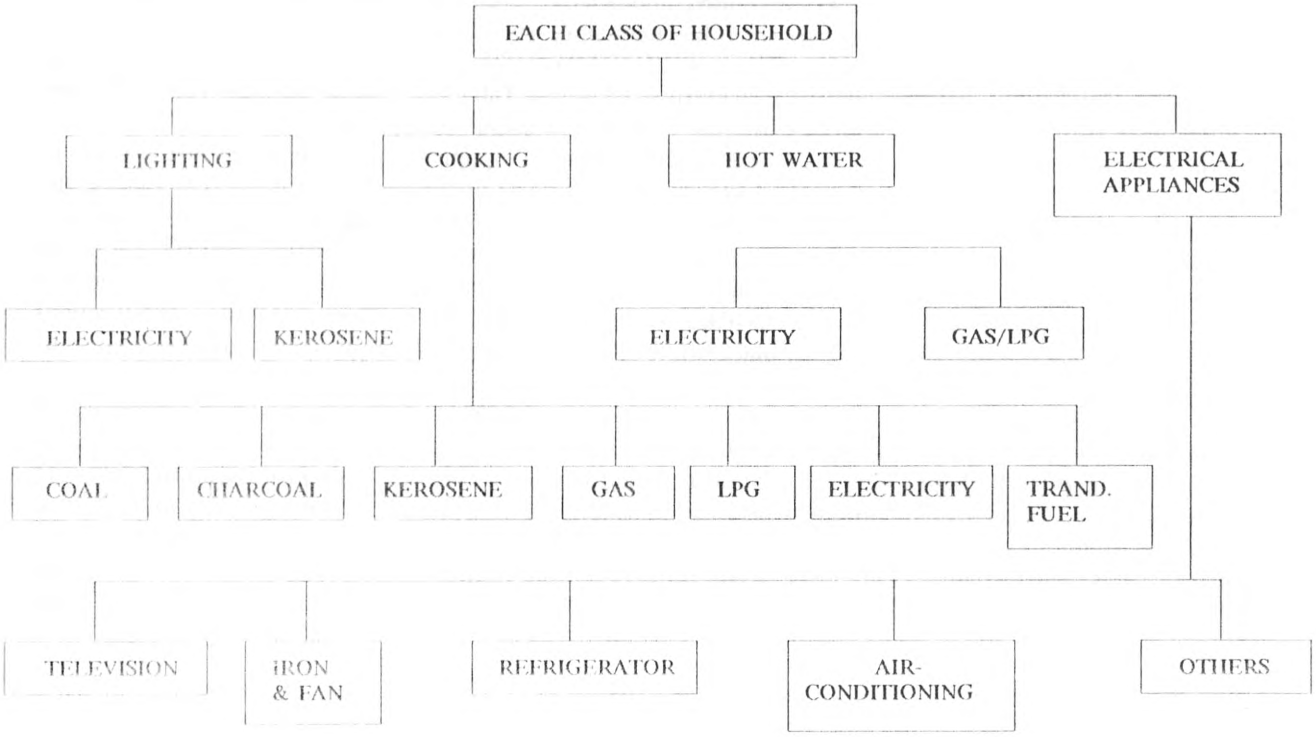
- Cooking using conventional fuels (coals, charcoal, kerosene, gas and LPG), electricity and traditional fuels. Cooking needs in each class of household are determined by type of fuels use. Broadly, the lower consumption band households possess primitive equipment with low efficiency and cosume low quality energy carriers (such as traditional energy). Consequently, in terms of final cooking energy consumption, is the highest among all household classes.

- Lighting requirement for each class of household in the form of electricity and kerosene consumption. For Non-electrified household, lighting is computed based on usage of kerosene. As a rule of thumb, all electrified households require electricity for lighting and the consumption per household remains, on the average, the same for the same class of household.

- Hot water requirement was analysed by class of household to reflect the differences in their requirement. Hot water requirement merely refers to that required for bathing and washing and not for cooking needs. In Malaysia, at least in the base year 1983, the majority of hot water is supplied by electricity and LPG although piped gas and solar heater could slowly penetrate the hot water market in the future.

- Energy consumption for electrical appliance is disaggregated into five main categories of appliances namely; Television, Fans & Iron, Refrigerator, Air-Condition and Other Appliances (Washing Machine, Vacuum Cleaner, Hi-Fi etc.). Modelling these end-uses take into consideration the percentage of households owning each appliance(s) and average annual consumption per appliance. Although consumption per appliance varies among classes of households, the MEDEE-S only allows for a single value of annual unit consumption /appliance for urban/rural household. As a result scaling of the ownership pattern of each household class is carried out with respect to the reference highest annual consumption per appliance for both urban or rural household. It must be mentioned that the air-conditioning needs are treated as an electricity appliance rather than the alternative option for air-conditioning in the model. This allows the differentiation of the level of air-conditioning usage by each household, class while the model's air-conditioning calculation derives air-conditioning demand through the average consumption for air-conditioning by all households with air-conditioners.

FIG. 6: MODELLING OF END-USEUS FOR EACH HOUSEHOLD CLASS



5.2.2.1 THE BASE YEAR (1983) SECTORAL ACCOUNTS

Derivation of demographic variables constitues the first step towards the residential sector household demand analysis. In 1983 total population in Malaysia was 14.888 million, urban/rural population split was 36.8%/63.2%, and average household size was 4.93 [1 - 7]. The number of urban and rural households was 1,142,578 and 1,877,299 respectively. The corresponding person per household were 4.795 and 5.012. Total electrification level was 63.8%. The electrification levels for rural and urban household were 53.0% and 81.6% respectively based on assumption that about 20% of "NEB other urban" domestic consumers are rural consumers and 45% of total domestic "SEB & SESCO" consumers are urban consumers.

In order to derive the split for both the rural and urban household, consumption band analysis was carried out based on NEB sample data for Kuala Lumpur/Petaling Jaya and other towns (Ipoh, Kuala Terengganu, Kuantan, Klang and Seremban) and rural areas of the other towns. For 1983, composition of urban consumers was 69.81 % (0-150 kWh/mth) [1], 27.11% (150 -500 kWh/mth)[2] and 3.08% (>500 kWh/mth)[3]. While the rural split of electrified consumers are 86% (<100 kWh/mth)[4] and 14% (>100kWh/mth)[5]. The electrification level corresponding to these classes of household are assumed as follows; urban - 75.58% Low, 100% (Medium), and 100% (High); rural - 49.23% (Low) and 100% (High). The non-electrified households fall in the low consumption bands. Table 5.5 shows the number for various household categories.

The assumptions used to calculate the amount of electricity used in lighting are shown in Table 5.6. To compute kerosene use for lighting in non-electrified households, it was assumed that about 6.4% of total kerosene used in the residential sector is for lighting, while the rest is for cooking. The derived average consumption of kerosene per non electrified household per year is 20.964 litre.

It was found that 6.43% of total household in Malaysia possessed hot water heater, primarily in the urban normal and high consumption class. The hot water useful energy requirement per person per year (with hot water) is 24.66 Mcal as compared to a value of 22.43 Mcal for Fiji [14]. For the urban high and urban medium, the corresponding values is 30.00 Mcal and 23.74 Mcal respectively.

The calculations of ownership pattern of electrical appliance are based on data from Surveys [3-4], Population Census [1-2], Economic Report [9] and Rural Electrification Study [5-6]. It was found that for the base year; 77.27% of urban household and 33.07% of rural household possessed television; 70.11% of urban household and 34.49% rural household possessed Iron & Fan; 61.87% of urban household and 29% of rural household possessed refrigerator; 7.14% of urban household and 0.92% of rural household possessed Air-Conditioning. For the other appliances, ownership rate is based on vacuum cleaner/washing machine ownership as reference. The ownership rate of other appliances is 16.18% for urban household and 1.83% for rural household.

The ownership pattern by class of household is further Computed based on the general rule that all urban high households posses all five appliances, all urban medium have television, iron & fan, refrigerator and some urban medium have air-conditioners and other appliances. Only a portion of the urban low possessed television, iron & fan refrigerator. All rural high has television, iron & fan, refrigerator and a small portion has air-conditioners and other appliances. Only a small portion of the rural low possessed television, iron & fan and refrigerator. The detailed ownership pattern is shown in Table 5.7. Table 5.8 and Table 5.9 show the breakdown of fuel for various end-uses in term of final and useful energy for 1983.

In order to estimate average electricity consumption of each equipment per year, reference is made to the PUB survey. To further differentiate the level of consumption of appliance among household classes, the lower consumption class are assumed to posses smaller or lower power/range of the same equipment, thereby consuming less energy per appliance. As an example, for consumers possessing televisions in 1983, the urban high group are assumed to posses 66 cm colour TV, the medium urban has 51 cm colour TV, and the low urban a mixture of 36 cm color TV and 51 cm black/white TV. Whilst the medium and low rural household possessed 61 cm black/white TV and 51 cm black/white TV respectively. The equivalent electricity consumption per appliance per year is given in Table 5.10.

The consumption pattern of electrical appliances are shown in Table 5.11, together with percentage of each appliance end-used. Electricity used for lighting purposes amounts to 31.1% for Urban Low, 18.3% for Urban medium and Urban high 13.6%. For Rural Low and High, the corresponding proportion is 35.1% and 20.2% respectively. Electricity for refrigeration constitutes a major proportion of total electricity in almost all classes of household; 42.8% for Urban Low, 37.2% for Urban Medium, 16.9% for Urban High, 40.3% for Rural Low and 46.8% for Rural High. Electricity requirement for air-conditioning is the highest in the Urban High household constituting 47.0% of total electricity. The corresponding proportion for other classes using

[1] define as Urban Low
[2] define as Urban Normal
[3] define as Urban High
[4] define as Rural Low
[5] define as Rural High

air-conditioners are 16.4% (Urban Medium) and 8.5% (Urban High).

Analysis of the total electricity consumption (excluding uses for cooking and hot water) indicates the following pattern of consumption for both urban and rural household:- For total household, the consumption pattern is as follows; lighting (24.4%), Television (8.7%), Fans & Iron (13.1%), Air-Conditioning (11.5%), and other appliances (4.2%). Refrigeration constitutes the largest end-use for electricity followed by lighting, Fan & Iron, Air-Conditioning and other appliances. Usage for high end\luxury electrical appliance such as air-conditioning is also more prominent for the affluent households namely the urban high and medium. Table 5.12 indicates the share of consumption by appliance for aggregate urban and rural households.

The computed total electricity consumption (excluding uses for hot water and cooking) for the base year 1983 was 7257.72 TJ which closely resembled that from reference [8 & 11]. The consumption per month of each household class was also calculated and the values are marginally lower than those obtained from the consumption band analysis. This is attributed to the fact that samples for the consumption band analysis of NEB consumers are derived from household in and around the vicinity of the nation's capital cities i.e K.Lumpur and Petaling Jaya and the other states' capitals who are relatively more affluent than the average urban or rural household. Thus, the monthly consumption are slightly upward bias and the computed kWh confirmed this fenomena.

For cooking, it is assumed that all conventional energy (charcoal, kerosene, gas & LPG) are used to satisfy cooking requirements except about 6.4% of kerosene used for lighting and 0.5% of total LPG used for hot-water needs. It is also estimated that about 2.5% of total electricity consumed in the sector was used for cooking. In terms of useful cooking energy, the rural household requirement (about 1100 Mcal/yr) is slightly higher (about 5%) than that of urban household (about 1050 Mcal/yr) because the urban majority are working and therefore cook less, especially for lunch (noon-meal). The average annual energy required for cooking per household of about 1080 Mcal useful energy is comparable to that of 1 GJ per person (about 1200 Mcal based on 5 person per dwelling) quoted for ASEAN countries [15]. The energy required for cooking per household value is very much higher for rural household, if expressed in final energy, as the poorer rural household is most likely to use less efficient cooking stoves.

For cooking, the following broad assumptions are made. All electricity are consumed only in the Urban Medium, Urban High and Rural High households. Charcoal and kerosene are used only in all Urban Low, Rural Medium, and Rural Low households. A small proportion (about 1%) of total urban medium also used kerosene for cooking. Whilst LPG is used in all electrified urban and rural households.

It could be observed that kerosene contributed the highest share in terms of cooking energy needs due to the fact that kerosene stoves are relatively cheap and affordable by the poorer household. Furthermore kerosene is readily available and was subsidised (subsidy of about 16.2 cents per litre) about 46.2 cents per litre (1983 price).

Table 5.13 shows the breakdown of sectoral consumption and breakdown of fuels in terms of Final Energy. Tables 13 - 15 depict the historical pattern of available data on appliance ownership, cooking fuel share and rural household lighting usage described in the preceeding paragraphs.

TABLE 5.1:
ELECTRICITY CONSUMPTION IN ALL HOUSEHOLDS

YEAR	Residential Elect. consumption/population (kWh/population)	Residential Elect. consumption/household (kWh/household)
1978	81.502	434.476
1979	92.542	487.93
1980	107.072	559.112
1981	119.82	613.724
1982	129.979	653.382
1983	148.778	733.458
1984	154.467	760.206
1985	169.097	831.888
1986	182.225	896.563
1987	192.231	945.821

TABLE 5.2:

ELECTRIFICATION LEVEL

YEAR	AVERAGE (% of h'hold)	URBAN (% of h'hold)	RURAL (% of h'hold)
1978	46.94	71.28	34.89
1979	51.71	72.40	40.85
1980	57.09	74.16	48.02
1981	59.25	76.28	49.60
1982	61.49	79.04	51.26
1983	63.82	81.60	52.96
1984	67.98	85.15	57.28
1985	72.54	88.78	61.76
1986	74.33	89.76	63.98
1987	76.08	90.41	66.16

TABLE 5.3:

RESIDENTIAL UNIT CONSUMPTION

YEAR	kWh/GDP	kWh/private consumption
1978	28.241	63.695
1979	30.007	63.470
1980	33.109	65.430
1981	35.562	55.332
1982	37.390	56.751
1983	41.339	60.755
1984	41.198	60.080
1985	46.528	65.883
1986	51.295	81.148
1987	52.786	84.601

TABLE 5.4:

SOME BASIC DEMOGRAPHIC PARAMETERS

YEAR	Population (million)	Household Size	No of Household (Urban) (million)	No of Household (Rural) (million)
1978	13.128	5.33	0.817	1.646
1979	13.433	5.27	0.868	1.680
1980	13.764	5.22	0.922	1.714
1981	14.128	5.12	0.990	1.768
1982	14.507	5.03	1.064	1.822
1983	14.888	4.93	1.142	1.877
1984	15.400	4.92	1.200	1.929
1985	15.725	4.92	1.258	1.938
1986	16.287	4.92	1.331	1.979
1987	16.708	4.92	1.385	2.011
1988	17.132	4.91	1.447	2.042

TABLE 5.5:

HOUSEHOLD CATEGORIES ('000 HOUSEHOLDS:1983)

TYPE OF HOUSEHOLD	URBAN HOUSEHOLD			RURAL HOUSEHOLD	
	LOW	MEDIUM	HIGH	LOW	HIGH
ELECTRIFIED	651	253	28	856	139
NON ELECTRIFIED	210	0	0	882	0
TOTAL	861	253	28	1738	139

TABLE 5.6:

LIGHTING REQUIREMENT ASSUMPTION

HOUSEHOLD CLASS	EQUIVALENT LIGHTING REQUIREMENT	
	FLUORESCENT	FILAMENT
URBAN HIGH	13X40WX4 HRS/DAY	-
URBAN MEDIUM	7X40WX4 HRS/DAY	-
URBAN LOW	3X40WX3 HRS/DAY	2X40WX3 HRS/DAY
RURAL HIGH	3X40WX4 HRS/DAY	2X40WX4 HRS/DAY
RURAL LOW	2X40WX2 HRS/DAY	1X40WX2 HRS/DAY

TABLE 5.7:

OWNERSHIP PATTERN BY APPLIANCES (PERCENTAGE)

ELECTRICAL APPLIANCE 1983	URBAN HOUSEHOLD			RURAL HOUSEHOLD	
	LOW	MEDIUM	HIGH	LOW	HIGH
LIGHTING	75.6	100.0	100.0	49.2	100.0
TELEVISION	69.4	100.0	100.0	27.7	100.0
FAN & IRON	60.4	100.0	100.0	29.2	100.0
REFRIGERATOR	49.4	100.0	100.0	23.3	100.0
AIR-CONDITIONING	0.0	20.9	100.0	0.0	12.4
OTHER APPLIANCES	0.0	61.8	100.0	0.0	24.7

TABLE 5.8:

BREAKDOWN OF FUELS AND THEIR APPLICATIONS IN HOUSEHOLD SECTOR (TJ) 1983

FUELS	END-USES (FINAL ENERGY)					
	Cooking	Hot-Water	Air-Cond.	Electrical Appliance	Lighting	Total
LPG	4998	25	0	0	0	5024
Natural Gas	644	0	0	0	0	644
Kerosene	12526	0	0	0	800	13326
Charcoal	1430	0	0	0	0	1430
Traditional	20000	0	0	0	0	20000
Electricity	638	80	838	4649	1770	7975
Total	40236	105	838	4649	2570	46968

TABLE 5.9:

ASSUMPTIONS FOR EFFICIENCIES TO DERIVE USEFUL ENERGY 1983

FUELS	EFFICIENCIES (%)				
	Cooking	Hot-Water Appliance	Air-Cond.	Electrical	Lighting
LPG	65	65	-	-	-
Natural Gas	65	65	-	-	-
Kerosene	50	-	-	-	100
Charcoal	35	-	-	-	-
Traditional	13	-	-	-	-
Electricity	100	100	100	100	100

FUELS	END-USES (USEFUL ENERGY)					
	Cooking	Hot-Water	Air-Cond.	Electrical Appliance	Lighting	Total
LPG	3249	16	0	0	0	3265
Natural Gas	419	0	0	0	0	419
Kerosene	6263	0	0	0	800	7063
Charcoal	501	0	0	0	0	501
Traditional	2600	0	0	0	0	2600
Electricity	638	80	838	4649	1770	7975
Total	13670	96	838	4649	2570	21,823

TABLE 5.10:

CONSUMPTION BY APPLIANCE (KWH/APPLIANCE/YEAR)

ELECTRICAL APPLIANCE (1983)	URBAN HOUSEHOLD			RURAL HOUSEHOLD	
	LOW	MEDIUM	HIGH	LOW	HIGH
LIGHTING	248.4	504.0	1008.0	151.2	316.8
TELEVISION	96.0	198.0	306.0	90.0	108.0
FAN & IRON	150.0	379.4	428.4	93.0	214.8
REFRIGERATOR	522.9	1025.5	1248.0	366.0	732.0
AIR-CONDITIONING	0.0	2160.0	3480.0	0.0	1080.0
OTHER APPLIANCES	0.0	323.6	930.8	0.0	242.4

TABLE 5.11:

TOTAL CONSUMPTION BY APPLIANCES (TJ)

ELECTRICAL APPLIANCE (1983)	URBAN HOUSEHOLD			RURAL HOUSEHOLD	
	LOW	MEDIUM	HIGH	LOW	MEDIUM
LIGHTING	582	459	104	466	159
TELEVISION	208	180	32	156	54
FAN & IRON	281	345	44	170	108
REFRIGERATOR	801	933	129	534	367
AIR-CONDITIONING	0	412	359	0	67
OTHER APPLIANCES	0	182	96	0	30
TOTAL APPLIANCES	1872	2511	764	1326	785
COMPUTED kWh/mth	66.56	229.93	616.77	35.86	130.42
SAMPLE* kWh/mth	69.11	234.56	964.42	45.24	151.31
PERCENTAGE UTILISATION OF APPLIANCE BY CLASS					
LIGHTING	31.1	18.3	13.6	35.1	20.2
TELEVISION	11.1	7.2	4.1	11.8	6.9
FAN & IRON	15.0	13.8	5.8	12.8	13.7
REFRIGERATOR	42.8	37.2	16.9	40.3	46.8
AIR-CONDITIONING	0.0	16.4	47.0	0.0	8.5
OTHER APPLIANCES	0.0	7.3	12.6	0.0	3.8

* derived from consumption band analysis of NEB consumption

TABLE 5.12:

CONSUMPTION BY APPLIANCE IN PERCENTAGE

ELECTRICAL APPLIANCE (1983)	URBAN HOUSEHOLD	RURAL HOUSEHOLD
LIGHTING	22.24	29.60
TELEVISION	8.15	9.96
FAN & IRON	13.02	13.16
REFRIGERATOR	36.20	42.68
AIR-CONDITIONING	14.98	3.17
OTHER APPLIANCES	5.40	1.42

TABLE 5.13:

SECTORAL ENERGY CONSUMPTION IN 1983

SECTORAL ENERGY CONSUMPTION IN 1983
ENERGY CONSUMPTION (1983) (UNITS IN TJ)

Fuel Type	Residential	Service
Electricty	7974.8	13447.3
Diesel	0.0	1770.0
Kerosene	13326.1	510.0
LPG	5023.3	1601.6
Nat Gas	1841.0	0.0
Fuel Oil	0.0	1186.0
Coal	0.0	0.0
Total Commercial	28165.2	18515.0
Percentage by Fuel Type		
Electricity	28.31	72.63
Diesel	0.00	9.56
Kerosene	47.31	2.76
LPG	17.84	8.65
Nat Gas	6.54	0.00
Fuel Oil	0.00	6.40
Coal	0.00	0.00
Total Commercial	100.00	100.00

source: Table 3 MAED Study (11)

TABLE 5.14:

SELECTED APPLIANCES OWNERSHIP

End-Use	Overall Energy *	Rural + Ownership Share	Kajang/KL # Ownership	NEB Survey @ P'M'SIA Ownership	Bangsar & Ownership	1980 CENSUS URBAN OWNERSHIP	1980 CENSUS RURAL OWNERSHIP	1970 CENSUS RE, URBAN OWNERSHIP	1970 CENSUS RURAL	1987 1978 RURAL OWNERSHIP
Lighting	25.30%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Air-Conditioner	8.30%	0.40%	9.00%	3.83%	51.00%	5.49%	0.63%	2.23%	0.18%	NA
Fan	10.10%	55.00%	74.80%	91.31%	94.90%	60.32%	23.63%	35.63%	6.70%	21.91%
Refrigerator	26.30%	30.00%	70.10%	89.13%	97.60%	48.77%	16.29%	24.64%	4.15%	17.12%
TV/VCR/Radio/Hi-Fi	11.10%	77.00%	78.70%	96.01%	98.70%	67.38%	40.06%	23.77%	5.19%	47.81%
Iron	2.50%	56.00%	77.40%	86.70%	94.50%	59.19%	24.34%	NA	NA	40.95%
Rice Cooker	6.00%	10.00%	43.90%	74.08%	86.50%	NA	NA	NA	NA	4.65%
Water Heater	2.00%	0.00%	12.30%	7.79%	56.90%	10.64%	3.19%	NA	NA	NA
Other appliances	8.40%	2% to 13%	15.9% to 42.	.27% to 52.75%	3.8%to60.4%					17.67%
	100.00%									

* based on PUB Utilisation/LLN consumer analysis 1988
\# SERU report 1981
@ RURAL + URBAN 1988
& HIGH INCOME URBAN 1987

\+ SOURCES: 1. TABLE A-24 RURAL ELECTRIFICATION SURVEY
2. TABLE 4.11 TYPE OF ELECTRICAL APPLIANCE
THE SOCIO-ECONOMIC IMPACT OF RE IN M'SIA, 1983 P.L.CHEE
- TABLE 3.10, PENINSULAR RE, 1978, VOL II

TABLE 5.15:

COOKING FUEL UTILISATION

COOKING FUELS	UTILISATION RURAL (1A)	UTILISATION RURAL (1B)	UTILISATION URBAN (2)	UTILISATION RURAL (3)	UTILISATION RURAL (4)	1970 CENSUS RURAL	1970 CENSUS URBAN
FIREWOOD	46.50%	59.00%	8.70%	57.90%	47.72%	76.65%	46.92%
CHARCOAL	8.20%	10.00%	26.70%	2.35%	4.00%	(COMBINE)	(COMBINE)
LPG	21.20%	16.00%	53.60%	10.00%	20.57%	3.65%	21.59%
KEROSENE	63.30%	53.00%	49.30%	29.26%	30.57%	11.20%	27.16%
ELECTRICITY	10.00%	12.00%	36.30%	0.49%	1.14%	0.36%	2.21%
	>100%	>100%	>100%	100.00%	104.00%		

>100% INFERENCE - USE OF COMBINATION OF FUELS

(1A) SOURCE: 1. TABLE 4.9 & 4.10 THE SOCIO ECONOMIC IMPACT OF RE IN M'SIA
CHEE PENG LAM,1983

(1B) SOURCE: 2. TABLE A-23 RURAL ELECTRIFICATION SURVEY 1983, NEB

(2) SOURCE: 1. SERU KAJANG/KL SURVEY 1981

(3) SOURCE: 1. TABLE 3.7 RURAL ELECTRIFICATION SURVEY, JUNE 1977, SURVEY 1

(4) SOURCE: 2. TABLE 3.7 RURAL ELECTRIFICATION SURVEY, AUGUST 1978, SURVEY 2

TABLE 5.16:

LIGHTS POINT IN RURAL AREAS

NUMBER OF LIGHTS AND POWER POINTS					
NO OF LIGHTS	PERCENTAGE 1 OF HOUSEHOLD	PERCENTAGE 2 OF HOUSEHOLD	NO OF POWER POINTS	PERCENTAGE 1 OF HOUSEHOLD	PERCENTAGE 2 OF HOUSEHOLD
0			0	23.56%	6.00%
1	0.27%	0.40%	1	33.56%	17.50%
2	2.33%	3.90%	2	26.58%	43.50%
3	26.16%	26.70%	3	8.08%	17.40%
4	20.69%	21.40%	4	4.38%	8.60%
5	21.10%	16.50%	5 OR MORE	3.84%	3.30%
6	10.00%	10.00%	6	NA	1.80%
7 AND MORE	19.45%	21.20%	7 AND MORE	NA	1.90%
	100.00%	100.10%		100.00%	100.00%

1 TABLE 3.9, RURAL ELECTRIFICATION STUDY, PEN. M'SIA, 1978

2 TABLE 4.6, THE SOCIO ECONOMIC IMPACT OF RE, CP LAM, 1983

5.2.2.2 SPECIFIC ENERGY CONSUMPTION - A CURSORY REVIEW

The various main energy variables driving household energy demand is given in Table 5.17. For most end-use, marked variation is observed for different household categories except for cooking. The cooking needs per dwellings average about 1080 Mcal of useful energy which can be compared with 1995 Mcal [3] for ASEAN countries and 1400 Mcal for Fiji [14].

TABLE 5.17:

UNIT CONSUMPTION (HOUSEHOLD SECTOR)

COOKING: URBAN			1049.8	MCAL/DW/YR
RURAL			1101.7	MCAL/DW/YR
ELECTRIFIED HOUSEHOLD				
LIGHTING:	URBAN:	LOW	248.4	KWH/DW/YR
		MEDIUM	504.0	KWH/DW/YR
		HIGH	1008.0	KWH/DW/YR
	RURAL:	HIGH	151.2	KWH/DW/YR
		LOW	316.8	KWH/DW/YR
NON-ELECTRIFIED HOUSEHOLD				
LIGHTING:	URBAN:	LOW	30.0	LITRE/DW/YR
NON-ELECTRIFIED		(KEROSENE)		(KEROSENE)
HOUSEHOLD	RURAL:	LOW	18.8	LITRE/DW/YR
WATER HEATING IN HOUSEHOLD WITH WATER HEATERS				
	URBAN:	MEDIUM	23.7	MCAL/DW/YR
		HIGH	30.0	MCAL/DW/YR
ELECTRICITY CONSUMPTION IN HOUSEHOLD WITH CORRESPONDING APPLIANCES				
	URBAN: HIGH			
	TELEVISION		306.0	KWH/DW/YR
	FAN & IRON		428.4	KWH/DW/YR
	REFRIGERATOR		1248.0	KWH/DW/YR
	AIR-CONDITIONING		3480.0	KWH/DW/YR
	OTHERS		930.8	KWH/DW/YR
	RURAL: HIGH			
	TELEVISION		108.0	KWH/DW/YR
	FAN & IRON		214.8	KWH/DW/YR
	REFRIGERATOR		732.0	KWH/DW/YR
	AIR-CONDITIONING		1080.0	KWH/DW/YR
	OTHERS		242.4	KWH/DW/YR

5.2.2.3 CROSS-CHECK OF METHODOLOGY FOR 1985

In order to ascertain the accuracy od MEDEE-S output for the residential sector, the same analysis is applied using available data for 1985. Total energy by end-use and by fuel computed for the base year resembled closely the actual final value. By energy forms, the model output underestimated actual values by between -0.1 to -1.2% and for selected end-uses (cooking and lighting), by between 0.0% to -0.2%. The highest underestimate is experienced for total electricity (about -1.2%) and this is mainly attributed to rounding errors accumulated by multiple stages of computation to arrive at final energy consumption for each appliance considered.

Using the same assumptions of disaggregation, the detailed breakdowns of the residential energy consumption compared to actual statistical value for the year 1985 are shown in Table 5.18. By energy form, the model gives marginally lower values compared to statistical value; Traditional Fuels (-0.1%), Charcoal (-0.2%), Kerosene (-0.1%), Gas (0.9%), LPG (+0.9%), Electricity (-0.1%) and Total Commercial (+0.3%). The results show that the input for the base year and the year of 1985 are reasonably well calibrated as the errors generated are almost negligible (below absolute 1.2%)

TABLE 5.18:

COMPARISON OF INPUT VALUES AND MODEL OUTPUT FOR 1983 AND 1985 (TJ) - RESIDENTIAL SECTOR

	ACTUAL STATISTICAL VALUE		MODEL OUTPUT		STATISTICAL DIFFERENCE PERCENTAGE	
	1983	1985	1983	1985	1983	1985
BY ENERGY FORM						
TRADITIONAL FUEL	20000	20300	19977	20284	-0.1	-0.1
CONVENTIONAL FUELS						
COAL	0	0	0	0	-	-
CHARCOAL	1430	2040	1427	2035	-0.2	-0.2
KEROSENE	13326	11735	13313	11722	-0.1	-0.1
GAS	644	688	643	682	-0.1	-0.9
LPG	5023	6611	4996	6669	-0.5	+0.9
ELECTRICITY	7974	9572	7880	9558	-1.2	-0.1
TOTAL COMMERCIAL	28397	30646	28259	30666	-0.5	+0.3
BY SELECTED END-USES						
COOKING						
ELECTRICITY	637	765	637	764	0.0	0.0
CONVENTIONAL	19599	20392	19580	20478	-0.1	+0.4
ELECTRICITY	1769	2142	1766	2127	-0.2	-0.7
KEROSENE	800	632	799	630	-0.1	-0.3

5.2.3 ENERGY DEMAND FORECAST

5.2.3.1 PERFORMANCE OF MODEL

Before embarking on the forecast simulation, a rigorous analysis of simulating the historical energy demand to match actual estimated stastistics was carried out. The objective of this analysis was to ensure that the derived base year intensities are stable and consistent. In addition, some of the parameters derived in this simulation can indicate to a certain extent future evolution of relevant variables. In the simulation, the base year 1983 costant data is maintained, and two series of scenario and exogenous variables for the period 1983 - 1987 and 1978 - 1983 are derived.

In both cases, all evolution of itensities for cooking needs, appliances consumption and hot water requirement are kept constant (set to 1) and changes are made only with actual estimated value of GDP and value added share, demographic variables and pattern (urbanisation rate, person/dwelling), ownership pattern of electrical appliances, distribution of urban and rural households, and electrification level. The ownership pattern was varied using the elasticity of household ownership rate of electrical equipment to household income. Whilst, the electrification level of urban and rural household was derived using the annual addition of new electrified household scenario parameters. For the cooking energy requirement, the share of the three assumed strategic fuel (Kerosene, LPG and Gas) for cooking were varied accordingly to actual demand of such fuel in the household sector.

Table 5.19 depicts the results of the performance test and the differences between estimated actual and model output for conventional fuel were within reasonable range (mainly +/- 1%). Fig. 7 shows the model output for forecasting historical commercial energy demand in the sector. For electricity, the model output for past years from 1978 to 1987 differs from 'actual' by between -1.18% to 1.73%. The results indicated that the assumed base year intensities exhibit stable and consistent characteristic when applied to historical years.

TABLE 5.19:
COMPARISON OF MODEL OUTPUT AND
ESTIMATED ACTUAL FOR HISTORICAL YEARS (1978-1987)

Estimated Actual Consumption Derived From Energy Balance

Electricity	3,852	4,475	5,305	6,094	6,788	7,974	8,564	9,573	10,864	11,562
LPG	2,899	3,270	3,405	3,506	3,809	5,023	5,393	6,611	8,003	8,803
Natural Gas	439	468	498	556	659	644	688	688	791	1,084
Kerosene	12,530	13,326	13,048	13,684	13,684	13,326	13,857	11,735	11,777	10,695
Total	19,721	21,540	22,256	23,840	24,940	26,967	28,502	28,607	31,255	32,144
Total Conventional	15,869	17,064	16,950	17,746	18,152	18,993	19,939	19,034	20,570	20,581
Model Output For Performance Test										
Electricity	3852.16	4552.66	5310.13	6102.81	6787.9	7880.01	8553	9558.29	10609.47	11472.77
LPG	2891.91	3265.8	3397.78	3505.1	3810.51	4996.53	5423.29	6669.51	8121.06	8834,34
Natural Gas	458.52	458.93	492.08	559.73	655.14	643.48	684.57	682.27	795.47	1076.56
Kerosene	12670.35	13314.03	12972.64	13491.69	13424.63	13313.06	13753.55	11721.54	11598.48	10502.31
Total	19,873	21,591	22,173	23,659	24,678	26,833	28,414	28,632	31,124	31,886
Total Conventional	16,021	17,039	16,863	17,557	17,890	18,953	19,861	19,073	20,515	20,413
Percentage Difference										
Electricity	0.01%	1.73%	0.09%	0.14%	0.00%	-1.18%	-0.12%	-0.15%	-0.70%	-0.78%
LPG	-0.25%	-0.13%	-0.21%	-0.03%	0.03%	-0.53%	-0.56%	-0.89%	-1.48%	-0.36%
Natural Gas	4.42%	-2.01%	-1.12%	0.64%	-0.53%	-0.08%	-0.54%	-0.87%	-0.59%	-0.65%
Kerosene	1.12%	-0.09%	-0.57%	-1.41%	-1.90%	-1.10%	-0.75%	-0.11%	-1.51%	-1.80%
Total	0.77%	0.24%	-0.37%	-0.76%	-1.05%	-1.50%	-0.31%	-0.09%	-0.42%	-0.80%
Total Conventional	0.96%	-0.15%	-0.52%	-1.07%	-1.44%	-1.21%	-0.39%	-0.21%	-0.27%	-0.82%

With respect to the model itself, the working team felt that the following specific items if made available, could further assist the modelling and simulation of MEDEE-S;

- The main manual for the MEDEE-S which is currently in - The main manual for the MEDEE-S which is currently in French if translated to English will lead to better understanding of the governing equations among the Malaysian working team.
- For the consumption per equipment, separate value should be allowed for different household classes instead of just only a single value for Urban or Rural household.
- The output results of the present version of MEDEE-S released to the Malaysian Team only give end-uses of cooking and lighting and does not give details for others uses.
- The result should also include the calculated ownershippattern of appliance by class of household and overall rural and urban average ownership pattern to provide across check for the input elasticities.

Despite the above reservation, the overall advantages and flexible structure and ease to use of the MEDEE-S model made it a handy and consistent end-use model for sectoral energy demand analysis.

5.2.3.2 DEVELOPMENT SCENARIOS

Consistent development scenario is necessary in arriving at a plausible forecast. It is therefore necessary to develop consistent macroeconomic and demographic scenarios outside the model before any sensible forecast can be performed. This probable scenario are than used in the model for forecasting purposes.

The demographic forecast forms the initial basis of the whole pattern of housing stock and household classes. In this study, the population is projected to grow at 2.32% pa from 1990 to 2000 and 2.26% pa for the period 2000 to 2010. Urbanisation rate is expected to increase from 36.8% in 1983 to 40.7% in 1990, 45.6% in 2000 and 51.4% in 2010. Table 5.20 depicts the main demographic variables driving demand in the sector. Household size for both urban/rural household is expected to reduce from 4.8/5.0 person per dwelling in 1983 to 4.5/ 4.9 person per dwelling in the year 2010.

The variation of the share of each consumption band classes for both rural and urban over the forecast horizon is shown in Fig. 9 and Fig. 10. This share is derived based on the fact that the household will become more affluent in the future and some will gradually move to the higher consumption classes. However, the increase in the share of the higher consumption classes will be very gradual as household stock of applianc-eschanges very slowly. For the urban household, the share of the high and medium class will increase from 2.5% and 22.1% in 1983 to 3.1% and 27% in the year 2010. Consequently, the lower urban class share will decrease from 75.4% in 1983 to 69.9% in the year 2010. Whilst, the rural low and high household class share will change from 7.4% and 92.6% in 1983 to 13.2% and 86.8% in 2010 respectively.

The macroeconomic scenario is derived based on the latest likely trend [7] while maintaining overall consistency in the sectoral GDP formation. The Malaysian economy is dependent on several factors such as the growth of the international trade/economy especially its major trading partners, growing protectionism as a result of economic alignment among countries such as the United Europe in 1992, and other related elements driving the economy. Whilst, the GDP formation is dependent on the Government policy on industrialisation and long term diversification plans for the economy.

For this study, only one scenario is developed although this could be extended to several possible scenarios in future review. The gross domestic product in constant term is expected to grow by 4.8% pa from 1990 to 2000 and a slightly reduced growth of 4.5% pa from 2000 to 2010. In terms of sectoral share, contribution from industrial and services sector vary from 19.5% and 54.1% in 1983 to 30% and 48.4% in the year 2010.

The following paragraphs will describe the likely evolution of technical parameters effecting energy demand for household sector. These are related to lighting, electrical appliances (include air-conditioning), hot water and cooking purposes. All end-use efficiency of various fuel is assumed to be constant although it may improve marginally as a result of future technological development. However, it was felt that such improvement which is extremely difficult to predict will be very small and the impact on overall result will be negligible. All intensities namely cooking requirement per household is assumed to remain constant at about 1080 Useful Mcal per dwelling based on the fact that the useful cooking energy will not change with time although the forms of energy use will vary. For all classes of household, an increase in share of electricity, LPG, and Gas for cooking is expected to reflect increased penetration of these fuels. Kerosene and traditional energy share for cooking is anticipated to decrease significantly in the future. Traditional energy share for cooking in the rural low household is expected to decrease from 32.3% in 1983 to 10% in the year 2010 as urban areas expandin size and land becomes scarce and is mainly utilise for export-orientated commercial agricultural crops.

For lighting, it is assumed that the electricity lighting (kWh/household per year) requirement by urban and rural classes of household will remain the same in the future. The actual model value of lighting intensities driving household demand are shown together with forecast value in Fig. 8. Similar assumption is also made for kerosene lighting requirement (liter/dwelling per year) for non electrified household. Electrification level in the urban areas will increase from 81.6% in the year 2000 and attaining full electrification in the year 2010. With the continuous emphasis on rural electrification programmes by the Government, rural areas will achieve 95% electrification level in 2010 compared to the 1983 level of 53%. The growth in electrification rates is shown in Fig. 11 and Table 5.20.

Ownership pattern of electrical appliances for the various household classes is assumed to increase substantially in the long term. For the urban high consumption classes, all household will own all electrical appliances. For the urban medium household, air-conditioning ownership will increase from 21.3% to 27.0% in the year 2000. The evolution of ownership pattern of various appliances for various household classes is shown in Fig. 12 to Fig. 15. As the basic assumption of classes of household refers to consumption band, the ownership rate in low household class is bound to increase moderately with income as the high and medium consumption classes already achieved almost saturated ownership level.

5.2.3.3 RESIDENTIAL SECTOR DEMAND FORECAST 1983 - 2010

Fig. 16 shows the forecast of total commercial energy by Fuel Type in the residential sector, while Fig. 17 depicts the forecast of total energy (including traditional) by the main end-uses. Total conventional fuel (excluding traditional) grows from 20240 TJ to 32480 TJ in 2000 and 41670 TJ in the year 2010.

The share of each commercial fuel in the sector is shown in Table 5.21. Kerosene demand is expected to decrease substantially from 13313 TJ in 1983 to 8670 TJ in 2000 and 5230 TJ in 2010. This is mainly due to the fact that kerosene will become a relatively expensive cooking fuel with the removal of Government subsidy and thus will be substituted by other cooking fuels namely gas, electricity and LPG. Kerosene for lighting will also reduced with saturation of electrification level in both rural and urban household. Gas and LPG demand is expected to increase from 643 TJ and 5000 TJ in 1983 to 5080 and 22300 TJ in the year 2010. Electricity is expected to increase from 7880 TJ in 1983 to 29760 TJ in 2000 and 45410 TJ in the year 2010. Fig. 18 and Table 5.22 compare the forecast with that recently established by NEB MAED and Sectoral Econometric Forecast [12]. In the medium term till 1995, the sectoral forecast is fairly close to the other two projections. While in the longer term, the MEDEE-S forecast is marginally higher than the MAED Forecast and significantly lower than the econometric forecast [12].

Fig. 19 shows the projection of cooking fuel requirement by fuel type. In terms of final energy, LPG will be the largest contributor to commercial cooking fuel requirement overtaking kerosene in 1995. Fig. 20 depicts the forecast of end-use of electricity. The share by end-use throughout the forecast horizon will remain relatively constant with electrical appliance (including Hot Water) as the largest component followed by lighting requirement and cooking uses.

Electrical appliance electricity needs will increase from 5480 TJ in 1983 to 23520 TJ in 2000 and 36200 TJ in the year 2010. The corresponding values for lighting needs are 1766 TJ in 1983, 4240 TJ in 2000 and 5980 TJ in the year 2010.

Fig. 21 shows the forecast of lighting end -use by fuel type. Electricity is expected to penetrate the lighting requirement provided by kerosene and its share will increase from 69% in 1983 to 94.0% and 98.6% in the year 2000 and 2010 respectively.

Table 5.23 shows the simulated index of energy to total GDP ratios, elasticity or expenses to GDP and consumption per electrified household. The results indicate a general decline of this index for all total energy and modern energies. While for electricity, this ratios continue to increase initially and remain fairly constant at the end of the forecast horizon. This clearly shows the growing importance of electricity in satisfying future residential sector demand as electricity will continue to penetrate other uses in the sector. The elasticity of energy expenses to GDP shows a general decline from 2.10 for the period 1983 - 1995, 1.50 for the period 1983 - 2000, 1.39 for the period 1983 - 2005 and 1.31 for the period 1983 to 2010.

This is calculated by escalating the base year price in constant term in the following manner; oil product at 3.86% pa, and Charcoal /Gas/LPG at 2% pa. This indicates that as percentage increase in energy expenses to percentage increase in GDP will decline in the long term indicating saturation of energy demand in the sector. This is a consistent phenomena as energy demand could reach saturation level in the long term but GDP would continue to grow. It also shows an increase in productivity, whereby to produce a unit of GDP, one spends less on energy expenses. The annual electricity consumption per electrified household will continue to increase significantly from 1136 kWh in 1983 to 1900 kWh and 2107 kWh in the year 2000 and 2010 respectively. This further indicates the growing role of electricity in modern household.

TABLE 5.20:

MAIN DEMOGRAPHIC VARIABLES AND ELECTRIFICATION RATIO

DEMOGRAPHIC VARIABLES	1983	1985	1990	1995	2000	2005	2010
PO PULATION	14.89	15.73	18.02	20.27	22.67	25.35	28.35
FROM URBAN	5.48	5.88	7.33	8.70	10.34	12.27	14.57
FROM RURAL	9.41	9.84	10.69	11.57	12.33	13.08	13.78
RATE OF URBANISATION	0.37	0.37	0.41	0.43	0.46	0.48	0.51
NUMBER OF HOUSEHOLDS (MILLIONS)	3.02	3.20	3.66	4.18	4.73	5.36	6.08
FROM URBAN (MILLIONS)	1.14	1.25	1.56	1.88	2.26	2.71	3.26
ONE AREA (SHARE)							
Class One - Low	0.754	0.733	0.723	0.711	0.702	0.701	0.699
Class Two - Medium	0.221	0.240	0.249	0.260	0.268	0.269	0.270
Class Three - High	0.025	0.027	0.028	0.029	0.030	0.030	0.031
FROM RURAL (MILLIONS)	1.88	1.94	2.10	2.30	2.47	2.65	2.82
ONE AREA (SHARE)							
Class One Low	0.926	0.914	0.898	0.890	0.882	0.875	0.868
Class Two - Medium	0.074	0.086	0.102	0.110	0.118	0.125	0.132
SHARE OF ELECTRIFIED HOUSEHOLDS							
ALL CLASSES	0.64	0.73	0.82	0.86	0.92	0.95	0.98
FROM URBAN	0.82	0.89	0.93	0.96	0.99	0.99	1.00
FROM RURAL	0.53	0.62	0.73	0.78	0.85	0.91	0.95

TABLE 5.21:

MODEL OUTPUT OF ENERGY DEMAND FOR RESIDENTIAL SECTOR

HOUSEHOLD SECTOR BALANCE SHEET OF TOTAL USAGE MALAYSIA (TJOU)	1983	1985	1990	1995	2000	2010
TOTAL CONSUMPTION	48236.98	50951.48	55573.17	64876.75	76143.63	85749.34
CONSUMPTION BY ENERGY FORM						
TRADITIONAL FUELS	19977.03	20284.42	16809.63	13757.03	13899.68	8663.95
CONVENTIONAL FUELS	20379.95	21108.77	24621.80	29191.72	32480.30	41674.75
Coal	0.00	0.00	0.00	0.00	0.00	0.00
Charcoal	1426.89	2035.45	2693.13	5039.61	6474.16	9062
Kerosene	13313.06	11721.54	11513.39	10433.93	8666.20	5233.37
Gas	643.48	682.27	1161.63	2047.99	2795.41	5080.63
LPG	4996.53	6669.51	9253.66	11670.19	14546.54	22297
ELECTRICITY	7880.01	9558.29	14141.74	21928.00	29764.07	45410.64
SOLAR	0.00	0.00	0.00	0.00	0.00	0.00
CONSUMPTION BY USAGE						
COOKING	40195.08	415.27.16	42106.48	44021.41	48120.62	53493.67
LIGHTING	2564.92	2757.56	3268.95	3863.96	4505.23	6060.99

TABLE 5.22:

COMPARISON OF ELECTRICITY FORECAST

RESIDENTIAL SECTOR ELECTRICITY END-USE (TJOU)	1983	1985	1990	1995	2000	2005	2010
COOKING	637.33	764.36	1137.19	1475.86	2010.89	2475.89 ..	3237.11
LIGHTING	1765.69	2127.16	2806.83	3460.75	4235.41	5073.35	5978.86
ELECTRICITY APPLIANCE	5476.98	6666.76	10197.74	16991.38	2314.78	29576.86	36194.68
TOTAL ELECTRICITY	7880.01	9558.29	14141.74	21928.00	29764.07	37117.11	45410.64
MAED FORECAST (1989)7			4159.00	23805.00	28566.00	35054.00 --	39951.00
SECTORAL ANALYSIS 8 (ELECTRICITY PENINSULAR X 1.15)			13533.66	21901.00	36225.00	52426.00	75873.00

TABLE 5.23:

SOME INDICES OF DEMAND ANALYSIS

RESIDENTIAL SECTOR RELEVANT INDICES	1983	1985	1990	1995	2000	2005	2010
INDEX OF ENERGY DEMAND/ TOTAL GDP RATIOS							
Electricity	100.00	113.68	130.15	161.16	171.39	171.51	168.38
Modern Fuels	100.00	94.32	83.91	73.80	62.27	56.04	50.28
Modern Energies	100.00	100.01	97.49	99.45	94.31	89.95	84.96
Total	100.00	99.00	83.55	77.89	71.63	65.01	58.00
PRODUCT ELASTICITIES OF ENERGY DEMAND *							
Electricty	1.00	3.08	1.55	1.99	1.26	1.00	0.92
Modern Fuels	1.00	0.10	0.54	0.42	0.30	0.52	0.50
Modern Energies	1.00	1.00	0.90	1.09	0.78	0.78	0.74
Total	1.00	0.84	0.33	0.68	0.65	0.55	0.48
ENERGY EXPENSES (106 Local currency)**							
Electricity	469.10	591.77	967.30	1655.23	2480.62	3416.04	4614.56
Total	761.92	918.29	1413.72	2244.04	3218.04	4354.58	5794.25
Elasticity of Expenses to GDP	1.00	2.97	1.71	2.10	1.50	1.39	1.31
kWh per electrified dwelling	1136	1145	1316	1457	1902	2004	2107

NB: For product elasticity, the values given should be taken with caution, as the governing equation are not well defined and therefore not fully understood.

5.2.4 DISCUSSION AND CONCLUSIONS

The main objective of the sectoral demand study for the household sector has been achieved. This includes gaining the know-how in running the MEDEE-S model for the sector proficiently and adopting available data to suit the model structure in the context of the Malaysian situation. Through the modelling process, the working team has been able to improve information relevant to demand analysis, and identify gaps in data availability and data needs which would improve future energy demand study and survey. Although energy data needs especially with regard to conventional fuels by end-use were still lacking, the working team has analysed extensively available energy surveys\studies to derive consistent assumption and estimates of the residential sector energy demand.

The detailed fossil energy consumption data are unavailable. This includes amount of each type of energy used for cooking and hot water. Information on usage of traditional energy is also seriously lacking. As mentioned in the preceding text, inferences has been made from various studies and survey for the purpose of this study. Thus, future effort in sectoral demand analysis could concentrate on a consistent effort to verify the inferences made and further confirm or disprove some of the findings of this study. Surveys on electrical equipment ownership pioneered by NEB should be continued in the future and be enhanced to include specific consumption of major electrical appliances. If possible, this effort could be supplemented by other nationwide surveys and studies by utilities in Sabah and Sarawak.

Based on the predetermined development scenarios described in the main text, the following are the main conclusions of these studies:

- Total commercial final energy demand of the sector is expected to increase form 21110 TJ to 32480 TJ and 41680 TJ in the year 2000 and 2010 respectively. This represents an average annual growth rate of 2.91% pa for the period 1985 - 2000 and 2.75% pa for the period 1985 - 2010. This corresponds to a commercial energy demand/household income elasticity of 1.006 for the period 1985 - 2000 and 1.005 for the period 1985 - 2000. While for electricity the same elasticity value for period considered are 1.043 and 1.037. This is consistent with universal trend where electricity demand increases at a more rapid rate than that of other commercial energy and this increase should be slightly dampened in the long term due to saturation effect.

- In terms of conventional thermal share, LPG will increase its contribution from 31.5% in 1985 to 44.7% and 53.5% in the 2000 and 2010 respectively. Gas will also increase its share rapidly from 3.2% in 1985 to 12.2% in 2010. While kerosene will reduce its share drastically from 55.5% in 1985 to 26.7% in 2000 and 12.5% in the year 2010. This scenario of fuel share forecast appears plausible and consistent with the future energy resource option in Malaysia, whereby its large domestic natural gas reserve will sustain the increase of Gas/LPG utilisation. Kerosene by the year 2000, would also be prohibitively costly when Malaysia becomes a net importer of oil.

- Electricity demand in the sector will increase from 9558 TJ in 1985 to 29760 TJ and 45410 TJ in the year 2000 and 2010. The corresponding share of electricity to total final commercial energy will be 32.1% in 1985, 47.8% in 2000 and 52.1% in 2010.

- Consumption per electrified dwelling is expected to increase from 1145 in 1985 to 1902 and 2107 in the year 2000 and 2010 respectively. Residential sector consumption per capita increases from 169 in 1985 to 364 and 445 in the year 2000 and 2010.

- Based on a predetermined constant 1983 fuel prices and an assumed constant fuel escalation rate, total electricity expenses share in total conventional energy expense in the sector will increase from 64% in 1985 to about 79% in the year 2010. The elasticity of energy expenses to GDP will also decrease from 2.10 in year 2000 to 1.31 in the year 2010.

Finally, future energy demand in the household sector is strongly dependent on various variables. The accuracy of forecast is thus dependent on how precise these parameters are projected. From the plausible scenario simulated, electricity and to a lesser extent LPG/Gas will continue to grow in importance in satisfying future energy requirement in Malaysian homes.

Possible sources of error in the projection could be attributed mainly to the assumptions used for the scenario parameters. These include unit consumption for lighting for electrified household although technology improvement could reduce these values. This is also applicable to the assumed future evolution of unit consumption of electrical appliance. For instance, technological improvement in air-conditioning cycle could improve the performance of air-conditioning unit which in turn could reduce the value in the future. However, such parameter are extremely difficult to predict and the assumptions made are based on available information at this point in time.

From the forecast of total commercial energy, it appears that the energy consumption till the year 2010 for the sector is moving towards a favourable situation. This includes significant reduction of kerosene consumption which would be substituted for cooking by LPG and Gas. It is also a distant possibility (not reflected in this forecast), that complete substitution of kerosene by gas products (namely LPG and Natural Gas) for cooking could occur if oil price increases rapidly in the future. One disturbing trend in the forecast is the increase in the proportion of charcoal consumption which implies that continuous deforestation could take place. This, however could be circumvented by having a forecast scenario whereby natural gas and LPG would penetrate extensively cooking fuels even in the rural areas to substitute charcoal. Such a scenario would entail cheaper gas/LPG for rural areas and extending the distribution network to such areas. This will also helpto reduce traditional energy requirement which will further alleviate the environmental impact associated with continuous deforestation.

In retrospective, the implication of future trends of various fuel demand will not be complete unless analysedin a global context. This involves looking at the evolution of energy consumption for all energy consuming sectors. The overall scenario will help to identify the dominant and critical fuels in tandem with availability of supply sources in the long term.

Fig. 7: Model Output of Commercial Energy

(1978 - 87)

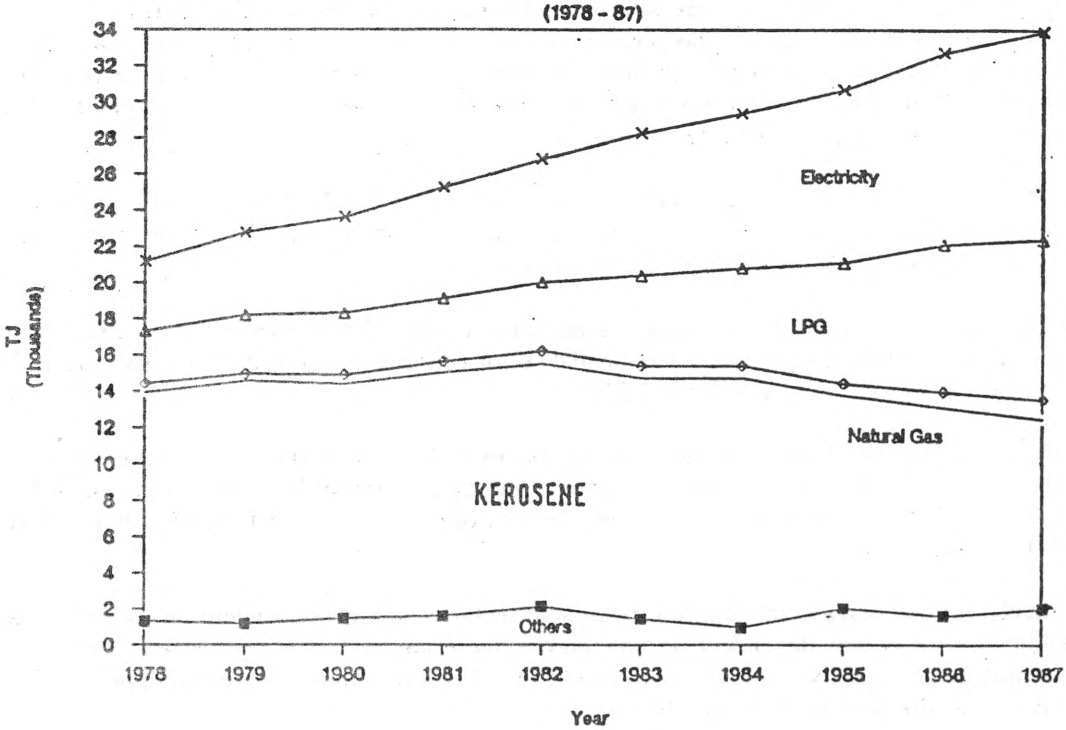


Fig. 8: Lighting Unit Consumption

per electrified household

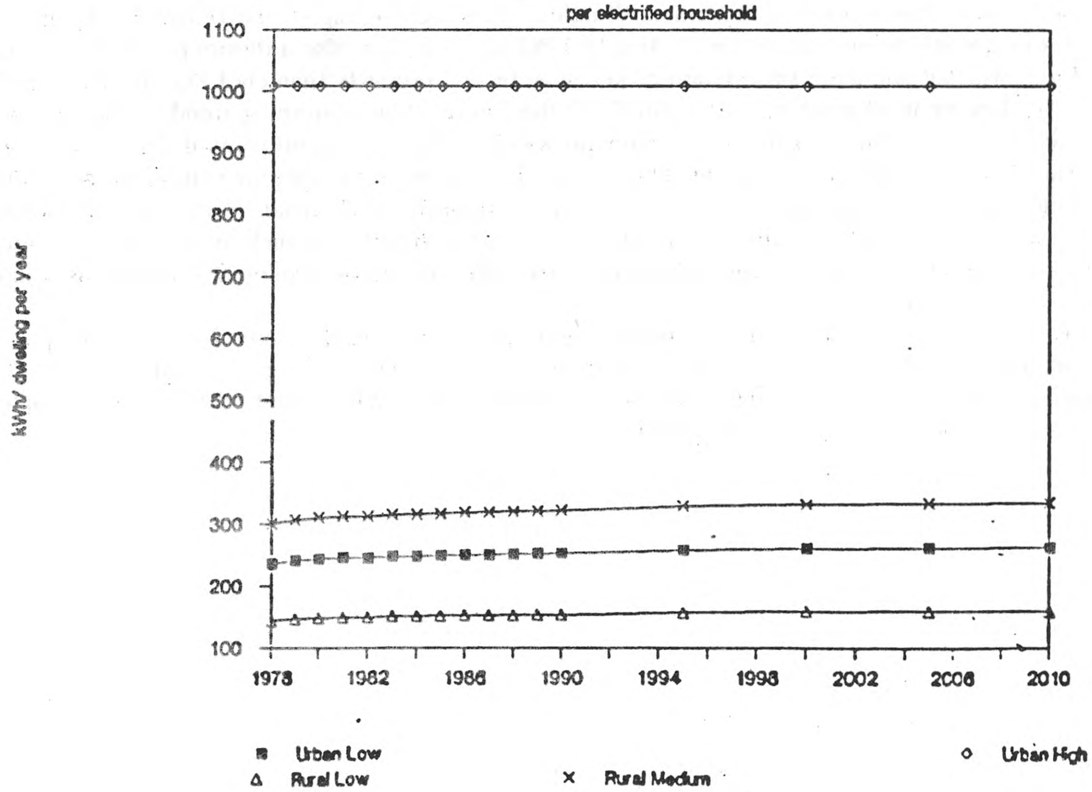


Fig. 9: Urban Split by Class

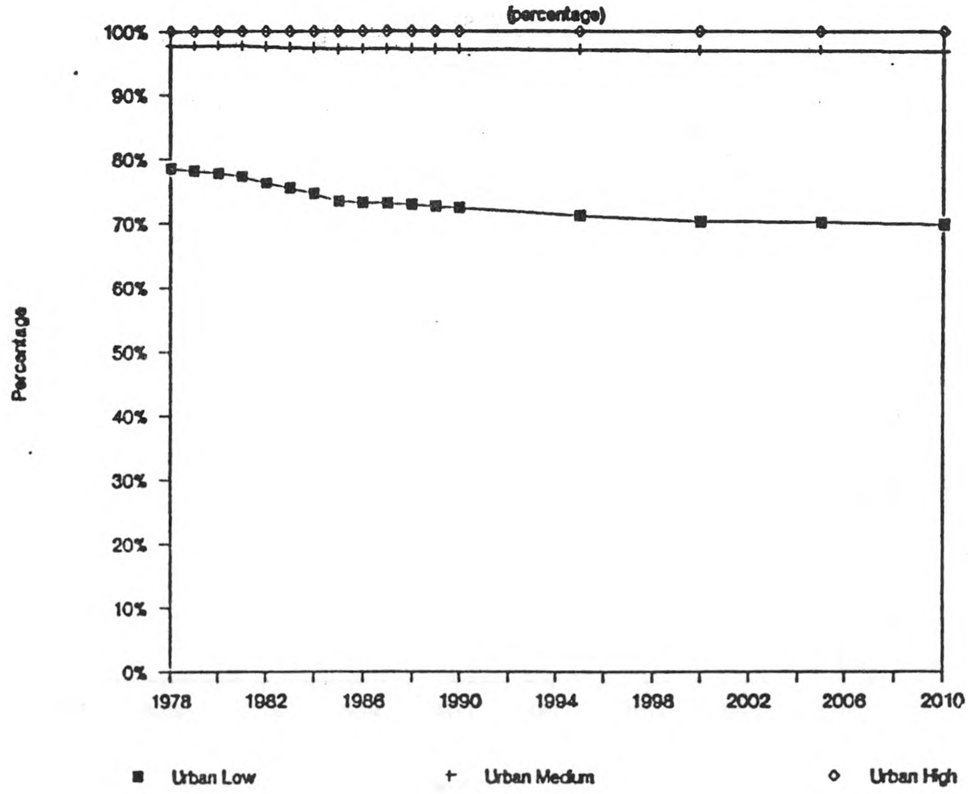


Fig. 10: Rural Split by Class

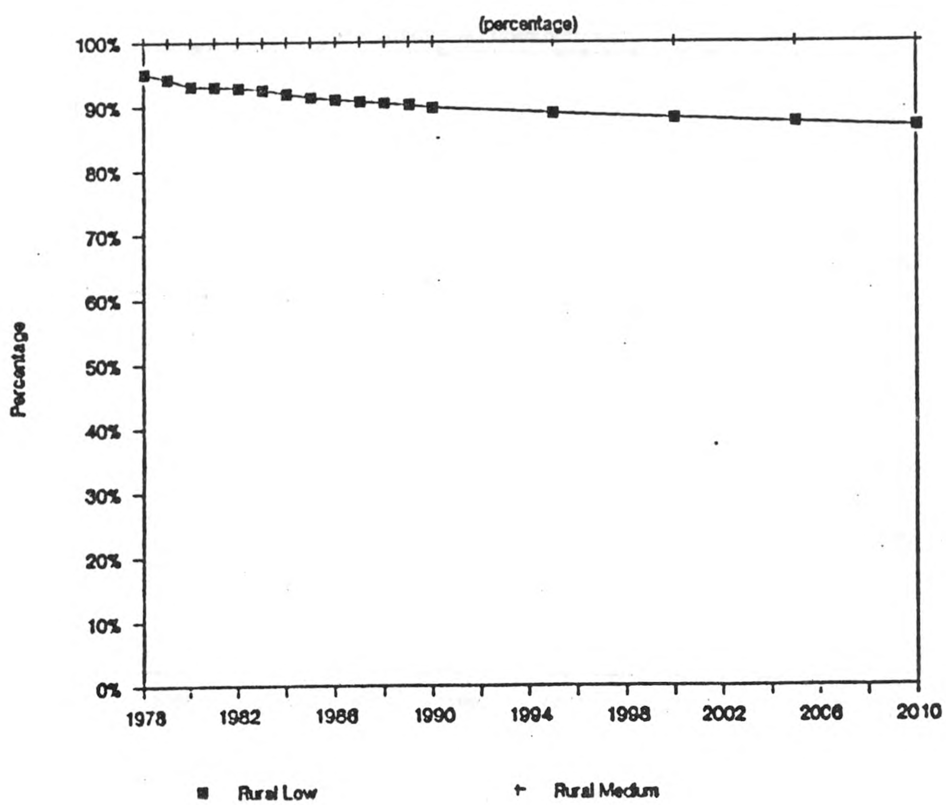


Fig. 11: Electrification Level

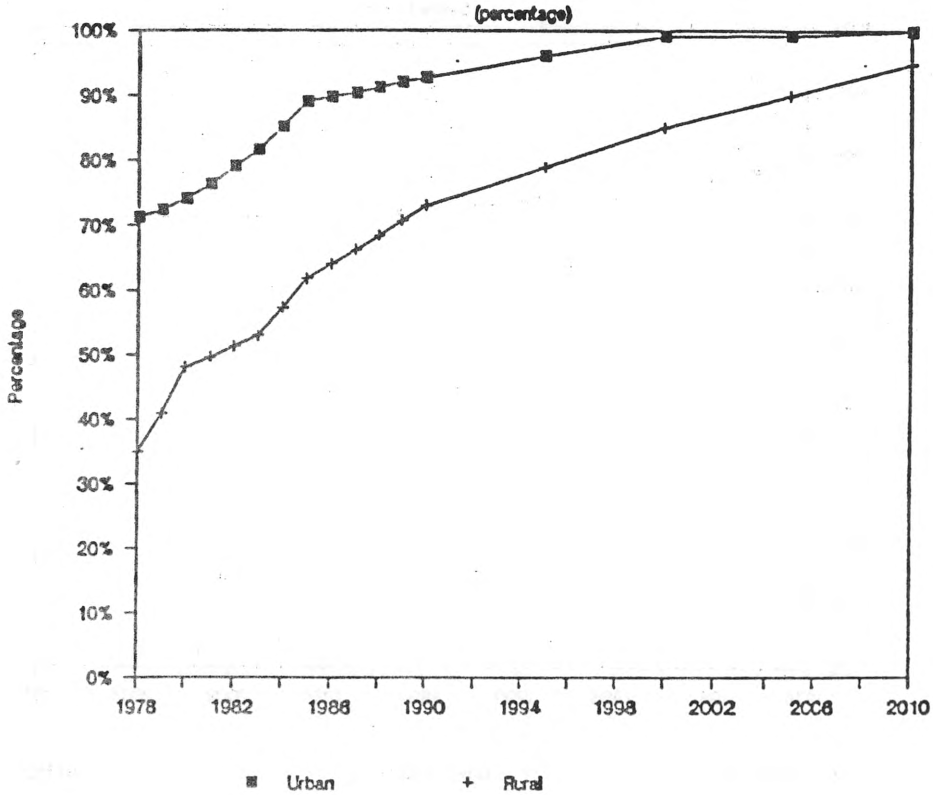


Fig. 12: Ownership Of Electrical Appliances

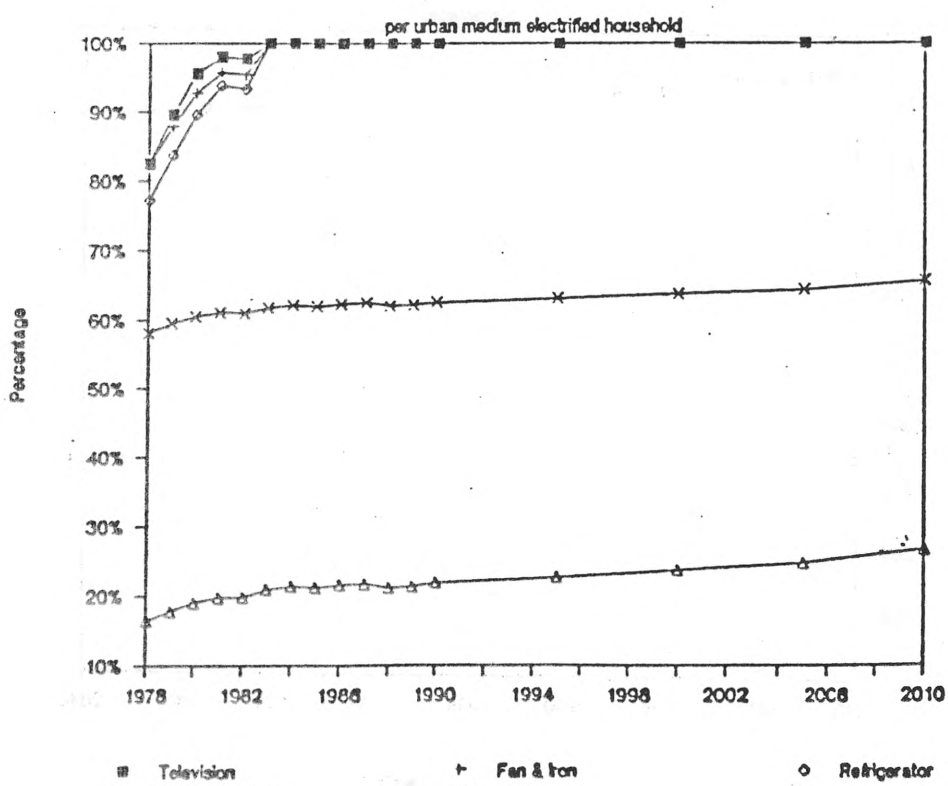


Fig. 13: Unit Consumption By Equipment

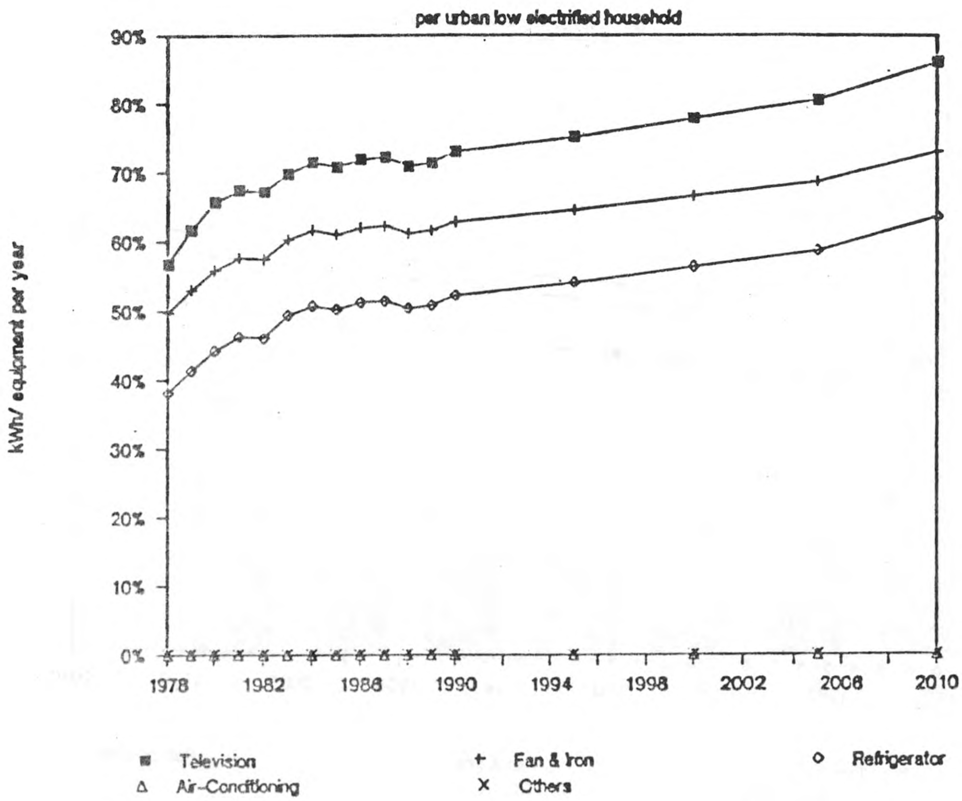


Fig. 14: Ownership by Equipment

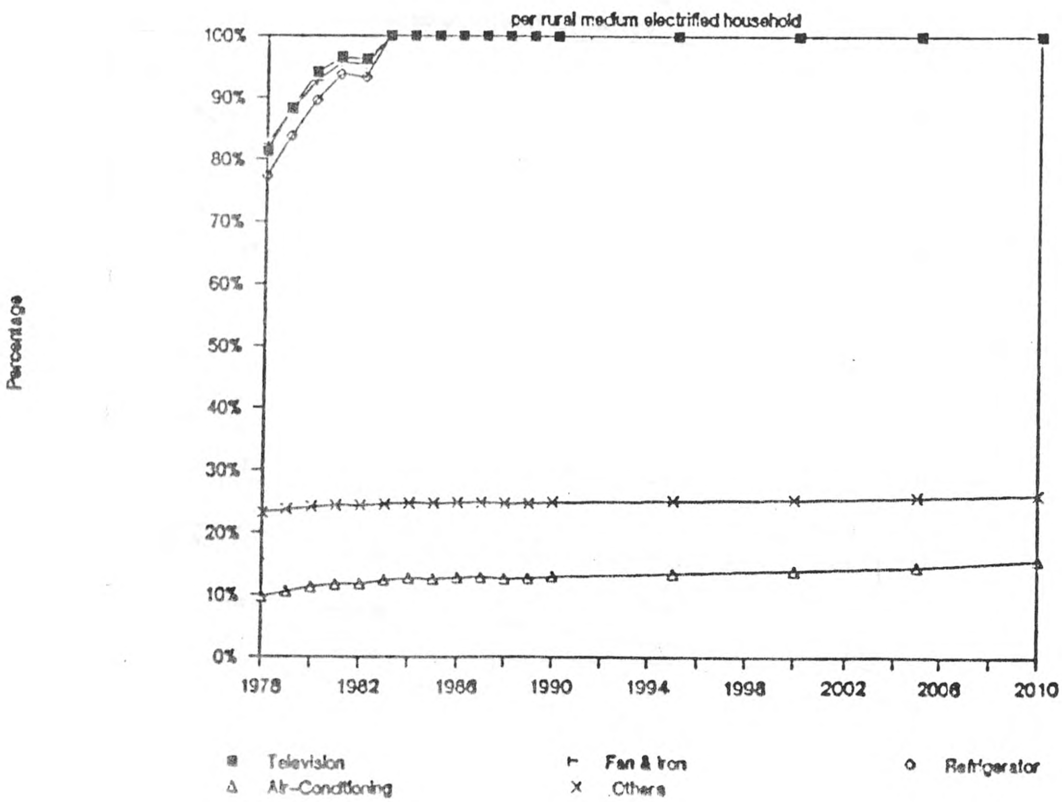


Fig. 15: Ownership by Equipment

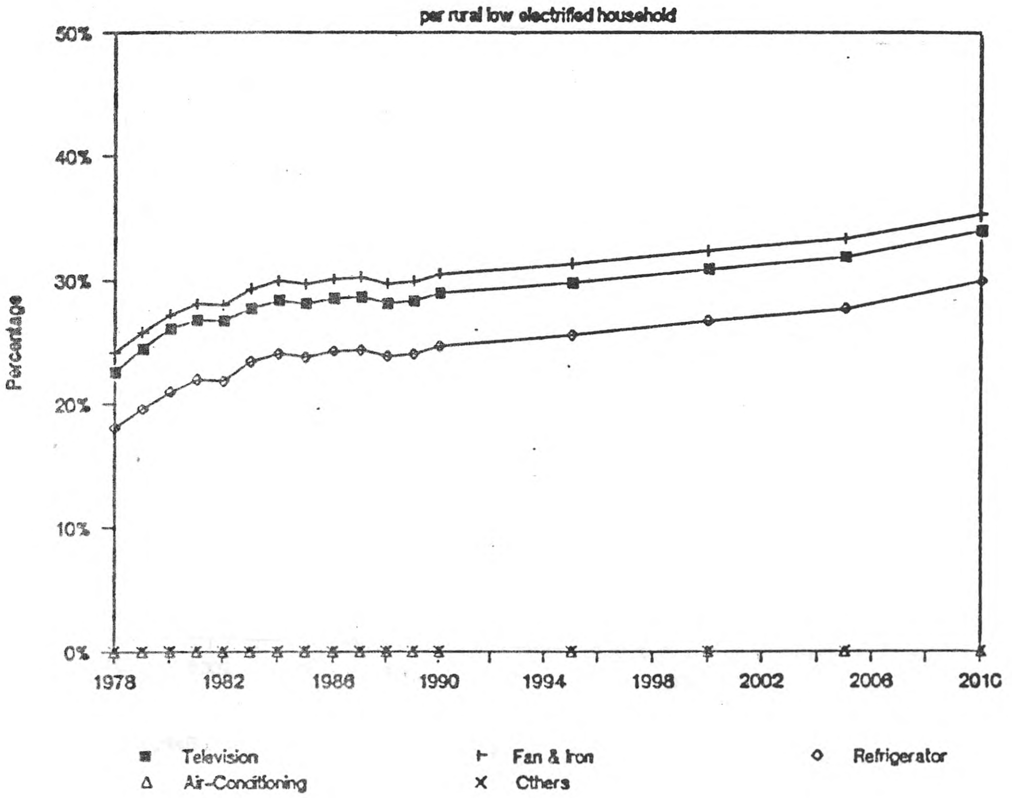


Fig. 16: Forecast of Commercial Energy

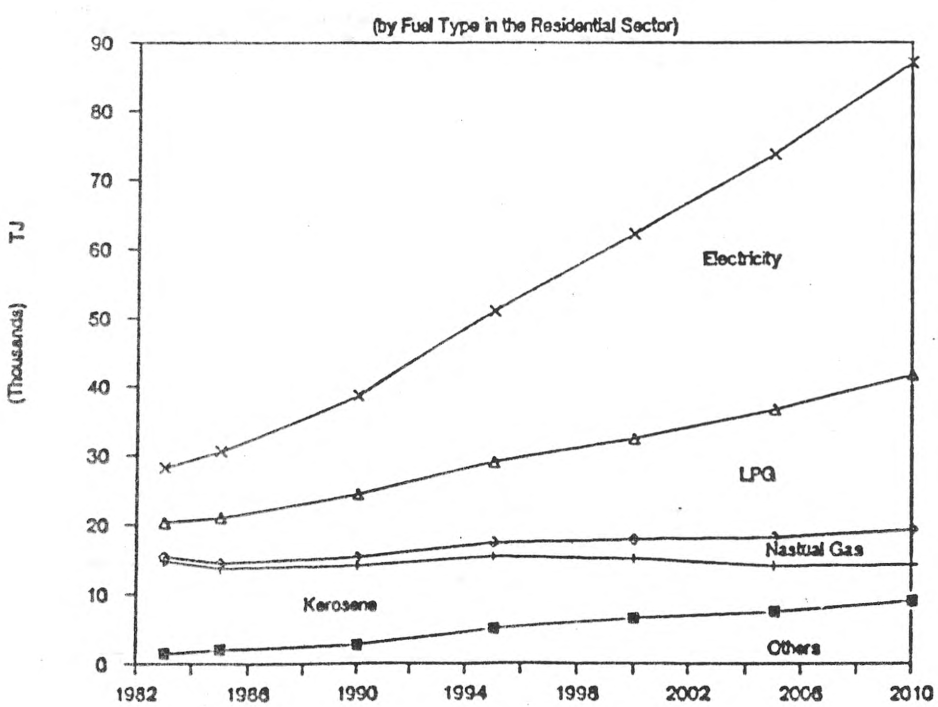


Fig. 17: Forecast of Total Energy

(by Use)

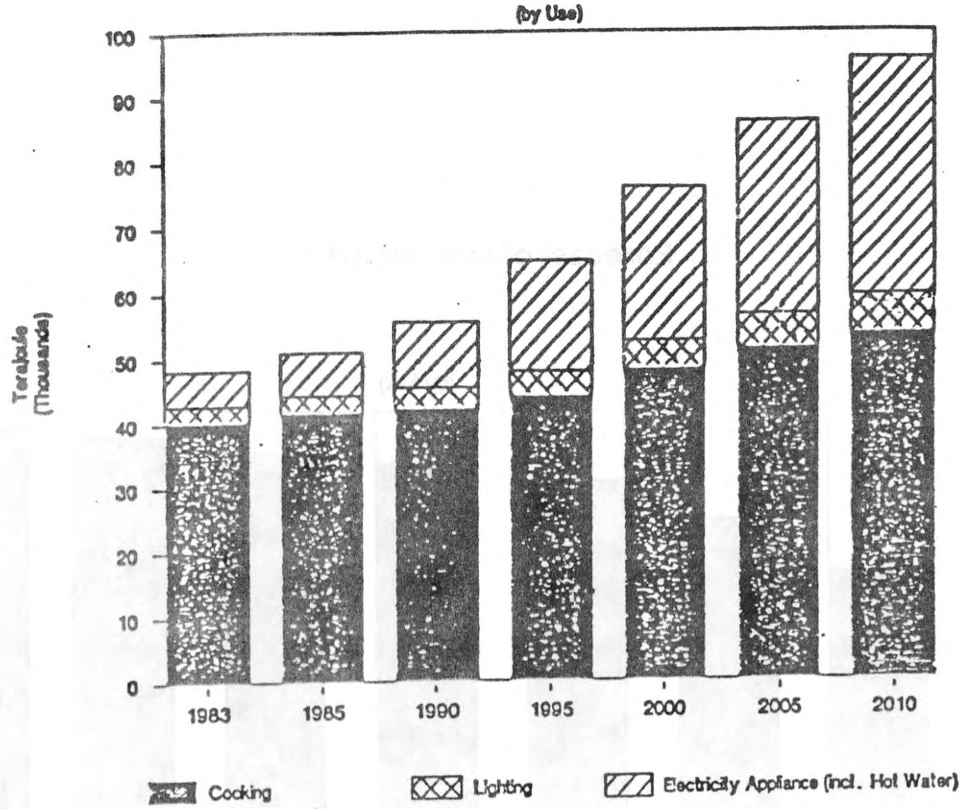


Fig. 18: Comparison of Electricity Forecast

(for Residential Sector)

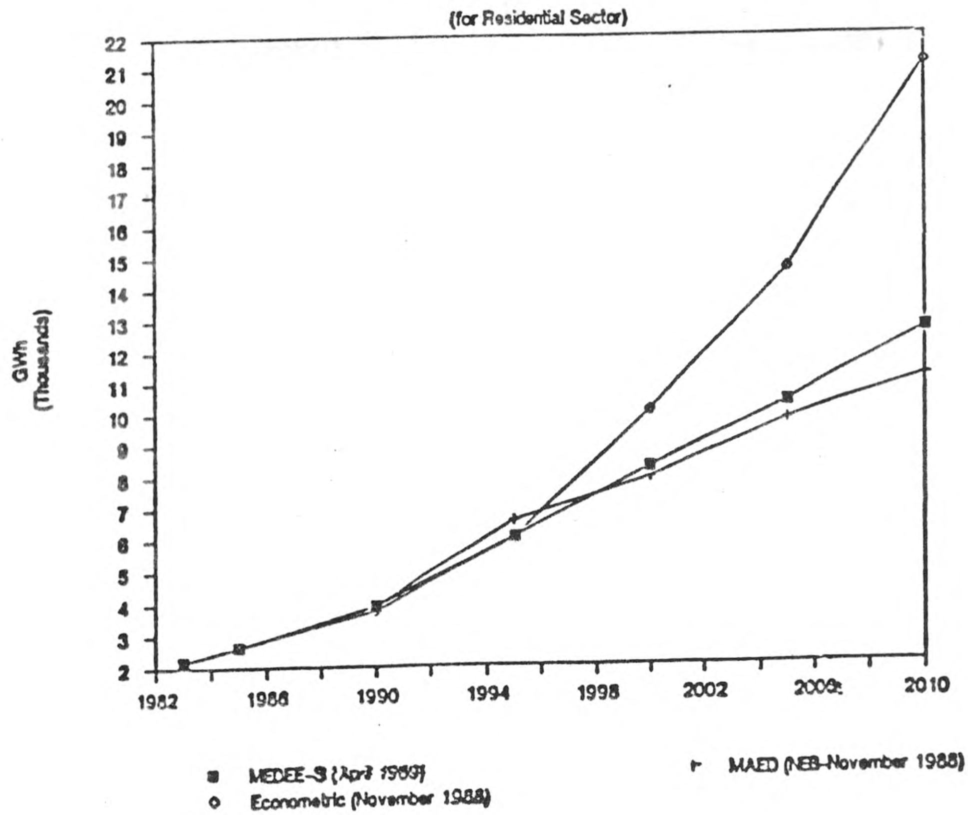
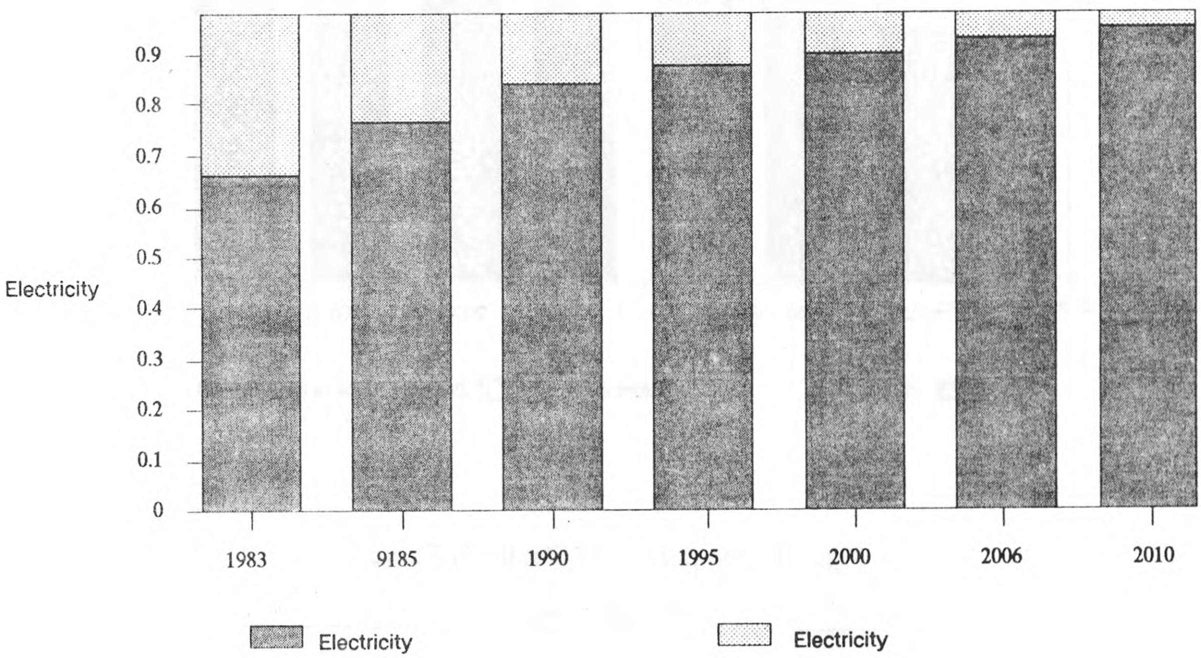


Fig.21

Forecast of Lighting Use

(by fuel)



CHAPTER 6

SERVICE/COMMERCIAL SECTOR

CHAPTER 6

SERVICE/COMMERCIAL SECTOR

6.1 INTRODUCTION: MODELLING THE SERVICES SECTOR IN MEDEE-S

The subsectors selected to disaggregate the service sectors are chosen based on the groupings used by NEB to compile the statistics on Large Power Consumers (LPCs). A subsector comprises one or more groups of business enterprises i.e.:-

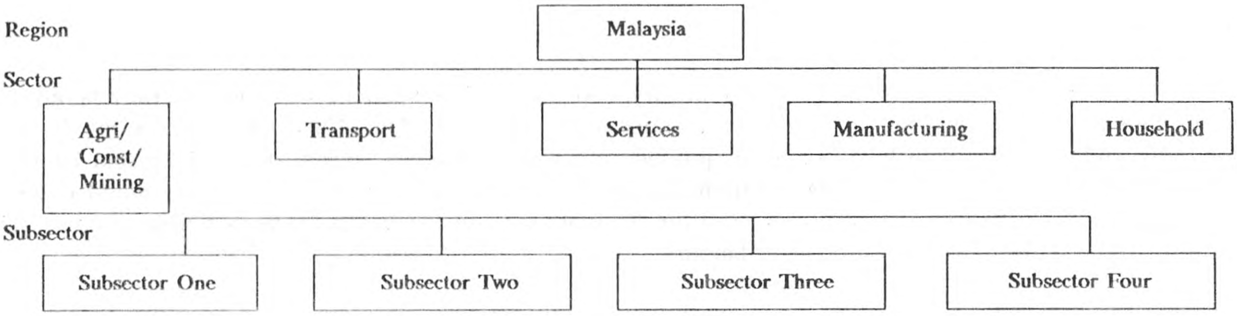
a) Subsector One : consisting of supermarkets and departmental stores;

b) Subsector Two : which includes Government Offices, Education Institutions, Private Offices and Multi-purpose Buildings;

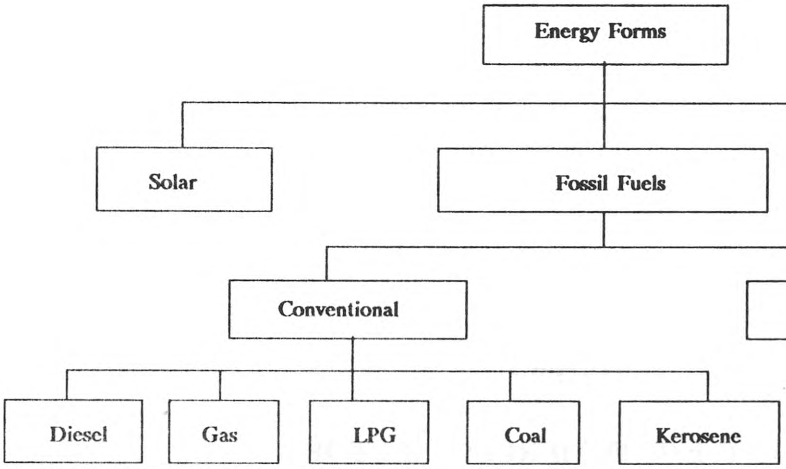
c) Subsector Three : comprising Hotels/Motels, Hospitals, and Medical Institutions;

d) Subsector Four : which includes the following groups of business:-

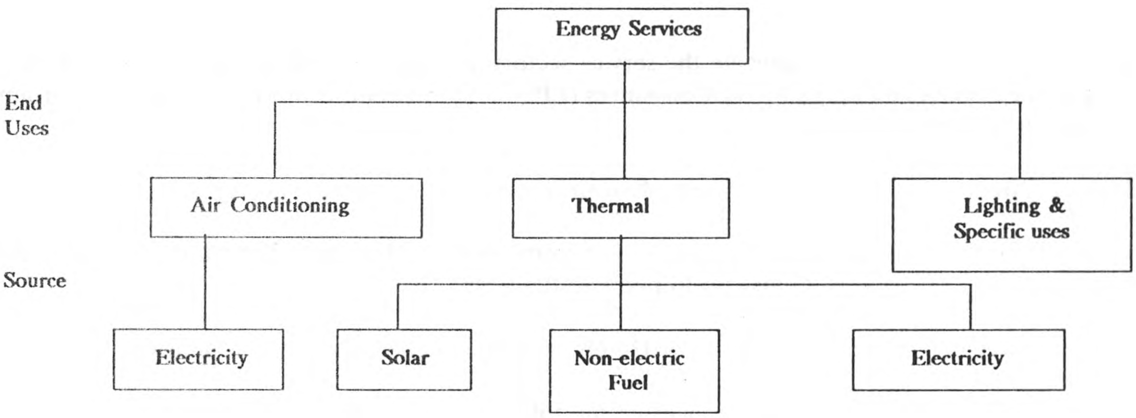
i. Entertainment Centres
ii. General Businesses
iii. Multi Storey Flats
iv. Other non-LPC consumers viz shops and shophouses.



Several energy forms are consumed in the services sector. The fuels can be categorised as conventional or strategic group, if required. For this study, solar, coal and traditional energy are not considered as options to satisfy the energy demand in this sector.



For each subsector, the energy consumed is categorised into three main end-uses i.e. air-conditioning, lighting & electrical uses and thermal uses. It is assumed that electricity is the only fuel used for air-conditioning and lighting. For thermal uses which include cooking and water heating various energy forms, including electricity can be used. The end-uses analysed in this study are shown below.



a) Air-conditioning

Air-conditioning plays a major role in the services sector. It makes up more than half of the total electricity consumed in three of the four subsectors. Only electricity is used for air-conditioning, at present.

b) Thermal uses

Thermal requirements or uses refer to laundry, cooking and hot water needs which are only significant in the Subsector Three and Subsector Four like shops and restaurants. Diesel and LPG are commonly used for these end-uses; diesel to heat boilers to produce hot water for guest rooms, dishwashing and laundry; Kerosene and LPG for cooking while electricity for food warming and oven baking. It is assumed that 0.5 percent of total electricity consumption is used for thermal uses. In the hospitals diesel boilers produce hot water for use by patients, dishwasher and laundry.

c) Lighting & specific electrical uses

Electricity is used for lighting and other specific electrical uses e.g. operating lifts, escalators, fans, cash registers, office equipment and computers.

6.2 ASSUMPTIONS FOR PAST TREND ANALYSIS

The energy demand in the services sector is dependent on the total floor area in the sector. Since data on floor area is not available, it was decided to use number of employees per value added as the driving variable.

For electricity, consumption data was obtained from Large Power Consumers (LPC) statistics of NEB which were only available for the years 1978, 1985, 1986 and 1987. The base year LPC analysis is shown in Table 6.1. For missing years, the values are calculated by interpolation i.e.

$$Y_n = Y_{(n-1)} \times G_{(avg)}$$

Y_n = required data year n
$Y_{(n-1)}$ = available data in the previous year
$G_{(avg)}$ = the average growth calculated from available years

The electricity unit consumption for air-conditioning and lighting & electrical uses are calculated based on fraction of total electricity consumed for these end-uses divided by the number of employees in the subsector (kWh/employee).

For non-electric fuels, consumption data was obtained from the study entitled 'Energy Consumption in Buildingd' carried out for the Ministry of Energy, Telecommunications & Post (1985). The consumption patterns for all subsectors according to end-uses are are shown in Table 6.2. Since the study was only performed for a single year, the ratio in the consumption of these fuels to electricity was assumed to be constant for all past years (1978 - 1987) i.e. :

Pfc = Fc / Ec
Pfc = percentage of fuel consumption
Fc = Fuel consumption in the subsector
Ec = Electricity consumption in the subsector

This approach is adopted for easy comparisons and computations. The non-electric fuel consumed is then multiplied by the relative efficiency, given in Table 6.3, to get useful energy from the fuel. Useful energy from all fuel types are added to give total useful energy consumed in the subsector. These values are then divided by the total employees in the subsector to give thermal unit consumption (kWh/employee).

Table 6.4 shows the share of conventional fuel by subsectors. As indicated previously, the fuels used in Subsector Three are mainly LPG for cooking and diesel for heating. In the Subsector Four, natural gas and kerosene are also used while electricity for thermal uses are assumed to be used in this subsector only. In terms of useful energy, electricity accounts for about 38.5% of total energy for thermal uses (see Table 6.5).

Electricity consumption of each subsector in Malaysia is calculated by mutiplying the corresponding share in Peninsular Malaysia (Table 6.6) with total electricity consumed in the whole country. Table 6.7 shows electricity consumption for air conditioning in all subsectors.

The number of employees in each subsector is calculated from estimates of employees per establishment multiplied by number of establishments in Peninsular Malaysia. An additional 5 percent to this value is added to account for those employed in Sabah and Sarawak. Care is taken to ensure that the number of employees in the service sector calculated by this method equals the number given in the Economic Reports.

A summary of the share of each subsector by end-uses of total energy consumption is given in Table 6.8.

6.3 PAST TRENDS (1978 - 1987)

The energy demand in a country is closely related to the consumption habits of its population and the energy policies adopted by the Government. Tables 6.9 shows past trends of total energy consumed and number of employees in the services sector (1978-1987).

Electricity consumption in the services sector in Peninsular Malaysia increased from 1729 GWh in 1978 to 4076 GWh in 1987 while the number of consumers almost doubled the last ten years.

The subsector two experienced the highest growth in consumption from 475 GWh to 1,696 GWh i.e. a factor of 3.57 over ten years. The lowest growth for the last ten years was the Subsector Four which increased by a factor 1.7 only. Similar trends are observed for employment.

The unit consumption for air conditioning is relatively high for the offices and hotels compared to the electricity unit consumption.

Annex F1 gives detailed caculation for base year 1983.

It is observed that 85 percent of the total energy consumed in the commercial and public sector is in the form of electricity. The remaining 15 percent is supplied by other fuels such as diesel, LPG and gas, which are used mainly for water heating and cooking.

In the Subsector Three, electricity accounted for about 56 percent of total energy consumption while in subsectors like Subsector One and Subsector Two, electricity is the main fuel. The non-electric fuels consumed in hotels are utilised mainly for boilers and cooking in kitchens.

Electricity consumption in Offices and Shopping Complex are used mainly for lighting, air conditioning and office equipment. Air conditioning loads in buildings are normally influenced by climatic conditions, total air conditioned floor area and working conditions. In Malaysia, air conditioning is needed all year round in the services sector. This situation is similar to that of Singapore.

Table 6.10 shows a comparison of electricity demand characteristic by end-uses between Malaysia and Singapore. The similar climatic conditions and working environment in the two countries have resulted in similar pattern of electricity consumption. However, the consumption per capita in services sector of Singapore is higher than that of Malaysia. Singapore is a thriving financial centre requiring sophisticated equipment which in turn require electricity to run.

6.4 FORECASTS AND DEVELOPMENT OF THE SCENARIOS

The past trends of energy consumption in the services sector, give useful information for projecting future scenario, especially with regards to growth in energy unit consumptions, and share of various fuels for the three main end-uses and driving variables. The basis of the projection is the 'NEB's 1988/89 Load Forecast', since it is the only available long term forecast available in the country eventhough it only concentrates on electricity. Adjustments were made to balance the energy consumed with number of employees.

Energy is used in services (tertiary) sector for four main purposes:

- to maintain a certain inside temparature for comfort (Air-conditioning or space heating).
- to heat for bathing and to some extent washing.
- to cook.
- to use electrical appliances and lighting.

Space heating is not required in Malaysia to keep offices warm even in highlands area. Therefore, the unit consumptions for space heating are left to zero.

For both the services and residential sectors, the same values for socio-economic variables e.g. population, GDP, and share of the GDP were used in various sectors. Projection of GDP and its structure are shown in Figures 6.1 and 6.2.

Driving force in MEDEE-S for air conditioning are related by surface area i.e. consumption per unit area, employment per unit area, and part of building supplied with air conditioning. Since data related to surface area is not available and hard to judge; it is assumed that each employee occupies 1 sq metre of floor area. Hence, energy demand is dependent on total number of employees. It is also assumed that 100% of the floor area is air conditioned.

The projections of employment distribution in the four subsectors are shown in Figure 6.3. The graphs exhibit declining share in subsector four and increasing share in subsector two, while in subsector one and subsector three the share are almost consistent throughout the study period i.e. 1938-2000.

The evolution of productivity in each subsector are shown in Figure 6.4. They are given as value-added per employee.

Projection of unit consumption for electricity, air conditioning, and thermal uses are shown in Figure 6.5, 6.6, and 6.7 respectively.

In MEDEE-S Model, projection of share of conventional fuels in individual subsector are also required as input. The projection for LPG, Natural Gas, Diesel, and Kerosene share are shown in Figure 6.8 and 6.9 for subsector three, and subsector four respectively.

Projections of energy demand by end-uses for each subsector are given in Figures 6.10 and 6.13.

Conventional fuels are used mainly for heating purposes like water heating and cooking. The utilisation of electricity for heating is very small but has to be considered since it is likely to grow in future years compared to kerosene as can be seen in Figure 6.14.

For public lighting, only the elasticity of public lighting unit consumption to GDP, are projected, since all other driving variables (population and GDP) are already projected. Table 6.15 and 6.16 show the projected value of public lighting unit consumption respectively.

The input and output values in MEDEE-S are given in Annex F2 for the year 1983, 1985, 1990, 1995, 2000 and 2010.

6.5 CONCLUDING REMARKS AND CONCLUSIONS

The main objectives of this study have been achieved.
These are:

- To impart the capability of using MEDEE-S Model proficiently to the Malaysian counterparts.

- To assess the suitability of MEDEE-S Model to forecast energy and electricity demand in the Malaysian context.

The end-use approach incoporated in the MEDEE-S Model is found to be suitable for analysing and forecasting energy and electricity demand in Malaysia. By disaggregating energy-consuming economic sectors, the model can easily simulate the changing structure of Malaysian economy, thereby its impact on energy demand.

The MEDEE-S Model can also look innto the switching of one fuel to another.

It was found that eighty five percent of the total energy consumed in the commercial and public sector is in the form of electricity for air conditioning, lifts and office equipment. The remaining fifteen percent of the energy is supplied by other fuels such as diesel, LPG and gas which are used mainly for water heating and cooking.

It was found that the hotel subsector used fifty six percent of its total energy consumption on electricity compared to subsectors like subsector one and subsector two which use mainlyelectricity. The non-electricity consumption in hotels are utilised mainly for boilers and cooking in restaurants.

Electricity consumption in the office and Shopping Complex are made up of lighting, air conditioning and office equipment. Air conditioning determinants in buildings are climatic conditions, value added amount, floor area and working conditions. Offices generally use the maximum share of air conditioning of all the subsectors.

The energy demand pattern of the commercial and public sector shows that for the modern office where air conditioning is needed all year round, it is found to be highly energy intensive.

The rate of urbanisation also plays a crucial role in energy consumption as modernisation of the services sector would indicate increse usage of energy intensive end-use such as air conditioning.

The commerial and public sector in Malaysia relies mainly on electricity as its major energy carrier. Other energy forms such as solar is not used extensively and form a negligible part of the total energy supply. Technological advances in this field has yet to reach the point where solar energy can be used commercially to replace electricity as the major energy form.

Other forms of fuel have limited usage and are used in minor end-uses of this sector.

Malaysia's demand charecteristics are compared to Singapore in Table 6.10 and are found that the energy pattern is similar.

Table 6.1 :

NEB's LPC Statistics 1983)
(Peninsular Malaysia)

Subsectors	Total Consumption (kWh)	No. Consumers
S/Complex	203,684,602	241
Office	776,113,662	1068
Hotel	206,159,161	204
Hospital	78,793,313	68
Other	110,054,880	320
Total	1,374,805,618	1902

Source : Commercial Department NEB

Table 6.2 :

Consumption in Services Sector (1985)

Consumer	Air-cond	Lift	Heater	Cooker	Light
(% of Total Energy Consumption)					
Hotel A	33.00%	3.00%	20.00%	26.00%	18.00%
Hotel B	46.00%	1.00%	20.00%	18.00%	15.00%
Hotel C	45.00%	3.00%	26.00%	7.00%	19.00%
Hotel D	30.00%	4.00%	28.00%	17.00%	21.00%
Average	38.46%	2.85%	24.62%	15.45%	18.61%
(% of Non-electric Fuel to Electricity Consumption)					
Hotel A	0.00%	0.00%	37.04%	48.15%	0.00%
Hotel B	0.00%	0.00%	32.26%	29.03%	0.00%
Hotel C	0.00%	0.00%	38.81%	10.45%	0.00%
Hotel D	0.00%	0.00%	50.91%	30.91%	0.00%
Average	0.00%	0.00%	41.49%	26.61%	0.00%
S/Complex E	60.00%	2.00%	0.00%	0.00%	38.00%
S/Complex F	20.00%	4.00%	0.00%	0.00%	76.00%
S/Complex G	50.00%	2.00%	0.00%	0.00%	48.00%
S/Complex H	48.00%	3.00%	0.00%	0.00%	49.00%
S/Complex I	32.00%	5.00%	0.00%	0.00%	63.00%
Average	44.85%	3.24%	0.00%	0.00%	51.91%
Office J	58.00%	6.00%	0.00%	0.00%	36.00%
Office K	40.00%	6.00%	0.00%	0.00%	54.00%
Office L	36.00%	9.00%	0.00%	0.00%	55.00%
Office M	55.00%	6.00%	0.00%	0.00%	39.00%
Office N	61.00%	3.00%	0.00%	0.00%	36.00%
Office O	74.00%	2.00%	0.00%	0.00%	24.00%
Average	51.81%	5.68%	0.00%	0.00%	42.50%

Source : 'Energy Consumption in Buildings Study. Final Report'
Ministry of Energy, Telecommunications and Post

Table 6.3 :

Assumed Relative Efficiency of End-uses by Fuel

Fuel	Efficiency
Electricity	100%
Traditional	30%
LPG	65%
Natural Gas	65%
Diesel	40%
Kerosene	50%

Table 6.4 :

Share of Fossil Fuels by subsector

Subsector	Fuel	Share
Subsector Three	LPG	51.0%
Diesel		49.0%
Subsector Four	LPG	33.1%
Natural Gas		46.3%
Kerosene		20.6%

Source : 'Energy Consumption in Buildings Study. Final Report' Ministry of Energy, Telecommunication and Post

Table 6.5 :

Assumed Share of Electricity for Thermal uses (One Subsector only)

Subsector	Share
Subsector Four	3.84%

Table 6.6 :

Share of Electricity Consumption by subsector

Subsector	Share
Subsector One	7.08%
Subsector Two	26.98%
Subsector Three	9.91%
Subsector Four	56.03%

Source : LPC Statistical Group, Commercial Department of NEB

Table 6.7:

Share of Electricity Consumed for Air-Conditioning

Establishment	Percentage
S/Complex	45.00%
Office	52.00%
Hotel	51.00%
Hospital	10.00%
Other	10.00%

Source : 'Energy Consumption in Buildings Study. Final Report.' Ministry of Energy, Telecommunication and Post.

Table 6.8 :

Energy Consumption by End-uses

Subsectors	Air-Cond.	Thermal	Lighting & Others
Subsector One	38.46%	53.91%	7.63%
Subsector Two	44.85%	0.00%	55.15%
Subsector Three	51.81%	0.00%	48.19%
Subsector Four	10.00%	10.00%	80.00%

Source : Same as Table 6.17 + estimated values

Table 6.9 :

Past Total Energy Consumption in the Service Sector

Year	1978	1980	1981	1983	1985	1987
Energy Demand(TJ)	10,086	12,368	13,391	16,296	19,213	22,887
Employees	1,610	1,870	1,922	2,093	2,348	2,788

Source: Annual Economic Reports 1978 - 1987
Ministry of Finance

Table 6.10:

Comparison of Electricity Uses in Malaysia and Singapore

End-Use	Hotels		S/Complex & Offices	
	M'sia	S'pore	M'sia	S'pore
Air-cond	63.67%	67%	48.33%	50%
Lifts	4.88%	7%	4.46%	10%
Others	31.45%	26%	47.20%	40%

Source : B.W. Ang, 'Energy End-Use Structure of an Urban Society', The Energy Journal, January 1989, IAEE

Table 6.11 :

Public Lighting Unit Consumption and Consumption

	1983	1985	1990	2000	2010
Unit Consumption (kWh/person)	6.036	6.768	7.983	9.588	10.259
Consumption	323.04	381.44	517.11	781.33	1,045.55

Fig F1 : Total GDP

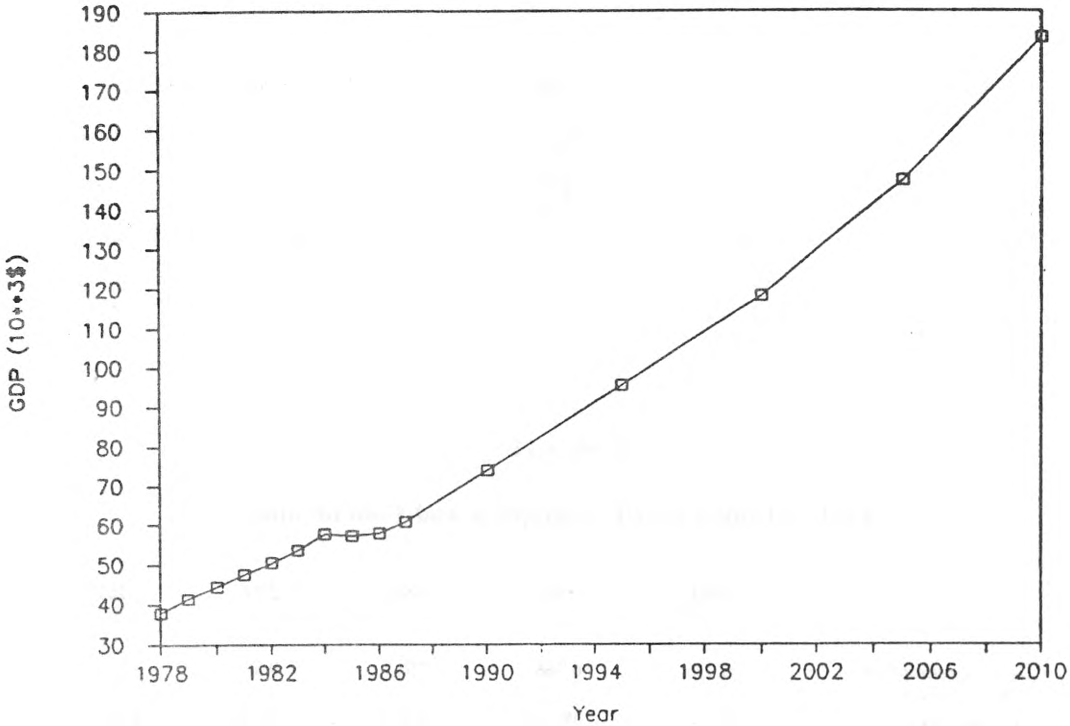


Fig F2 : Share of GDP by Sector

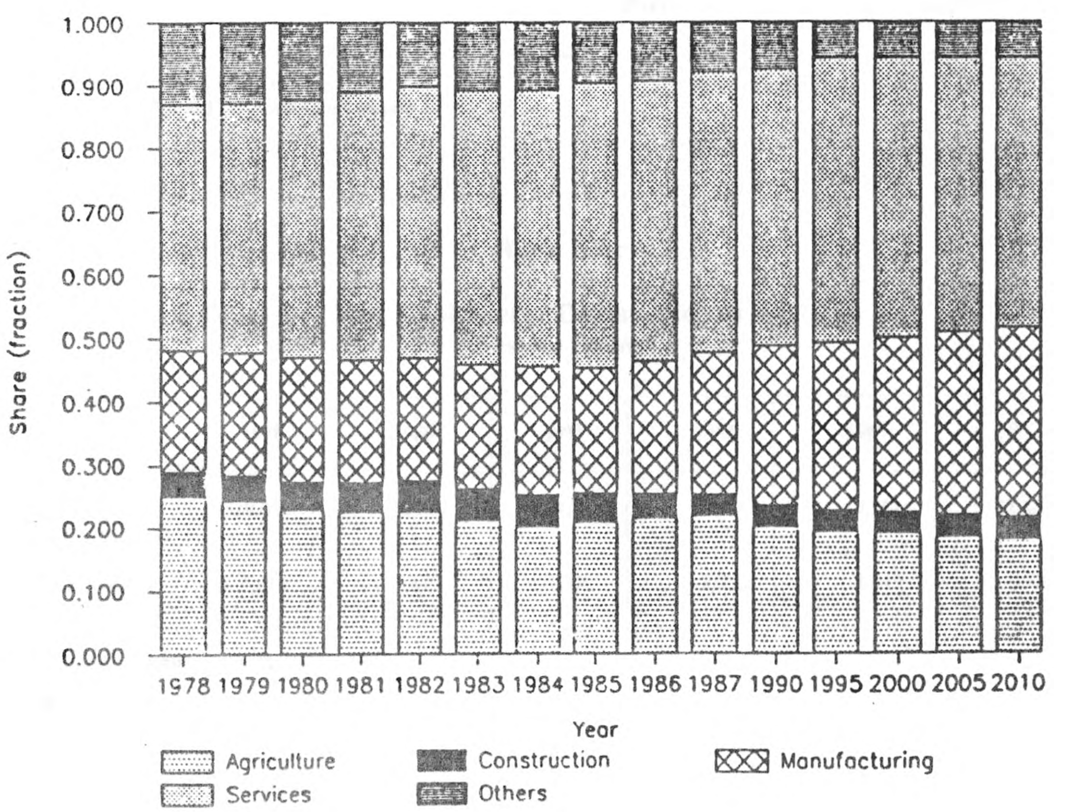


Fig F3: Employment Distribution

(Share in Various Subsector)

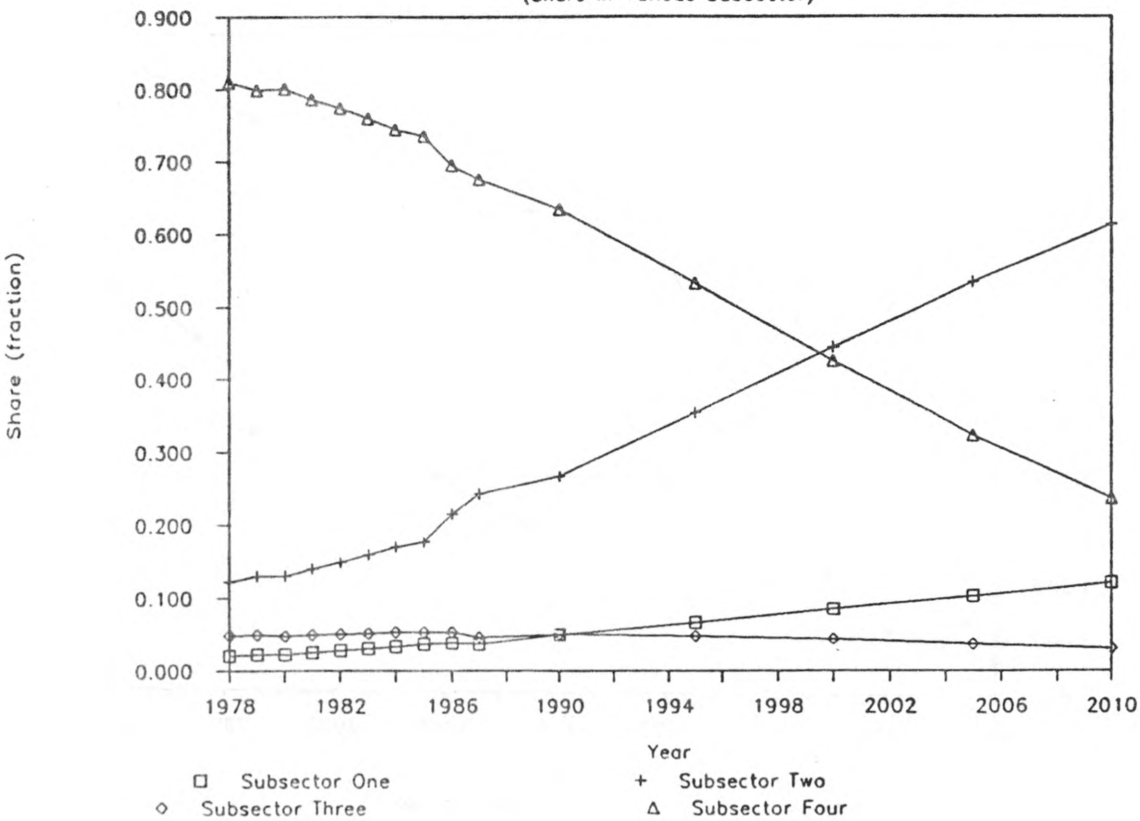


Fig F4: Value Added per Employee

(Service Sector)

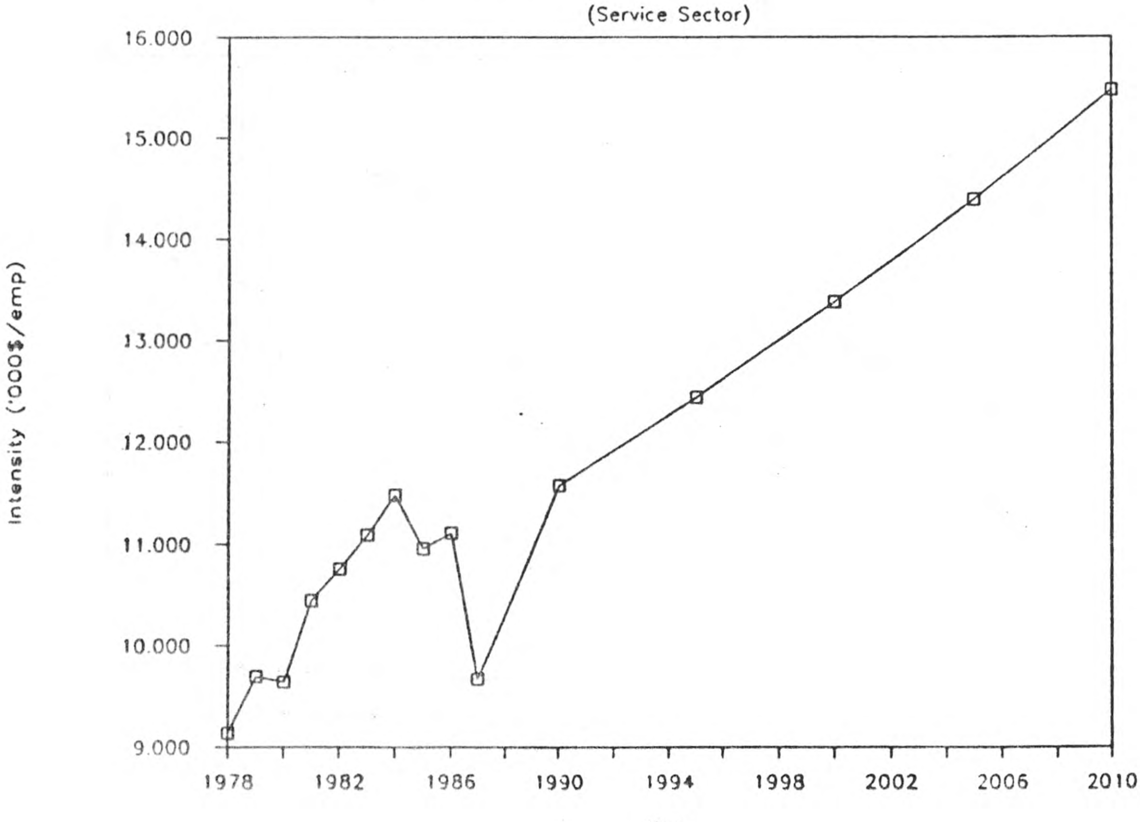


Fig F5: Electricity Unit Consumption

(Excluding Air-cond and Thermal Uses)

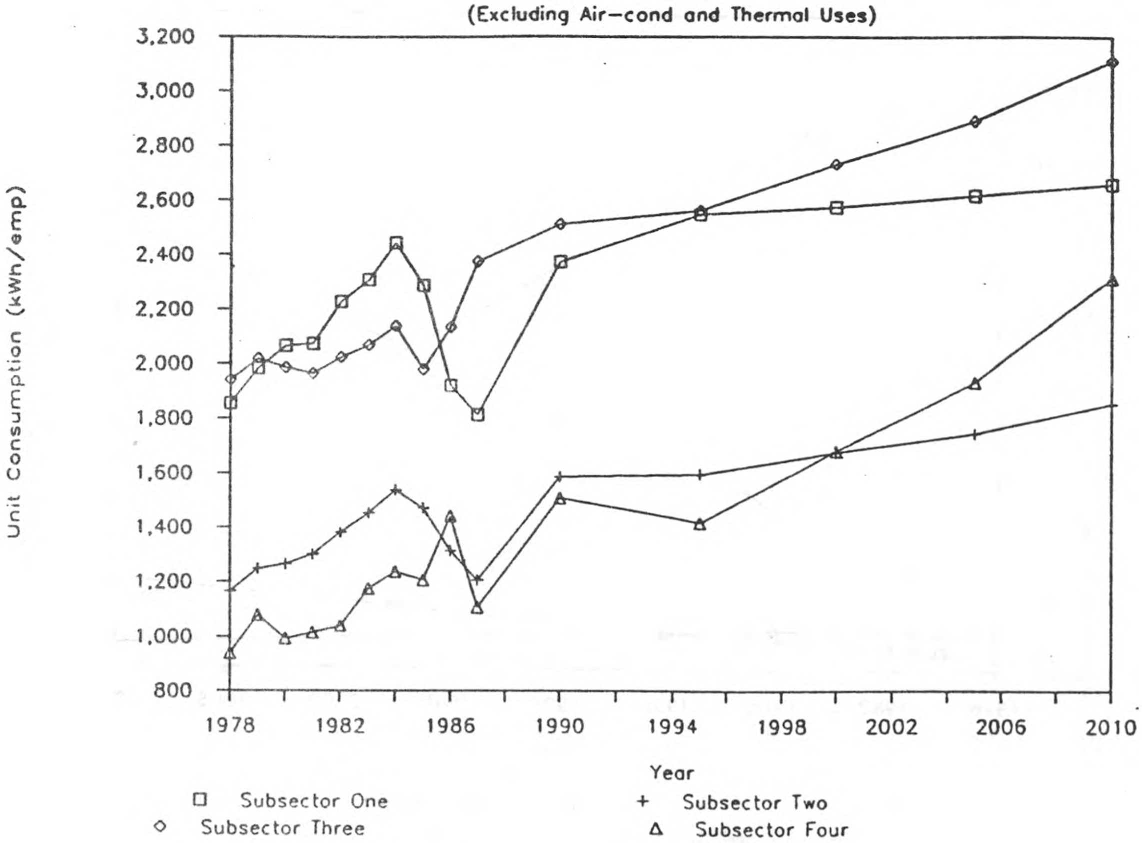


Fig F6: Air-Cond Unit Consumption

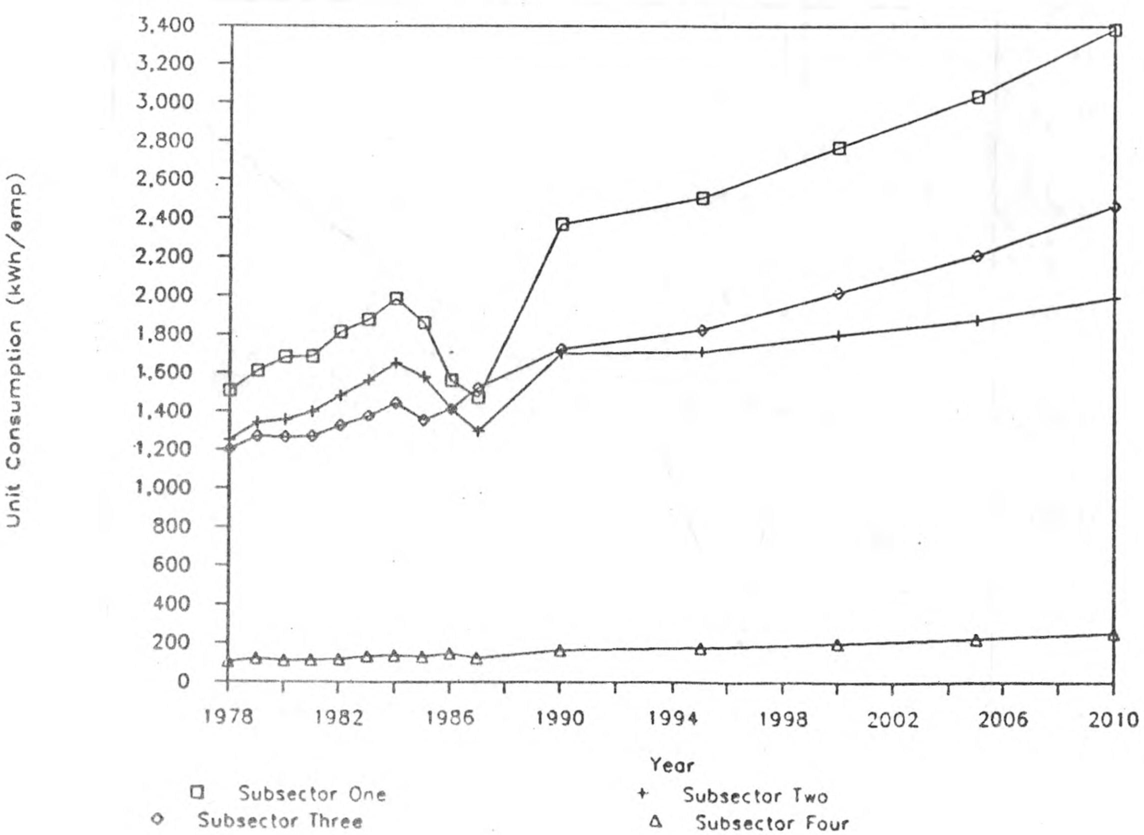


Fig F7: Thermal Uses Unit Consumption

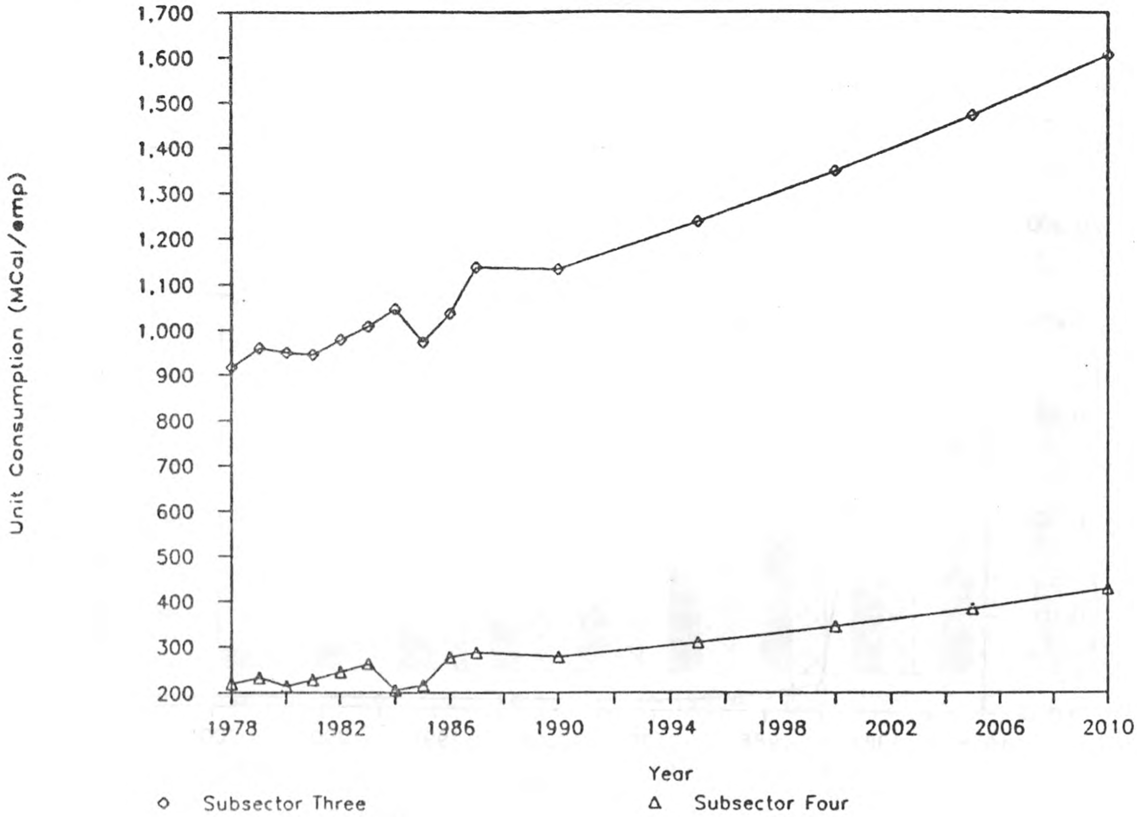


Fig F8: Conventional Fuel Share

(Subsector Three)

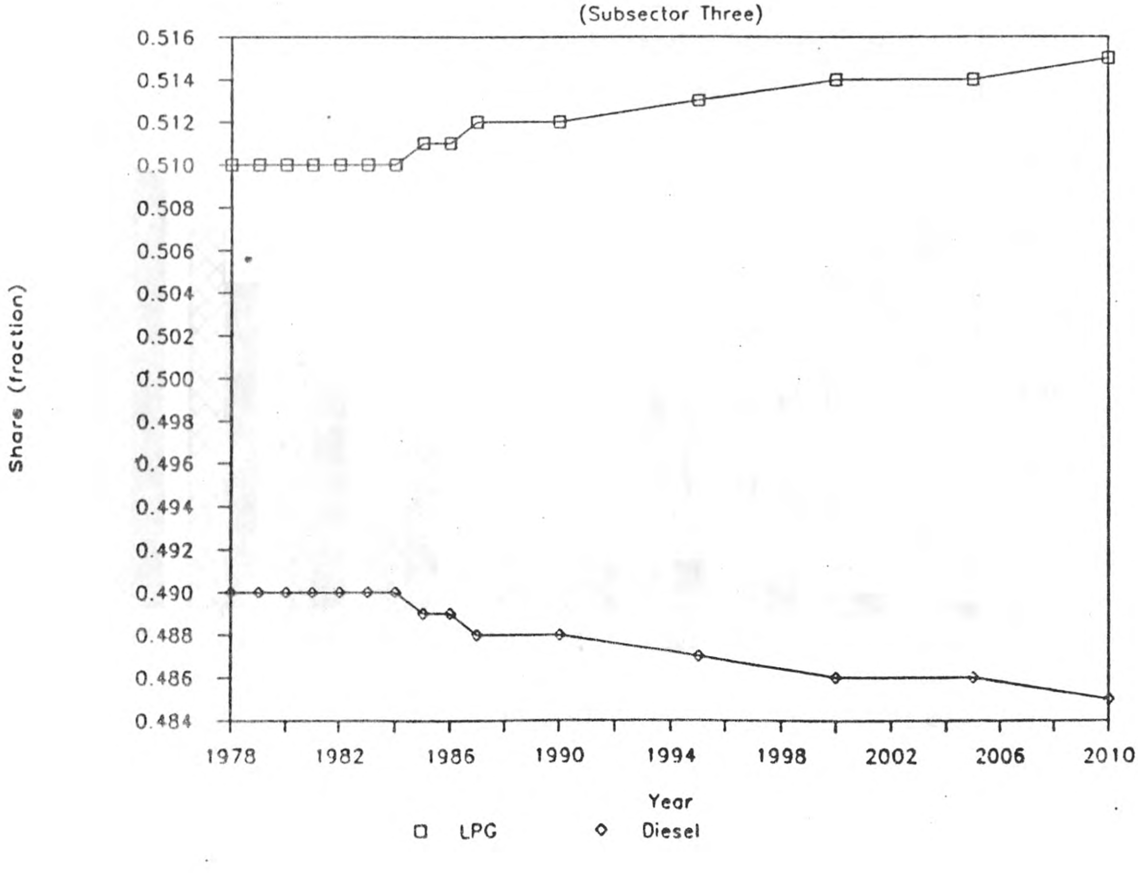


Fig F9 : Conventional Fuel Share

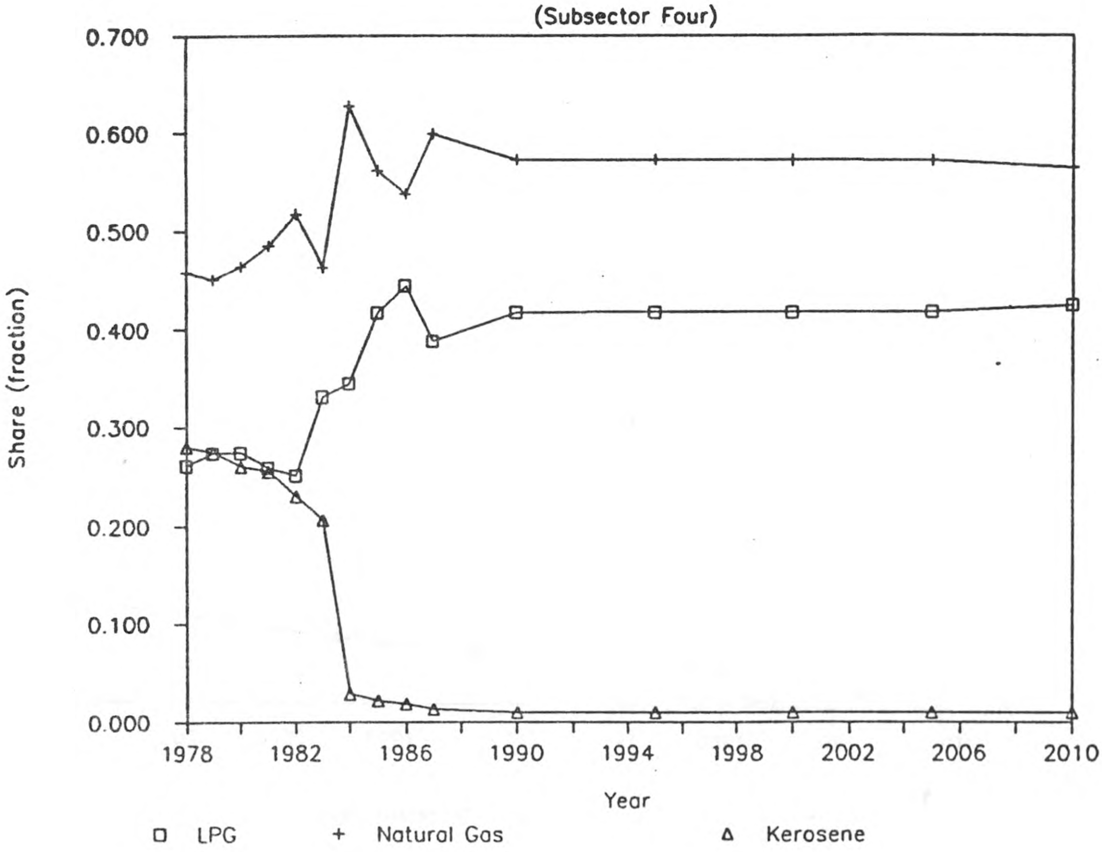


Fig F10 : Energy Utilisation by Subsector

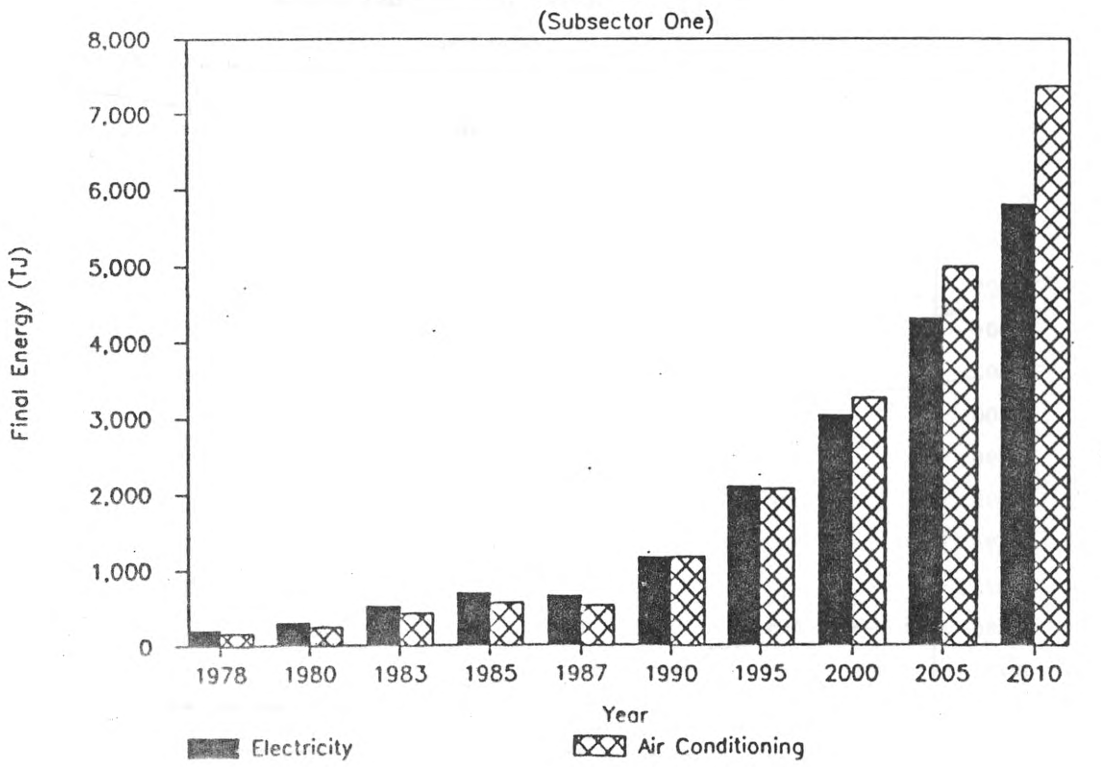


Fig F11 : Energy Utilisation by Subsector

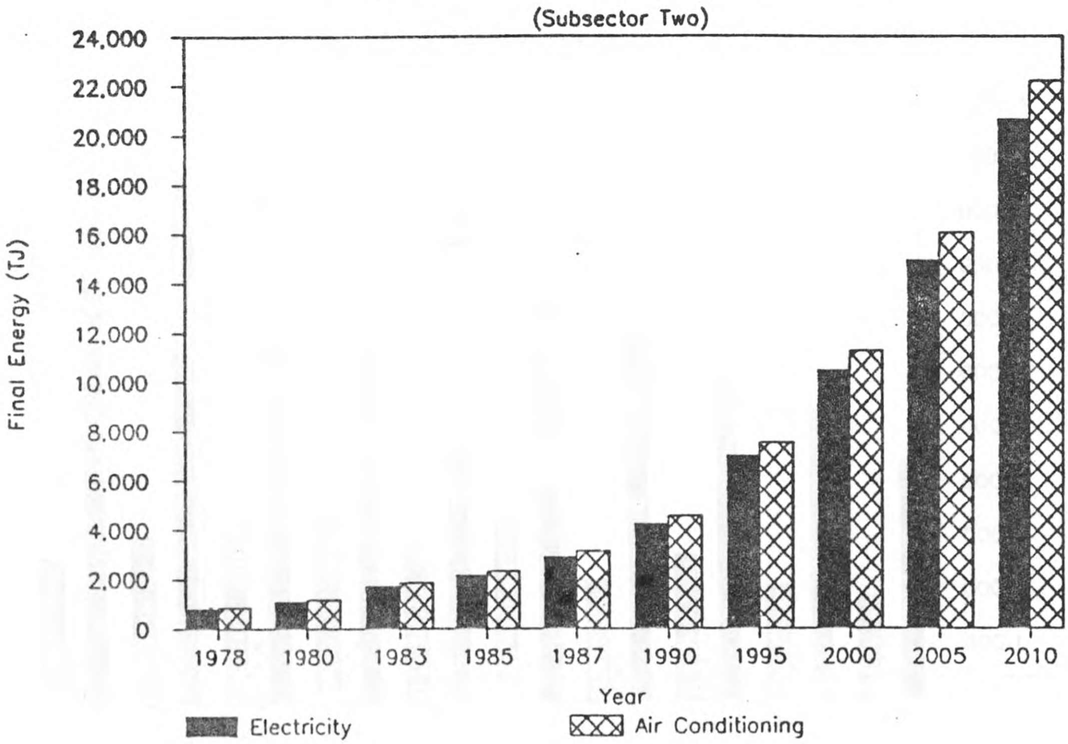


Fig F12 : Energy Utilisation by Subsector

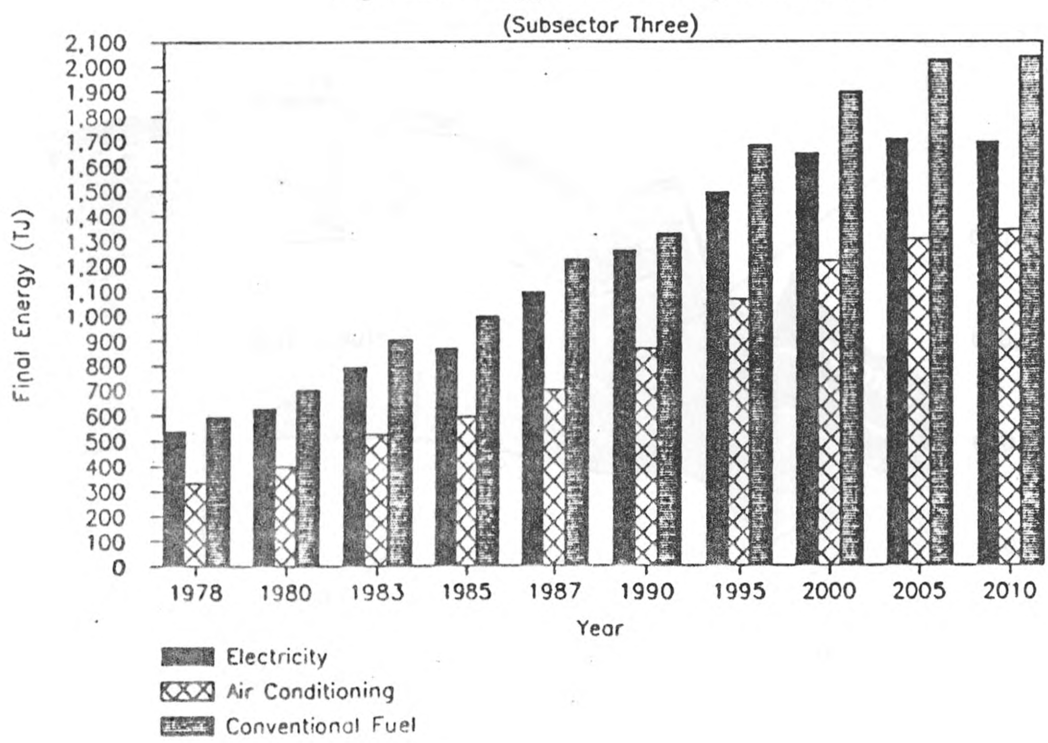


Fig F13: Energy Utilisation by Subsector

(Subsector Four)

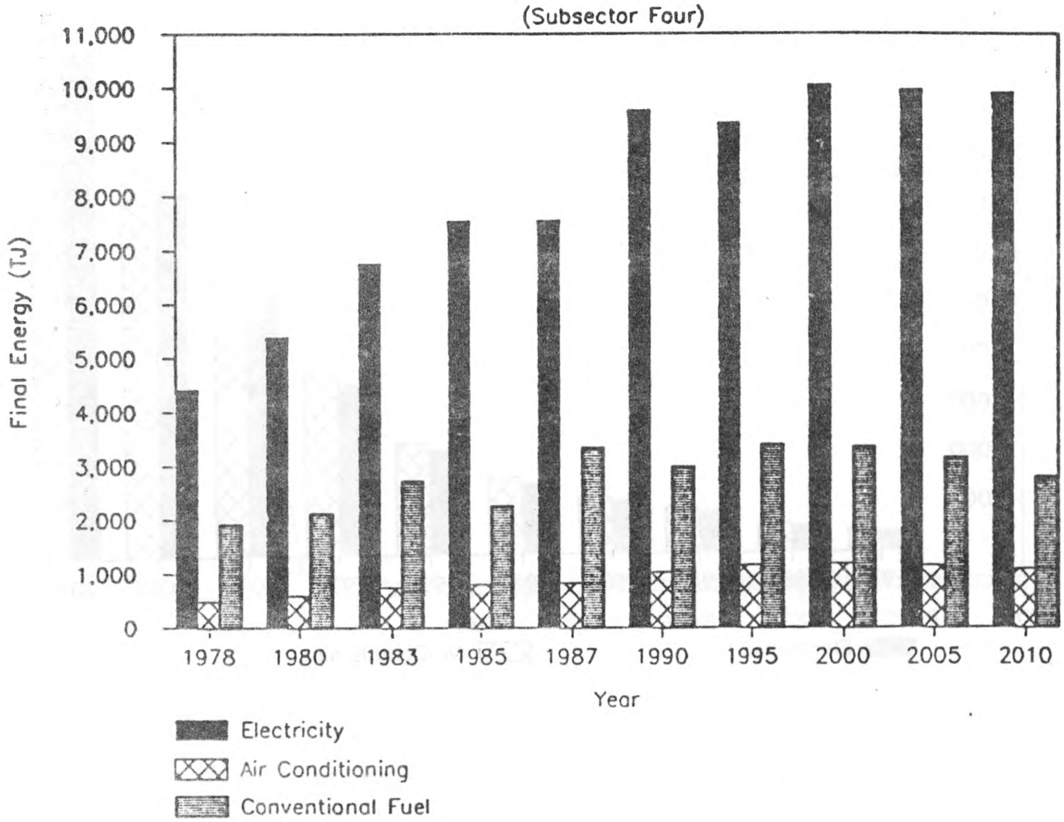
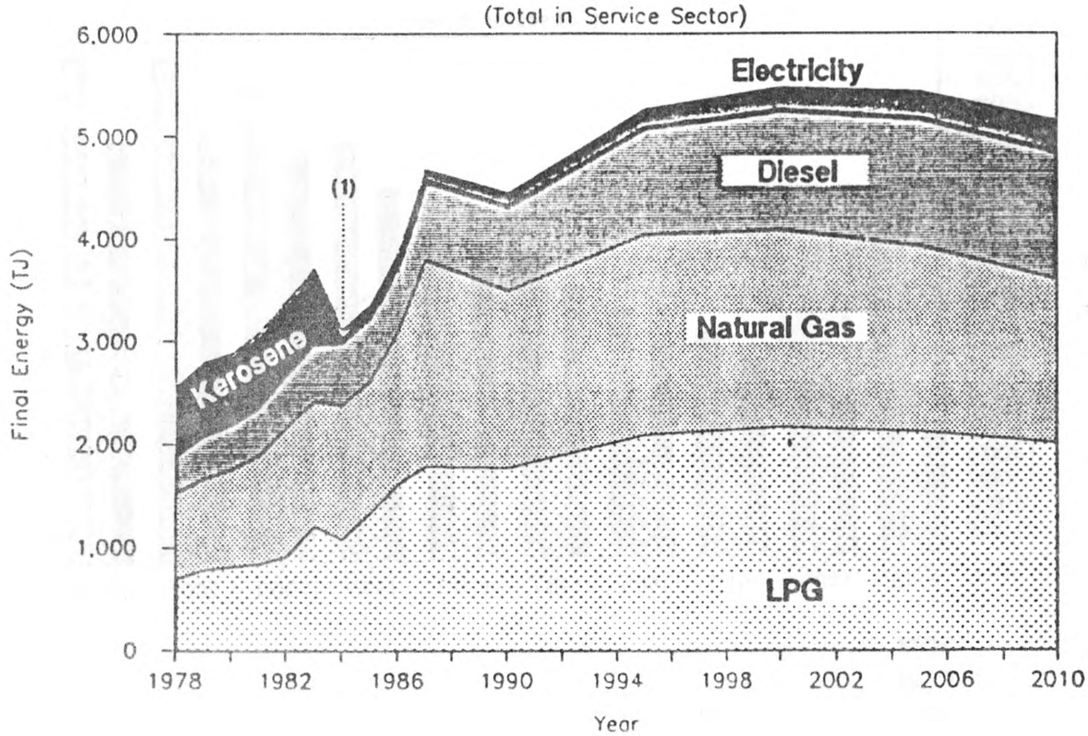


Fig F14: Thermal Uses by Fuel

(Total in Service Sector)



Note (1) In 1984,Subsidy for Kerosene was Removed

Fig F15: Public Ligthing Unit Consump.

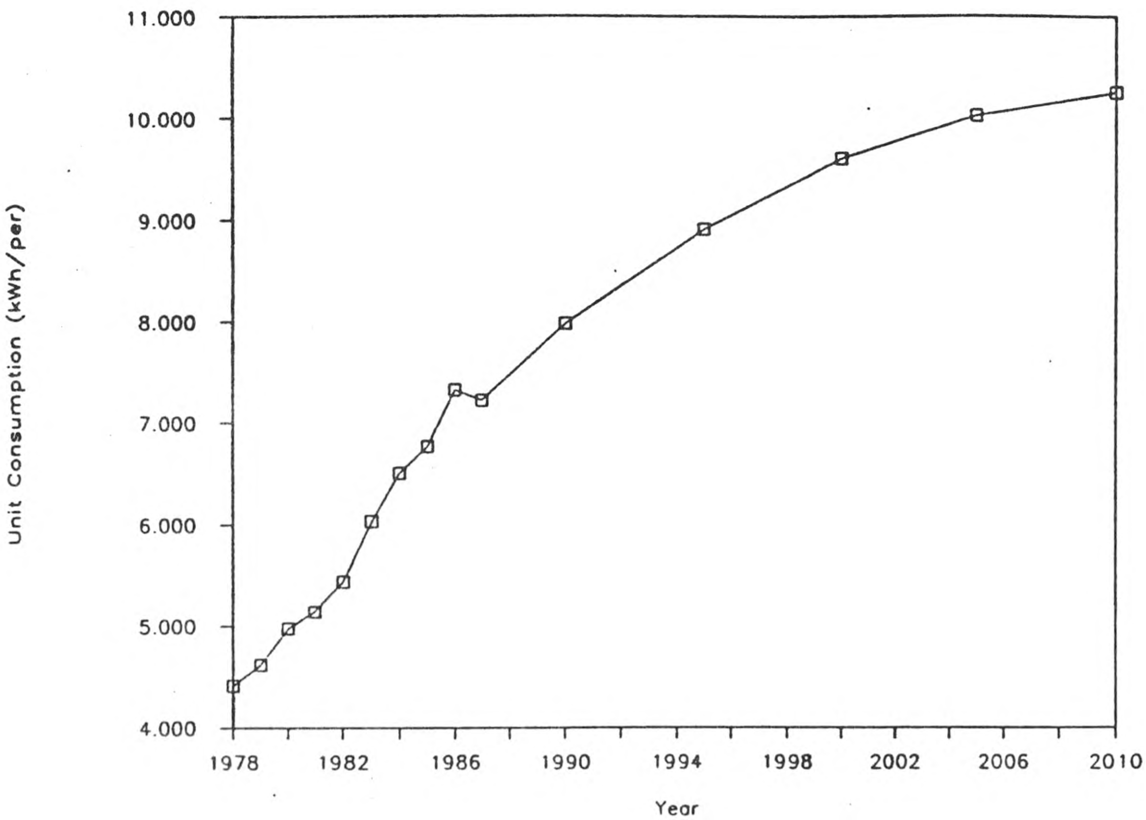
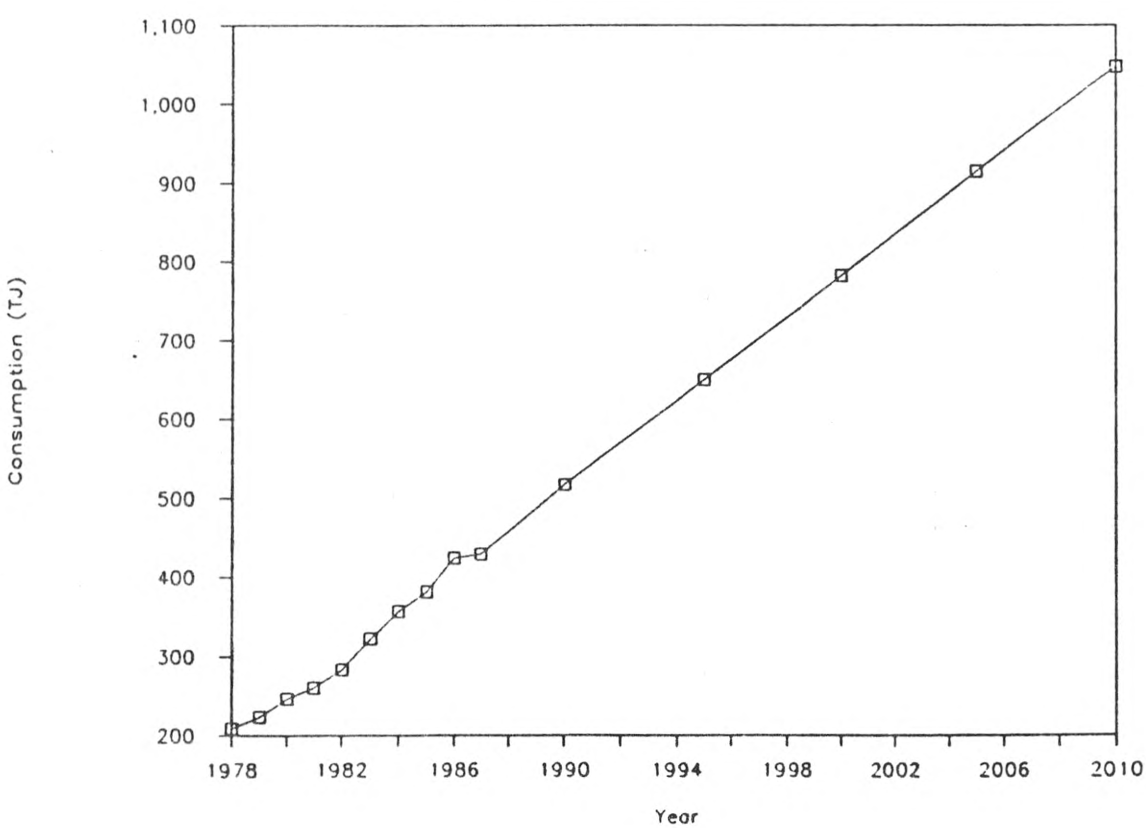


Fig F16: Public Lighting Consumption



CHAPTER 7

TRANSPORT SECTOR

CHAPTER 7.

ENERGY DEMAND IN THE TRANSPORT SECTOR

7.1 TRANSPORT DEVELOPMENT

7.1.1 INTRODUCTION

For a developing country, Malaysia has a relatively sound and well managed transport system. Transport forms an integral part of the nations development process as adequate and efficient transport ation, both infrastructure as well as services, facilitate the movement of resources between centres of production and consumption. In 1988, the value added of the transport, storage and commuications sector is estimated at $4,311 million.

Historical developments and geographical factors have also to a larger extent shaped Malaysia's transport system.

The Straits of Malacca has been and continues to be one of the most important trade routes in the world. Consequently the states on the West Coast of the Peninsular are more advance in economic development than the rest of the country. The West Coast States are inhabited by 82% of the Peninsular population and account for 88% of the GDP. The major product of the Peninsular are rubber, palm oil and tin which are all geared towards the export market. Whereas economic activity in East Malaysia is centred on the production of oil, gas, timber, cocoa, palm oil and fisheries. Road transport is the dominent made in the Peninsular and Sabah, while Sarawak is still highly dependent on marine and riverine transport.

The total population of Malaysia in 1985 was 15.8 million. In general, the overall annual average growth rate for the period 1970-1990 is estimated to be 2.7%. Again the West Coast States are projected to experience more rapid population growth rates due to the net migration effects respectively from projected land development schemes and industrialization as well as the recent boost in the tourism trade.

7.2 TRANSPORT INVESTMENTS

In line with the Government's policy of treating transport infrastructure and facilities as being an integral element in the development process, about $14.5 billion was provided for transport development under its first four five-year development plans (1966-1985). The first three plans concetrated on building the basic road network, upgrading and modernization of the railways and expanding ports and airport capacity.

During the fourth plan period (1981-1985), priority was given to the implementation of ongoing transport programmes. Management and operation of transport facilities as well as the need for Government agencies to provide a more efficient service to the public were stressed. The Government's privatization policy which was introduced in the early 1980's also had its impact in the ports, airports and road subsector. As shown in Table 7.1, transport investments accounted for between 9.7% to 15.1% of total Plan allocations in the 1980's.

TABLE 7.1

TRANSPORT INVESTMENTS, FOURTH AND FIFTH PLANS ($ MILLION)

	EXPENDED 4TH PLAN	REVISED 5TH PLAN
Roads	4,167	4,228
Rail	651	232
Ports and marine services	1,484	497
Civil aviation	874	1,568
Total Transport	7,172	6,524
Total Plan	74,063	43,181
Transport as % of Total Plan	9.7	15.1

SOURCE : NATIONAL TRANSPORT POLICY REVIEW, JUNE 1988 (NTPR)

Under the Fifth Plan (1986-1990), efforts continue to be made on the improvement and management of transport facilities as well as to identify and implement programmes for active private sector financing and management. To date, seven privatization excersises have been implemented in the transport sector as follows:-

(a) Malaysian Airline System Bhd. (MAS) in 1985;

(b) Malaysian International Shipping Corp. Bhd. (MISC) in 1986;

(c) North Klang Straits By-pass Project in 1984;

(d) Jalan Kuching-Jalan Kepong Road Interchange in 1985;

(e) Kuala Lumpur Roads and Interchanges in 1987;

(f) North-South Toll Expressway in 1988; and

(g) Container Terminal, Port Klang (Klang Container Terminal Sdn. Bhd.) in 1986.

7.3 TRANSPORT ADMINISTRATION AND PLANNING

Various Ministries and state departments share in the administration and planning of the transport sector. The Ministry of Transport (MOT) is responsible for all policy matters relating to ports, railways and aviation, although MAS operates with autonomy since it is a private company and nine port authorities are also quite independent, being statutory bodies. Various aspects of shipping matters are shared between MOT, Ministry of Trade and Industry (MTI) and the Implement ation Coordination Unit (ICU) in the Prime Minister's Department. Whereas the planning, design, construction and maintenance of federal roads are under the Ministry of Works (MOW) and state roads under the respective state Governments. Licensing of commercial motor vehicles is under the Commercial Vehicles Licensing Board (CVLB) which is under the administrative control of the Ministry of Public Enterprises. But enforcement both on private and commercial vehicles is the joint responsibility of the Royal Malaysian Police, Road Transport Department (under MOT), and in certain aspects the Public Works Department (under MOW), Malaysian Highway Authority (under MOW) and the City Hall of Kuala Lumpur.

4.2 At the macro level, the Economic Planning Unit (EPU) in the Prime Minister's Department, is responsible for reviewing all Federal Government investments, taking into account multi-modal considerations.

7.4 TRANSPORT FLOWS IN MALAYSIA

The National Transport Policy Review (NTPR) conducted various analysis of transport flows by mode and corridor in Malaysia for the year 1986.

(a) Freight

The NTPR concluded that an overwhelmingly large proportion of freight traffic is transported by road. Of the 76.2 million tons of freight carried in 1986, 68.7 million tons (90.1%) went by road, 4.8 million tons (6.3%) by coastal shipping and 2.8 million tons (3.7%) by rail (1985). Air freight traffic accounted for only 23,000 tons (0.03%) but the commodities carried were of higher value. The market share in terms of ton-km, were 73.5% to road, 8% to rail, 18.4% to coastal shipping and 0.1% to air transport. Rail and coastal shipping are more competitive over longerdistances (300-400km), while road transport is the predominent mode for shorter haul traffic (up to 200km) and where speed and customs handling are important.

In 1986, about 45% of the total volume of general cargo was carried by trucks. Other major commodities transported by road are palm oil, petroleum, logs and grains. Goods carried by rail are cement (41%), grains, basic food products, petroleum, rubber and logs. Coastal shipping was mainly used for transportation of petroleum (73%), cement, palm oil and rubber. The major items handled by air freight are paper and mail, fruit, and fragile or highly perishable commodities like vegetables and seafood.

As shown in Table 7.2, the amount of freight in terms of tonnage as well as ton km carried by the Malayan Railways Administration (MRA) has decreased over the period 1974 till 1988. This is due to strong competition from road transport as well as the economic recession over the last few years.

For the future, road transport is expected to continue to play the dominant role, especially when the 900km North-South Highway stretching from Perlis in the north to Johore in the south is completed in 1993. According to the NTPR road freight is projected to grow at 4% per annum up to 1995 and will reach 98 million tons. An optimistic rail freight forecast will hover around 2.9 - 3.2 million tons. Air freight is expected to grow at 5.4% per annum up to 1990, then drop to 4.2% during 1990 - 1995.

TABLE 7.2

Malayan Railways : Freight Traffic 1974 - 1988

Year	'000 tons	'000,000 ton km
1974	3,302	984.1
1975	2,782	822.4
1976	3,305	1,007.8
1977	3,787	1,208.9
1978	4,142	1,293.2
1979	4,188	1,356.6
1980	3,607	1,194.7
1981	3,374	1,122.9
1982	3,232	1,091.4
1983	3,187	1,072.2
1984	3,255	1,077.3
1985	2,929	1,018.1
1986	2,860	1,042.4
1987	3,082	1,118.9
1988	4,005	1,326.4

SOURCE : MALAYAN RAILWAYS

(b) Passenger Traffic

Road transport again plays a dominant role in passenger transport. The NTPR estimates that there were 183 million passenger movements in 1986, of which 175 million (95.5%) moved by road while the remaining 8.3 million went by rail or air. Coastal shipping is still in its infancy, with a weekly passenger and

(2) Data on rail traffic are for are for the year 1985

cargo service operating between the Peninsular to Sabah and Sarawak, whereas riverine transport is only important in Sarawak. The ferry services between Penang Island and Butterworth in the northwestern part of the Peninsular has experienced a sharp drop in clientele (over 50%) since the opening of the Penang Bridge in September 1985. Most of the heavy commercial vehicles have opted to use the Bridge.

As shown in Table 7.3, MR's passenger traffic has remained static, ranging between 6 to 7 million per annum although passenger km has been slowly inching up from below 1 million passenger km in 1973/74 to an average 1.4 million passenger km per annum.

In the future, the NTPR estimated the bus traffic will increase by about 2.5% per annum to about 38 million passengers a year by 1995. Car and taxi flows are also expected to increase between 2.3% to 5.3% per annum. KTM is expected to continue losing passengers to road and so will air travel, especially with the completion of the North South Highway.

TABLE 7.3

Malayan Railways : Passenger Traffic 1974-1988

Year	'000 passengers	'000,000 passenger km
1974	5,967	953.2
1975	6,109	1,014.2
1976	6,400	1,144.9
1977	6,389	1,273.1
1978	5,998	1,269.4
1979	6,243	1,371.8
1980	7,067	1,586.8
1981	7,356	1,640.1
1982	7,117	1,615.3
1983	6,641	1,498.7
1984	6,634	1,512.3
1985	6,356	1,408.7
1986	6,735	1,368.5
1987	6,571	1,424.6
1988	7,300	1,518.1

SOURCE : MALAYAN RAILWAYS

7.5 ENERGY CONSERVATION

The Railways however, do have some advantages over the roads in that it provides a more efficient transportation system from the conservation of energy point of view. Transportation on the whole accounts for approximately 50% of Peninsular Malaysia's national petroleum consumption.

Although there has never been a comprehensive study on the fuel conservation aspects of the railways, the General Transport/Railway Study for Peninsular Malaysia completed in early 1978 did make an assessment of MR's role in energy conservation and balance of payments. Based on 1976 figures, the Study concluded that MR's average consumption was 0.0027 gallons diesel fuel per net ton km compared to the average of 0.0059 gallons per net ton km for road transportation. This meant a savings in national fuel consumption achieved by MR of 3.2 million gallons. However, MR's energy consumption for passenger transportation was 0.0027 gallons per passenger km which is slightly higher than transport of 0.0017 gallons. If MR's passengers were carried by road, the savings in fuel consumption would be approximately 0.9 million gallons. On the balance this meant that in 1976, the natural energy savings derived from rail transportation was equivalent to 2.3 million gallons, representing some $2.7 million at 1976 world prices. Such savings will help to enhance Malaysia's international position by increasing its foreign currency reserves.

7.6 ROADS TRANSPORT SYSTEM

(a) Motor Vehicles

The number of registered vehicles in Malaysia at the end of 187 was 4,599,362 with the number of private cars being 1,475,807. The total number of motor vehicles increased annually at the rate of 10.7% during the period 1974-1987. Table 7.4 gives details of motor vehicle registration in Malaysia from 1974-1987. Of the total, 32% are private cars and 57% are motorcycles.

In Peninsular Malaysia, the number of registered vehicles increased four from 1,100,285 in 1974 to 4,274,380 in 1988, giving a growth rate of 10.2%. Private motorcars play a dominant role as a mode of travel in Peninsular Malaysia and this is reflected in the unduly high annual growth rate of about 9.7% in Peninsular Malaysia, from 357,910 in 1974 to 1,309,249 in 1988. The total number of registered vehicles in the states of Sabah and Sarawak in 1987 were 211,944 and 270,891 respectively. The number of private cars being 118,916 (56%) and 106,301 (39%) respectively. The rate of growth of motorization in East Malaysia between 1974 and 1986 was about 11.5%, which parallels the growth rate in the Peninsular.

TABLE 7.4

Registration Of Motor Vehicles By Type In Malaysia

			PUBLIC SERVICE VEHICLE					
YEAR	MOTORCYCLE	MOTORCAR	BUS	TAXI	HIRE AND DRIVE CAR	GOODS VEHICLE	OTHERS	TOTAL
1974	646,745	416,229	8,919	9,026		94,385	41,633	1,216
1975	761,389	462,030	10,001	10,654		106,499	46,307	1,396
1976	875,076	507,131	11,116	12,064		117,820	50,437	1,573
1977	998,670	570,217	11,903	13,938		129,959	55,072	1,779
1978	1,132,511	642,582	13,086	15,098		143,825	61,391	2,008
1979	1,241,247	693,545	13,625	15,574		158,693	67,850	2,190
1980	1,459,727	847,099	15,287	18,209		190,081	86,687	2,617,
1981	1,620,572	936,155	15,452	19,428	1,465	206,534	22,199	2,821,
1982	1,818,044	!1,037,171	16,783	20,839	1,766	226,386	22,713	3,143
1983	2,037,209	1,148,367	17,929	22,560	2,504	244,945	24,105	3,497
1984	2,236,283	1,265,904	19,002	23,030	3,044	267,293	25,194	3,839
1985	2,410,419	1,356,731	20,203	23,887	3,374	290,900	26,156	4,131
1986	2,534,346	1,425,608	21,367	24,321	3,632	206,002	26,588	4,241
1987	2,611,599	1,475,807	22,134	24,632	3,816	316,846	118,060	4,599

NOTE : Figures for taxis and hire and drive cars are combined for the years 1974-1980 because there was no breakdown between these two catagories for Sabah and Sarawak during that period.

SOURCE : ROAD TRANSPORT DEPARTMENT ANNUAL STATISTICAL BULLETIN 1987

(b) Road Network and Traffic

Increase in total road length in Malaysia over the period 1977 to 1986 ae shown in Table 7.5. A study of this Table shows that by the end of 1986 there were about 40,000 km or roads (excluding municipal roads) of which 69% were paved. Out of the total of 27,000 km of roads in the Peninsular, 78% are paved. Figures 'A' and 'B' show the existing pimary road network in Peninsular and East Malaysia respectively.

Biennial traffic censuses carried out since 1967 indicate that the traffic volumes and growth rates vary from route to route. Figure 'C' shows the average daily traffic volume in 1986 in the Peninsular. The figure indicates that the most heavily travelled road in the 40 km section of Federal Route 2 between Kuala Lumpur and Port Klang. The other route carrying high traffic volumes is the Federal Route 1 which runs from north to south along the West Coast of the Peninsular. High traffic volumes are also observed in the vicinity of cities and towns. The average traffic growth rate per annum for Federal Routes 1,2 and 3 over the period 1973-1980 are 5%, 10% and 7% respectively and for the period 1980-1986 were 5%, 5% and 6% respectively.

In Sarawak, the major highway carrying a large volume of traffic is the Kuching-Serian Road, with traffic ranging from 26,000 to 32,000 pcu per day, In Sabah, the Kota Kinabalu-Tamparuli, Kota Kinabalu-Donggongan and the Tawau-Kunak roads are the three major roads carrying 12,000, 28,000 and 14,000 vehicles per day respectively.

In view of the capacity constraints experienced along the network on the West Coast, the Government had privatised the construction of the new 900 km North-South Highway of which to date about 340 kms have already been constructed. Table 7.6 shows the Expressway construction. Other highways of significance which have been planned are the Shah Alam Highway in the Kelang Valley and the Simpang Pulai - Kuala Berang Highway, running east to west along the northern part of Peninsular Malaysia. It is anticipated that the Simpang Pulai-Kuala Berang Highway will help promote economic growth of the region.

In Sabah, the immediate priority is to improve the land transport system between the isolated areas and development centres as well as to provide better access to its interior. In sarawak, the immediate priority is the sealing of the First Trunk Road from Kuching to the Sabah border to all - weather standards. This will form part of the Pan-Borneo Highway. Future plans are for the development of a Second Trunk Road System which will indirectly open up the sparsely populated areas.

TABLE 7.5

LENGH OF (Km) IN MALAYSIA BY SURFACE AND JURISDICTION, 1977-1986

SURFACE TYPE	FEDERAL				STATE				TOTAL			GRAND
YEAR	PAVED	GRAVEL	EARTH	TOTAL	PAVED	GRAVEL	EARTH	TOTAL	PAVED	GRAVEL	EARTH	TOTAL
1977	2,967	309	195	3,471	7,646	3,869	750	12,265	10,613	4,178	945	15,736
1978	2,807	244	622	3,673	6,816	3,740	1,976	12,532	9,623	3,984	2,598	16,205
1979	2,918	208	665	3,791	7,832	3,848	1,902	13,582	10,750	4,056	2,567	17,373
1980	4,938	760	302	6,000	13,972	5,299	948	20,219	18,910	6,059	1,250	26,219
1981	5,290	691	212	6,193	14,386	6,291	829	21,506	19,676	6,982	1,041	27,699
1982	6,602	1,039	550	8.191	16,649	9,208	755	26,612	23,251	10,247	1,305	34,803
1983	6,642	1,485	410	8.537	16,837	10,514	977	28,328	23,479	11,999	1387	36,865
1984	7,060	1,823	294	9,177	17,624	10,535	1,103	29,262	24,684	12,358	1,397	38,439
1985	7,231	1,966	334	9,531	17,894	10,445	1,103	29,422	25,125	12,411	1,437	38,973*
1986	8,532	3,298	334	12,164	16,686	9,150	1,068	26,905	25,218	12,448	1,403	39,069

TABLE 7.6

Progress of Construction of North-South Expressway

Section	Completion Year
Bukit Kayu Hitam-Jitra	Completed
Jitra-Alor Setar	February 1988
Alor Setar-Gurun	Completed
Gurun-Butterworth	(1992)
Butterworth-Changkat Jering	(1992)
Changkat Jering-Ipoh	(1987)
Ipoh-Kuala Lumpur	(1992)
Kuala Lumpur-Seremban	Completed
Seremban-Air Keroh	Completed
Air Keroh-Johor Bahru	(1992)

SOURCE : NATIONAL TRANSPORT POLICY REVIEW, JUNE 1988

(c) Freight Transport Industry

As shown in Table 7.7, the good vehicles fleet in the Peninsular increased at an average rate of 16.3% per annum between 1978-1987. Out of the total of 333,699 goods vehicle licences issued up till 1987, 70% are small trucks/vans of 2,500 kg and below (decontrolled vehicles), 24% 2-axle 6-wheel rigid vehicles and only 6% 3-axle, 10-wheel articulated vehicles.

This pattern of ownership is a direct result of the country's commercial licensing policy which is exercised by the CVLB. Permits are issued by the CVLB for each goods vehicle and are valid for seven years after which a renewal must be secured. 'A' permits are issued for vehicles involved in the transport of goods for hire and reward whilst 'C' permits are for vehicles transporting owners goods only incidental to their principal business. Since permits are not required for vehicles weighing 2,500 kg and below used for carrying owner goods, this accounts for the high percentage (70%) of decontrolled vehicles.

Rates for goods transport are controlled by the CVLB and are stipulated as maximum rates. These rates, which were introduced in 1959 have been reviewed twice in the late 1970's and 1980's but were found to be still applicable as none of the road hauliers were charging above the approved rates, due to keen competition amongst themselves.

Based on capacity analysis along the major corridors in the Peninsular, the NTPR found that in 1986, the utilization rates for medium and large trucks were 0.24 and 0.62 respectively, indicating ample reserve in the fleet to handle expected traffic up to 1995. However the annual rotation (including empties) and lapse time factor also affects utilization of vehicles. As shown in Table 7.8, taking all these factors into account, the NTPR projected that the total number of medium and large trucks required for 1990 and 1995 are 41,848 and 52,995 respectively.

TABLE 7.7

Cummulative Number of Goods Vehicle Licences Issued in Peninsular Malaysia by State During 1978 - 1987

STATE YEAR	JOHOR	KEDAH	KELANTAN	MELAKA	NEGERI SEMBILAN	PAHANG	PERAK	PERLIS	PULAU PINANG	SELANGOR	TERENGGANU	WILAYAH PERSEKUTUAN	TOTAL
1978	16260	9663	4772	5274	7597	7278	18191	512	12712	49557	2813	-	135029
1979	18716	10800	5686	5898	8751	8312	20171	566	14334	58065	3582	-	154881
1980	20866	12125	6675	6596	9637	9598	22742	693	15277	65295	4437	-	173941
1981	22560	13476	7678	7136	10241	10862	29592	826	16265	69735	4865	1894	195130
1982	24351	12983	8744	7644	10857	12132	35358	2439	17566	64473	5356	13375	215278
1983	26356	14068	9866	8097	11483	13711	4069	2584	18782	67425	5928	18717	237707
1984	28561	15323	11368	8588	12077	15731	46545	2721	20207	70926	6484	24763	263294
1985	30761	16665	12535	8998	12658	17503	53377	2876	21641	72137	6941	32522	288614
1986	32877	18107	13717	9356	13149	19247	59343	3064	22881	74372	7485	36897	310495
1987	63145	18592	15051	10215	14248	20944	62954	3111	24599	78405	8245	41190	333699

SOURCE: ROAD TRANSPORT DEPARTMENT ANNUAL STATISTICAL BULLETIN 1987

TABLE 7.8

Trucking Industry Capacity Utilization and Forecasts of Fleet Needs In Peninsular Malaysia, 1986 - 95

Assumptions	1986	1988	1990	1995
Vehicle-Kilometers ('000)				
Medium trucks /a	491,865	546,741	621,836	783,379
Large trucks /b	433,965	449,299	537,286	692,921
Average Actual Payload (tons) /c				
Medium trucks	7.14	7.14	7.14	7.14
Large trucks	14.08	14.08	14.08	14.08
Capacity Utilization Indicator /c				
Medium trucks	0.24	0.24	0.24	0.24
Large trucks	0.62	0.62	0.62	0.62
Average Theoretical Payload (tons) /c				
Medium trucks	6.61	6.61	6.61	6.61
Large trucks	14.07	14.07	14.07	14.07
Total Trucks Required				
Medium trucks	25,372	28,683	32,622	41,097
Large trucks	7,433	7,715	9,226	11,898

/a Two-axle, six-wheel rigid vehicle.
/b Three-axle, ten-wheel articulated vehicle.
/c Actual 1986 values used in calculating projected truck needs.

SOURCE: NTPR

(d) Passenger Services

Public transport services are provided by buses as well as taxis and hire cars. The bus industry in Peninsular Malaysia comprises publicly and privately owned buses ranging from a single large company with a total fleet of 200 buses to medium - and small - size companies with 60 to 20 buses each. There are six categories of buses :-

(i) express bus which is used for the carriage of passengers at separate fares on a service which contains no fare stages of less than 16 km;

(ii) stage bus which is used for the carriage of passengers at separate fares which contains no fare stages of more than 32 km;

(iii) excursion bus which is used exclusively for the conveyance of tourists on a single journey and in consideration of a single payment which has no fare stages;

(iv) school bus which is used exclusively for the conveyance of pupils or staff of schools or other educational institutions;

(v) factory bus which is used exclusively for the conveyance of employees of factories to and from their place of work; and

(vi) mini bus which has a seating capacity of not more than 25 persons (including the driver) used for the carriage of passengers at separate fares.

In early 1989, the CVLB also started licensing a new category of vehicles, called employees vehicle which is owned by any company and used exclusively for the conveyance of its employees to and from their place of work without fare charges.

Table 7.9 gives the cummulative number of bus licences issued in the Peninsular by type or service for 1978-1987. In 1987, the fleet totaled 20,349 of which roughly half are school buses. In Sabah, there were a total of 245 and Sarawak 67 buses registered in 1987.

All buses are licensed by the CVLB. Conditions attached to the licence (permit) define the areas of operation, routes, points served, timetable indicating the frequency of service as well as designated bus depots for departures and returns. Express buses operate inter-urban services whereas stage buses operate mostly in the urban areas. Mini buses which were introduced in 1975 and which number 485 at the moment, have been licensed to operate in Kuala Lumpur and Petaling Jaya. According to the NTPR express buses operate between 180,000 and 200,000 km per annum with peak and off-peak load factors of 65% and 30%. Stage buses cover 50,000 to 65,000 km per annum with peak and off-peak load factors of 30% and 14%. Bus fares are also regulated by the CVLB. The last fare revision was done in 1984.

Table 7.10 shows the number of licences issued for taxis, hire cars, limousine taxis and hire and drive cars in Peninsular Malaysia from 1978-1987. The definitions for these vehicles are as follows:-

(a) taxi cab is a vehicle having a seating capacity of not more than six persons (including the driver) used for carrying persons on any journey in consideration of a single fare;

(b) limousine taxi cab is a vehicle having a seating capacity of not more than six persons (including the driver) used for the carriage of persons in consideration of a single payment and operating from a fixed base and which does not ply for hire on any road;

(c) hire car is a vehicle having a seating capacity of not more than six persons or in areas approved by the CVLB, twelve persons (in all cases including the driver) used for carrying persons on any journey in consideration of separate payments made by them;

(d) hire and drive car is a vehicle let on hire for the purpose of being driven by the hirer or his nominee.

For the period 1978-1987, total number of licences issued have being increasing at the rate of 10.5% per annum. Since 1983 there had been a freeze on taxi/hire car licences in the following areas :-

(a) hire car licences in Perlis;

(b) taxi and hire car licences in Malacca;

(c) taxi licences in Johor Bahru town;

(d) taxi licences in Kuala Lumpur, Petaling Jaya and Shah Alam;

(e) taxi and limousine taxi licences in Subang International Airport (since mid 1988) and Penang International Airport.

Very recently, on 1989, the freeze was lifted for all these areas (except the two airports) and to date the CVLB has received about 10,000 applications from the public for taxi licences. The processing of such applications will take time and the CVLB expects to issue about 2,000 new taxi licences up till 1990 for the Klang Valley alone. This figure will cater for the increase in demand for taxi services especially with the forthcoming Visit Malaysia Year in 1990 as well as to make up for cancelled licences.

Due to the paucity of data, the NPTR did not make any projections for the overall demand of passenger vehicles. A projection of the number of express bus required was however obtained, assuming that capacity utilization remains constant at 1986 levels. As shown in Table 7.11, the number of express buses required will be 1,071 and 1,848 in 1990 and 1995 respectively.

TABLE 7.9

Cummulative Number of Bus Licences Issued in Peninsular Malaysia By Type of Service During 1978 - 1987

TYPE YEAR	SCHOOL BUSES	FACTORY BUSES	EXCURSION BUSES	EXPRESS BUSES	STAGE BUSES	MINI BUSES	TOTAL
1978	6389	691	227	367	3706	400	11780
1979	6594	744	242	550	3771	400	12301
1980	7070	1009	384	654	3690	400	13206
1981	7418	1233	415	751	4109	400	14326
1982	8054	1405	449	1025	4269	400	1560
1983	8532	1561	445	115	4469	490	1660
1984	8692	1427	491	1243	4582	490	16925
1985	8680	1496	491	1286	4776	490	17219
1986	10034	1533	497	1301	5016	494	18925
1987	10656	1728	628	1378	5406	553	20349

SOURCE: COMMERCIAL VEHICLES LICENCING BOARD (CVLB)

TABLE 7.10

Cummulative Number of Licences For Taxis/Hire Cars/Limousine Taxis/ Hire And Drive Cars Issued in Peninsular Malaysia During 1978 - 1987

YEAR	TAXIS	HIRE CARS	LIMOUSINE TAXIS
1978	3653	7504	364
1979	3752	7822	476
1980	4829	9385	567
1981	6611	11189	228
1982	7594	12120	284
1983	8868	12886	378
1984	9488	13681	403
1985	10132	14198	429
1986	10558	14312	512
1987	10728	14967	584

SOURCE: ROAD TRANSPORT DEPARTMENT ANNUAL STATISTICAL BULLETIN 1987

TABLE 7.11

Forecasts of Bus Fleet Requirement up to 1995

	1986	1988	1990	1995
Pass-km (thousands)	4,143,242	4,550,210	5,078,496	6,392,803
Average seats per bus	40	40	40	40
Capacity utilization rate, 1986 /a	0.593	0.593	0.593	0.593
No. of express buses required	874	960	1,071	1,848

/a If the capacity utilization rate is assumed not to remain constant at the 1986 level, but to reflect past utilization trends,then utilization would fall to 0.411 by 1995, when 1,946 express buses would be needed.

SOURCE: NTPR

7.7 RAILWAYS

There are two railways operating in Malaysia. The MR, comprising 1,643 route-km of meter-gauge truck operates in the Peninsula, running from the south in Singapore and branching into two lines, one running up the west coast and the other northeast, both linking with Thailand in the north. MR's network is shown in Figure 'D'. MR has 3,447 bogie (four-axle) wagons which include 440 container flat cars and 94 guard cars. It also has 2,019 two-axle wagons and 332 coaches as well as 5 railbuses.

As shown in Tables 7.2 and 7.3, during the past decade rail services in terms of passenger and freight volumes have stagnated. In 1986, MR handled 7.3 million passengers or 1,518.1 million passenger km. Compared with the peak achieved in 1981 amounting to 7.356 million passengers and 1,640.1 million passenger km, the number of passengers and passengers km has declined by 8%. Towards the latter part of 1988, MR started operating its railbus services between Kulai-Singapore, Kuala Lumpur-Ipoh, Butterworth-Ipoh and Gemas-Mentakab. The fifth railbus service began between Port Kelang-Sentul in April 1989.

MR's freight traffic totaled 4,005 million tons and 1,326.4 million ton km, down from the 1979 peak of 4.188 million tons and 1,356.6 million ton km. While part of the decline in Mr's traffic is due to the economic downturn, there has also been an erosion to other competing modes of transport such as road transport and coastal shipping.

For the future, MR would have to strife in providing an efficient and low cost sservice for those goods which it has a competitive advantage i.e. bulky commodities which need to be transported in large quantities over longer distances. In order to enable it to operate as a fully commercial basis, the Government is studying the proposal on the privatisation of the MR.

In Sabah, the Sabah State Railway (SSR) operates a 134 km meter gauge track from Tanjung Aru to Tenom. The line first runs southwest along the coast to Papar and Beaufort on flat terrain, then turns to run south-easterly up the Padas Gorge to Tenom, a distance of 49 km from Beaufort. At the end of 1984 SSR had a fleetone steamand 1.4 diesel locomotives, 6 diesel train units, 17 passenger coaches and about 200 freight wagons. The service provided by the SSR is essentially non-profit motivated and is run as a cheap alternative to road transport.

7.8 AIR TRANSPORT

Malaysia has sufficient civil aviation infrastucture comprising four international (Kuala Lumpur, Penang, Kota Kinabalu and Kuching) airports, 14 domestic airports, 25 short take - off and landing (stol) airports and 12 rural airstrips. The international and domestic airports are equipped with radio and navigational aids while the stol and rural airstrips are operated under visual flight rules with minimum navigational facilities. Figures 'E' and 'F' show the location of airports in the Peninsula and East Malaysia respectively.

Table 7.12 shows the passenger air traffic from 1979-86. As stated earlier air transport only has a small market share of the transport sector in comparison to road and rail. However it plays an important role especially in Sabah and Sarawak where some rural air services provide the only link to some communities staying in isolated inland areas.

Air freight traffic in Sabah totals about 5,000 tons per annum and for various routes is expected to grow between 2.5% and 4.9% annually during 1989 - 95. Air passenger traffic stood at about 885,000 passengers in 1986 and is expected to grow at an average of 4.1% per annum up to 1995.

Air freight traffic in Sarawak is relatively insignificant, totalling, 3,307 tons in 1986, two - thirds of which were carried on the Kuching - Miri and Kuching - Sibu routes. A further erosian of air traffic is expected as the road network expands. Passenger traffic in 1986 stood at about 675,000 with the Kuching -Sibu and Kuching-Miri sector accounting for 50% of the total. As in Sabah, rural air services are also provided by the Malaysian Airlines System (MAS). These services play a vital role in providing transport to areas with no other reliable transport arteries. Rural air services passenger traffic during 1976 - 85 increased threefold to about 145,000 passengers per annum. Future growth is expected to decelerate to about 5.4% per annum. In 1986, about 685 tons of freight were transported compared to 554 tons in 1976. This gives a current annual growth rate of 4% which is projected to decline to 1.6% per annum up to 1996.

The vast majority of flight services in the country are provided by MAS, a private company with majority Government equity. Currently MAS has a fleet of 37 aircrafts and its future plans for fleet development up till 1992 are shown in Table 7.13.

TABLE 7.12

Passenger Air Traffic, 1979-86
('000)

	Peninsular Malaysia	East Malaysia	Total
1979	3,153	2,487	5,640
1980	3,940	3,257	7,197
1981	4,885	4,126	9,011
1982	5,160	4,138	9,298
1983	5,350	4,113	9,463
1984	6,078	4,337	10,415
1985	6,304	3,951	10,255
1986 est.	6,087	3,864	9,951

SOURCE: Department of Civil Aviation

TABLE 7.13

MAS Fleet Development, 1986/87 - 1991/92

Aircraft type	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
B-747-200c	2	2	2	2	2	2
B-747-300c	1	1	1	1	1	1
B-747-400c	-	-	-	1	2	2
DC-10	3	3	3	3	3	3
A-300B	4	4	4	4	4	4
B-737	11	12	13	14	14	15
F-27	11	11/10	10	9	9	9
Twin Otter	4	4	4	4	4	4
Total	36	37/36	37	37	37	38

7.9 MARITIME TRANSPORT

(a) Ports

An extensive port system exists in Malaysia, with 25 ports in the Peninsular, 17 in Sabah and 13 in Sarawak. The ports are grouped under nine Port Authorities, four in Peninsular (Kelang, Penang, Kuantan and Johore), four in Sarawak (Kuching, Bintulu, Rajang, Miri) and one in Sabah (Kota Kinabalu). All four ports in the Peninsula are federal ports while in East Malaysia only Bintulu is a federal port. Bintulu has a specialized liquified natural gas (LNG) terminal capable of handling vessels of up to 60,000 dwt and is also equipped with three general cargo and one bulk cargo berths. The other three ports in Sarawak come under the State Ministry of Infrastructural Development, whereas in Sabah all ports come under the Sabah PortAuthority in Kota Kinabalu, under the State Ministry of Communications and Works.

In addition to the principal ports administered by the various Port Authorities, numerous minor ports come directly under the Ministry of Transport Marine Department. These minor ports mainly serve passenger needs and cargo handling undertaken by private companies. There is very little data on movements through the minor ports which play a secondary role to the main ports.

Over the last two decades a rapid growth in maritime activities has been recorded. Nearly all the country's international trade is oceanborne. This can be seen from the growing total amount of cargo handled by the ports in the country. Table 7.14 summarises the amount of cargo loaded and unloaded by major ports in Malaysia. A total of 71.5 million metric tonnes of cargo were handled by all ports in Malaysia in the year 1986, compared to 50.8 million metric tonnes in 1980 and 38.1 million freight tonnes in 1970. This indicated that the flow of cargo - traffic in most ports in Malaysia had grown at a rate of 5.9% per annum over the period 1980 - 86.

The composition of the cargo throughput handled by major ports in Malaysia over the post - 1980 period also varied considerably. With steady growth in the Malaysian economy and expansion in international trade, the growth of dry bulk cargo was most significant, growing from 1.6 million metric tonnes in 1980 to 4.8 million metric tonnes in 1985, an annual rate of 24.3%. Liquid bulk cargo was next in importance, increasing from 6.1 million metric tonnes to 14.4 million metric tonnes, an annual growth rate of 18.5% over the same period. Containerised cargo doubled from 2.2 million metric tonnes in 1980 to 4.5 million metric tonnes in 1985, registering a growth of 14.9% per annum. Total general cargo, meanwhile recorded a growth rate of 5.7% per annum, increasing from 13.5 million metric tonnes in 1980 to 17.9 million metric tonnes in 1985.

For Peninsula Malaysia, the expected average annual cargo growth rates by volume for exports (excluding petroleum) are 3.5% from 1985 to 1990, 2.9% from 1990 to 2000 and 3.3% from 2000 to 2010. Since downstream industrial development as set out in the Industrial Master Plan is expected to raise export Values pe, tonne after 1990, the rate of increase in real export values is likely to be somewhat higher, at 5% per annum.

In Sabah and Sarawak export tonnage (excluding petroleum) is expected to decline. This is due to replacement of log shipments by sawn timber as the timber industry develops downstream. Again, real export value is expected to increase.

Excluding petroleum and dry bulk, inward seaborne movements to the Peninsula are expected to grow annually at 3% during 1985 - 1990, 4.1% from 1990 to 2000, and 4.5% from 2000 to 2010. Inward flows of dry cargoes to Sarawak and Sabah are projected to grow at faster annual rates than to the Peninsula. From 1990 to 2000 Sarawak imports will increase annually at 7% and between 2000 to 2010 at 6%. For the same periods, Sabah cargo growth is forecast at 6.6% in the first ten years and 5.7% thereafter. Port traffic demand projections for Peninsula Malaysia are shown in Table 7.15 while those for Sarawak and Sabah are shown in Table 7.16 respectively.

TABLE 7.14

CARGO LOADED AND UNLOADED AT MAJOR PORTS IN MALAYSIA (MILLION TONNES)

Year	Peninsular Malaysia*a		Sabah*b		Sarawak*b	
	Cargo Loaded	Cargo Unloaded	Cargo Loaded	Cargo Unloaded	Cargo Loaded	Cargo Unloaded
1970	10.1	7.9	3.0	1.0	9.1	7.0
1975	6.4	8.9	5.1	1.4	5.0	1.2
1976	7.2	10.1	9.0	1.5	5.1	1.3
1977	8.3	11.5	10.2	1.7	7.4	1.4
1978	9.4	12.5	12.0	2.0	10.1	0.7
1979	10.5	14.9	10.5	2.4	10.7	0.8
1980	10.7	16.7	9.1	2.8	10.6	0.9
1981	10.8	16.3	8.6	3.1	12.2	1.4
1982	10.4	17.3	12.6	3.3	13.3	1.4
1983	11.8	19.8	12.6	3.6	18.2	1.4
1984	11.8	20.2	11.7	3.8	19.3	1.7
1985	11.1*	17.8*	12.7	3.8	21.0	1.7
1986	13.1*	18.4*	13.9	3.7	20.9	1.5

Sources: Malaysia, Annual Statistical Bulletin, Department of Statistics, Kuala Lumpur, various issues.
Malaysia, Yearbook of Statistics, Department of Statistics, Kuala Lumpur, 1986

Peninsular Malaysia, Monthly Statistical Bulletin, Department of Statistics, Kuala Lumpur, various issues.

Sarawak, Annual Statistical Bulletin, Department of Statistics (Sarawak Branch); various issues.

Sabah, Monthly Statistics, Department of Statistics (Sabah Branch); various issues.

Note: Data in 1970 are shown in freight tons and data from 1975 onwards are in long tons/metric tonnes.

*a Data relate to all ports.
*b Data relate to major ports.
* Data in million metric tonnes.

TABLE 7.15(A)

CARGO PROJECTIONS FOR PENINSULAR MALAYSIA - OUTWARDS

(000' DWT)	1985	1986 (BASE)	1990	1995	2000	2005	2010
Petroleum and products	2,769						
Rubber	1,156	1,170	1,130	1,070	1,010	880	760
Latex	350	340	330	320	300	260	220
Palm oil	3,53	4,070	4,970	5,580	5,810	5,030	4,540
Palm kernel oil	258	300	370	420	460	390	360
Palm kernel waste	624	740	920	1,060	1,140	990	890
Timber, plywood and veneers	1,697	1,800	1,500	1,050	660	490	360
Woodchips	30	50	50	-	-	-	-
Tin and tin ore	63	40	40	40	40	4)	40
Ilmenite ore	187	120	120	120	120	120	120
Granite stone	411	400	400	400	400	400	400
Bauxite	514	500	500	500	500	500	500
Iron and steel	154	150	200	300	400	400	400
Fertiliser	50	50	50	70	90	110	130
Miscellaneous	1,992	2,000	2,520	4,070	6,550	10,080	15,500
Total excluding Petroleum	11,016	11,730	13,100	15,000	17,480	19,690	24,220

Source: National Port Plan, March 1988

TABLE 7.15(b)

CARGO PROJECTIONS FOR PENINSULAR MALAYSIA - INWARDS

('000 DWT)	1985	1986 (BASE)	1990	1995	2000	2005	2010
Petroleum and products	9,729						
Rice	201	200	220	250	290	320	360
Sugar	560	560	610	740	900	1,040	1,210
Milk	102	100	110	130	160	190	220
Wheat	502	500	540	660	800	970	1,190
Maize	677	600	650	790	960	1,170	1,420
Barley	-	-	-	-	-	-	-
Soya beans	161	160	170	200	230	260	280
Beans	65	70	80	90	100	110	120
Poultry and animal mash	83	80	90	110	130	160	190
Palm oil	396	430	450	330	130	100	100
Timber	27	30	640	870	1,190	1,060	1,070
Coal	122	300	2,100	2,300	2,500	2,700	3,000
Cement	247	300	500	500	500	500	500
Clinker	155	250	600	600	600	600	600
Clay	45	50	50	50	50	50	50
Iron and steel	1,149	1,200	1,200	1,610	1,070	860	770
Tin plates	81	80	90	100	110	110	110
Chemicals	362	400	470	660	920	1,290	1,810
Fertilisers	1,461	1,4[illegible]	1,520	1,930	2,470	3,000	3,650
Paper (incl. newsprint)	279	300	320	360	400	400	400
Machinery and parts	227	230	230	290	370	370	370
CKD vehicle parts	126	130	130	170	210	270	340
Electrical goods and parts	67	70	80	80	90	90	90
Hardware and tools	33	40	40	50	50	50	50
Household goods and provisions	55	60	60	70	80	80	80
Canned foodstuffs	26	30	30	40	40	50	50
Miscellaneous	1,962	2,000	2,250	3,160	4,430	6,210	8,710
New bulk	-	-	-	-	1,000	2,000	4,000
Total excluding petroleum	9,171	9,570	13,230	16,140	19,780	24,010	30,740

SOURCE: National Ports Plan, March 1988

TABLE 7.16(a)

CARGO PROJECTIONS FOR SARAWAK

(000 DWT (BASE)	1985	1986	1990	1995	2000	2005	2010
OUTWARDS							
LNG	4,473						
Petroleum products	6,824						
Logs	11,452	10,800	8,760	7,340	4,110	-	-
Timber, plywood and veneers							
Export	142	420	1,230	1,860	3,130	4,810	4,400
Intra-Malaysia	-	-	270	340	550	580	590
Palm oil:							
Export	-	-	-	30	60	90	90
Intra-Malaysia	43	50	60	40	30	-	-
Other cargo	338	350	450	620	1,02	1,660	2,140
Total excluding hydrocarbon	11,975	11,620	10,770	10,230	8,900	7,140	7,220
INWARDS							
Petroleum	289						
Dry cargo	1,015	1,000	1,170	1,640	2,300	3,080	4,120

NOTES:
(a) Sarawak port:
Kucing, Rajang< Bintulu, Miri, and other port.

(b) Flows associated with specific industrial projects at Bintulu.

SOURCE: National Ports Plan, March 1988

TABLE 7.16(b)

CARGO PROJECTIONS FOR SABAH (A)

('000 DWT)	1985	1986 (BASE)	1990	1995	2000	2005	2010
OUTWARDS							
Petroleum, crude	270						
Logs	8,266	7,200	5,840	3,150	1,030	-	-
Timber, plywood and veneers:							
Export	1,227	1,290	1,650	2,880	3,610	3,930	3,590
Intra-Malaysia	-	-	370	530	640	480	480
Woodchips	200	200	200	200	-	-	-
Copper concentrate	131	130	130	130	-	-	-
Palm oil:							
Export	48	70	180	370	640	680	670
Intra-Malaysia	216	280	290	190	-	-	-
Other major crops (B)	130	180	230	330	490	660	880
Other commodities	590	600	680	960	1,440	2,010	2,600
Total excluding petroleum	10,808	9,950	9,570	8,740	7,850	7,760	8,220
INWARDS							
Petroleum and products	750						
Rice	138	120	140	170	220	260	300
Fertiliser	150	150	160	210	260	320	390
Other goods	1,111	1,100	1,290	1,800	2,530	3,390	4,530
Total excluding petroleum	1,399	1,370	1,590	2,180	3,010	3,970	5,220

Notes: (A) Ports covered do not include Labuan

(B) Other major crops include rubber, copra, cocoa beans and palm kernels.

SOURCE: National Ports Plan, March 1988

(b) Coastal Shipping

Malaysia's licenced coastal shipping fleet in 1986 consisted of 329 vessel totalling about 807,000 GRT of which 274 ships of 572,000 GRT were Malaysian flag vessels. The rest were foreign - flag ships chartered on spot basis to make up for sudden and abrupt shortfall in capacity due to unavailability of suitable Malaysian tonnage at a particular time. Due to the introduction of the Cabotage Laws in 1 January 1980, there has been a dramatic drop in foreign - registered ships. Under the Cabotage Laws, any ship of 15NRT (nett Registered tone) and above which carry passengers and cargo between two ports or places in Malaysia must possess a valid domestic shipping licence. These licences are issued by the Domestic Shipping Licencing Board which is under the Ministry of Transport.

Statistics compiled by the Board indicate that there were 252 Malaysian vessels in 1987 totalling 490,426.84 GRT (Gross Registered Tons) compared to 132 vessels totalling 151,937.21 GRT in 1981. Table 7.17 1987 as well as types age and capacity of the vessels in up till the end of 1987.

About 40% of the Malaysian fleet is dedicated to the Transport of Petroleum products, 50% to dry cargo and the remainder to palm pil, passengers and other companies. The present theoretical tanker capacity is estimated at 4.5 million tons, assuming a 72% load factor and average of 40 trips a year. After 1990, the construction of a refinery at Malacca which is planned to begin operations in 1991, would require further increases in tanker capacity.

The dry bulk cargo fleet can at the moment sufficiently cater for bulk coastal trade, consisting mainly of cement and tanker movements from Telok Ewa to Sabah and Sarawak. In terms of general cargo, container capacity is sufficientfor the present level of traffic develops, there will be a shift from break - bulk ships to container ships.

TABLE 7.17

VESSELS REGISTERED UNDER CABOTAGE

i) Malaysian Registered Ships Under Cabotage

Year	No.	GRT
1981	132	151,937.21
1982	221	376,632.92
1983	204	559,106.54
1984	235	641,349.09
1985	275	776,349.09
1986	266	571,747.42
1987	252	490,426.84

ii) Malaysian Registered Ships Which Were Still Active Up Till The End Of 1987

	No. of Vessels
a) Conventional/semi container ship	81
(b) Roll-on roll-off ship	3
(c) Fully cellular container ship	8
(d) Petroleum tankers	43
(e) Parcel tankers	7
(f) Dry bulk cargo ship	12
(g) Passenger ship	9
(h) Supply, tug, anchor-handling. diving support, crewboat, etc.	48
(i) Pontoon (dry and liquid)	38
(j) Others	3
TOTAL	252

iii) Age of Malaysian Registered-Vessels, 1987

	No. of Vessels
(a) 0 - 5 years	55
(b) 6 - 10 years	58
(c) 11 - 15 years	54
(d) 16 - 20 years	51
(e) > 20 years	34
TOTAL	252

iv) Malaysian Registered Vessels According To GRT, 1987

GRT	No. of Vessels
(a) 50 - 500	84
(b) 501 - 1000	69
(c) 1001 - 1500	24
(d) 1501 - 2000	13
(e) 2001 - 2500	16
(f) 2501 - 3000	16
(g) 3001 - 3500	6
(h) 3501 - 4000	9
(i) 4001 - 4500	3
(j) 4501 - 5000	2
(k) 5001 ke atas	10
TOTAL	252

SOURCE : DOMESTIC SHIPPING LICENCING BOARD

7.10 FUTURE TRENDS

For the future, intermodalism and containerization is expected to play a major role in transport development in Malaysia. Intermodalism was introduced in Malaysia in 1974 when MR first handled ocean - going containers, but the rate of development was protected and slow, largely done to inadequate handling capacity of the railways and regulatory conditions on road container haulage. According to the NTPR, in 1986 about 345, 500 TEU (twenty foot equivalent units) were transported in the Peninsula by Malaysian carriers, 60% by road, 31% by coastal shipping and 9% by railway. Road container traffic involved shorter hauls, making coastal shipping and railway competitive for longer distances.

MR has ordered an additional 300 container flat cars as well as built a new inland clearance depot (ICD) at Brickfields to cater for future needs. In early 1989 the Government relaxed road container haulage to allow all the existing three licenced operators: Kontena Nasional (KN), Shapadu and Konsortium Perkapalan Malaysia to carry road containers all over the country. Prior to the relaxation only KN could carry containers throughout the whole of the Peninsula whereas Shapadu was restricted to a 20 km radius around Port Kelang and Koonsortium could operate in the North-Western states of the Peninsula only. In view of this change, KN and MR are planning to build four more ICD's at Butterworth (to be completed in 1990), Ipoh, Tampin and Mengkibol. KN already has three existing ICD's at Prai, Johor Bahru and Sri Setia at the moment. MR in cooperation with Konsortium are planning to build one ICD at Butterworth. Whereas Konsortium (which already has two ICD's at Butterworth and Prai) is also planning to set up on its own another ICD at Port Kelang by the end of 1989. Shapadu which currently does not have any ICD (except for a small interchange at Seremban) is planning to set up ICD's at Kuala Lumpur, Prai, Johor Bahru, Melaka, Kluang, Ipoh, Kuantan and Padang Besar by 1991-1993.

Another new development which will have a strong impact on the transport scenario is the plan to establish a dry port in the Ipoh area. The concept of a dry port is basically to provide for an extension of the facilities of an existing port. It is located in the marginal area some distance away off the hinterland of the original port. The facilities provided to dry port users are part of a package deal including :

(a) receiving/delivery of cargo into the dry port area;

(b) documentation and customs clearance;

(c) transportation between the dry port and the actual port;

On the part of the Government, it would continue to undertake programmes and projects to further improve mobility and acessibility, thereby ensuring improvement in the services provided. An integrated approach to transport planning between the various modes of land, sea and air as well as with landuse and regional planning. The investment in transport infrastructure and facilities in the rural sector will also be stepped up to improve the standard of living of the population in rural and isolated areas. Together with other rural development programmes, the Government views transportation programmes as a means to accelerate the upgrading of the socio-economic status of the communities.

7.11 ROAD TRANSPORT ENERGY DEMAND

7.11.1 Past Data

An exercise to collect and assemble existing data on road transport with respect to energy consumption was conducted within the REDP P-1.1 project. An investigation into existing/previous studies/works in this area revealed a lack of disaggregated data on road transport with respect to vehicle-type and fuel-type. The data collected was scrutinised and finally introduced into EPU's energy data bank within the framework on the DBA/VOID/DBMS software package provided by AIT via ESCAP.

The existing data compiled so far are:

i) cumulative stock of registered vehicles by certain vehicle type in time series, 1978 to 1987. This data was sourced from the Ministry of Transport and the Road Transport Department.

ii) A compilation of technical data from various studies commissioned by the Ministry of Transport, namely, e.g. unit consumption and annual mileage of trucks.

iii) attempts at establishing the operational fleet has been made by the Road Transport Department. However, due to logistic problems, a total population figure and no breakdown by vehicle type was available.

To augment these rather paltry database, a service station survey was launched in October 1988 to tryand obtain information regarding annual mileage and unit consumption by vehicle type and fuel type (gasoline and diesel). The results are presented in chapter 4.6.

7.11.2 Road Transport Operational Fleet

The operational fleet has to be derive from the cummulative stock by judgement and hypothesis as afirst attempt. The stock information are splited into 16 categories of vehicle type, viz:

o	motorcycles (inclusive of scooters)	(gasoline)
o	cars	(gasoline & diesel)
o	Minibus	(diesel)(KL/PJ only)
o	Bus	(gasoline & diesel)
o	Taxi cabs	(gasoline & diesel)(in town)
o	Hire Cars	(gasoline & diesel)(Intertown taxis)
o	Small Truck (< 2.5t, inclusive of Vans & 4-Wheel Drive)	(gasoline & diesel)
o	Medium Truck	(diesel)(>2.5t, <15t)
o	Heavy Trucks	(diesel)(> 15t)
o	Others	(gasoline & diesel)(eg tractors etc.)

The operational fleet was then calculated taking by a factor of 83% of cumulative stock. This methodology is questionable but as explained earlier, this method of 'inspection' is the best the team can come up with for the moment and will serve as the first attempt at sectoral analysis of the road fleet.

A Sumarry of the operational fleet for Malaysia for selected vehicle types is given below

Table 7.11

Derived Operational Road Fleet

UNIT VEH-TYPE ENERGYTYPE YEAR	VEHICLE MOTORCY MOGAS	VEHICLE CAR MOGAS	VEHICLE CAR DIESEL	VEHICLE BUS DIESEL	VEHICLE TAXI MOGAS	VEHICLE TAXI DIESEL	VEHICLE SM TRUCK MOGAS	VEHICLE SM TRUCK MOGAS	VEHICLE SM TRUCK DIESEL	VEHICLE TRUCK DIESEL	VEHICLE HV TRUCK DIESEL	VEHICLE TOTAL MOGAS	VEHICLE TOTAL DIESEL
1978	939984	437736	23211	8342	2447	7555	54315	31884	14721	2453	1439679	113103	1552782
1979	1030257	545131	27439	8747	2867	7679	58087	33640	16472	1507	1642916	126571	1769487
1980	1211573	669608	30312	10928	3794	8114	65781	37223	19101	6165	1959828	151599	2111427
1981	1345075	746514	30494	11300	6736	10605	71402	36906	20379	7582	2181570	173926	2355495
1982	1508977	828823	32029	12392	7211	11552	76901	43247	21703	8281	2434170	191347	2625517
1983	1690883	920017	33128	13209	7839	12965	84243	45755	22844	9633	2716231	206743	2922974
1984	1856115	1015982	34718	14483	8324	13367	92760	43810	24424	10987	2986987	223550	3210536
1985	2000648	1090002	36085	15044	8738	13881	102975	52441	25649	12013	3216502	235613	3452115
1986	2103507	1145797	37458	16012	8993	14208	110139	53992	27793	12936	3382879	246020	3628899
1987	2167615	1187083	37798	17091	9158	14455	11520	52688	30074	14608	3744704	251942	3744704

Table 7.11.2:
Percentage share by vehicle type of operational fleet

INFO-TYPE VEH-TYPE ENERGYTYPE	SHARE MOTORCY MOGAS	SHARE CAR MOGAS	SHARE CAR DIESEL	SHARE SM TRUCK MOGAS	SHARE SMTRUCK DIESEL	SHARE MDTRUCK DIESEL	SHARE HVTRUCK DIESEL	SHARE TOTAL MOGAS	SHARE TOTAL DIESEL
YEAR									
1978	60.54	28.19	1.49	3.50	2.05	0.95	0.16	92.72	7.28
1979	58.22	30.81	1.55	3.28	1.90	0.93	0.25	92.85	7.15
1980	57.38	31.71	1.44	3.12	1.76	0.90	0.29	92.82	7.18
1981	57.10	31.69	1.29	3.03	1.68	0.87	0.32	92.62	7.38
1982	57.47	31.57	1.22	2.93	1.65	0.83	0.32	92.71	7.29
1983	57.85	31.48	1.13	2.88	1.57	0.78	0.33	92.93	7.07
1984	57.81	31.65	1.08	2.89	1.50	0.76	0.34	93.04	6.96
1985	57.95	31.57	1.05	2.98	1.52	0.74	0.35	93.17	6.83
1986	57.97	31.57	1.03	3.04	1.49	0.77	0.36	93.22	6.78
1987	57.88	31.70	1.01	2.98	1.41	0.80	0.39	93.27	6.73

Overall, the road fleet has increased at an average growth rate of 10.3% per annum for the period 1978 - 1987. The corresponding growth figures for motor gasoline vehicles is 10.3% and that for the diesel vehicles is 9.3%. As can be seen from above tables, motorcycles and cars has the major share of the total road fleet, with motorcycles accounting for about 58% while motorcars (gasoline) holds about 32% share. For the period 1978 - 1987, the motorcycle fleet has been growing at an average annual rate of 9.7% while motorcars (gasoline) was increasing at 11.7%.

7.11.3 Energy Consumption in the Road Transport Sector

The energy consumption for each vehicle type was calculated by using the matrix of annual distance travelled and unit consumption data setup as shown below in table 7.11.3. As explained earlier, these technical figures were assembled through a limited survey in KL/PJ area and other existing studies.

The fuel consumption figures calculated with this matrix produced quite good consistency when compared to the national energy balance with respect to motor gasoline. However, the calculation results for diesel differs substantially from the national energy balance figures. The calculated figures are consistently higher with a difference of +94% for 1987. This result poses a problem implying either

i) hypothesis used for diesel vehicles is largely wrong or
ii) the energy balance figures are erroneous.

It is the team's opinion that both the hypothesis and energy balance are both erroneous but was not able to quantify the discrepancies. The energy balance is believed to undercount the diesel consumption for the transport sector as the consumption in transport for the industrial sector is difficult to estimate and extract. This is one area where more investigation is required.

Based on the analysis done in this project, the motor gasoline consumption reached 3198 Mliter in 1987 from a figure of 1281 Mliter in 1978, representing an average annual growth rate of 10.7%. The diesel consumption growth rate was calculated to be 11.5% for the same period. The energy balance final consumption figures (excluding railways consumption) grew from 805 Mliters in 1978 to 1380 Mliters in 1987, an average growth of 6.2% per annum. Motorcycles accounts for 35% and cars(gasoline), 50% of the totalgasoline consumption.

7.11.4 Technico - Economic Analysis of the Road Transport Sector

Further analysis based on the Central Consultant's recommendations were conducted in an attempt to provide better insight into Malaysia's road transport sector.

7.11.4.1 Equivalent Vehicles Analysis

Based on the matrix of annual distance travelled and unit energy consumption figures as presented in table 7.11.3 the structural change in the road fleet was further investigated with the "equivalent vehicle concept". The "coefficients" calculated in this case is actually only valid for 1988 as the data was acquired through the 1988 service station survey. Calculation of time-series in terms of equivalent vehicles implies that these coefficients remain stable over time. This approximation may be considered acceptable if the mileage remains stable over the period (or change in the same proportion for all vehicles) and if technical progress (in terms of fuel economy of the vehicles in km/l) is of the same order of magnitude for all vehicle types. This assumption may still be valid if we consider long term trends but would prove inaccurate to explain short term variations since mileage may change substantially with fluctuations of income and fuel prices. Firstly, for motor gasoline vehicles, the motorcar (gasoline) was chosen as the reference vehicle. Based on this, the "equivalent car" for the other gasoline driven vehicles were calculated and an "equivalent-car" fleet was constructed in time series 1978 - 1987.

Table 7.11.4

FLEET OF MOTOR GASOLINE VEHICLES, EQUIVALENT CAR AND UNIT COMSUPTION

YEAR	CARS (1)&(2)	MOTORCY (1)	MOTORCY (2)	SM TRUCK (1)	SM TRUCK (2)	TOTAL (1)	TOTAL (2)	MOGAS SALES MLITRE	UNIT CONSUMPTION KLITER/VEH/YEAR (1)	(2)	INDEX FLEET	INDEX EQ.CAR
1978	437736	939984	359406	54315	119813	1432036	916955	1333	0.93	1.45	100	100
1979	545131	1030257	393922	58087	128132	1633475	067185	1554	0.95	1.46	102	100
1980	669608	1211573	463249	65781	145105	1946963	1277962	1739	0.89	1.36	96	94
1981	746514	1345075	514293	71402	157503	2162991	1418311	1884	0.87	1.33	94	91
1982	828823	1508977	576962	76901	169635	2414701	1575420	2025	0.84	1.29	90	88
1983	920017	1690883	646514	84243	185829	2695143	1752360	2317	0.86	1.32	92	91
1984	1015982	1856115	709691	92760	204618	2964857	19309291	2539	0.86	1.32	92	91
1985	1090002	2000648	764954	102975	227150	3193624	2082015	2761	0.86	1.33	93	91
1986	1145797	2103507	804282	110139	242953	3359442	2193031	2902	0.86	1.32	93	91
1987	1187083	2167615	828794	111520	245999	3466217	2261876	3052	0.88	1.35	95	93

(1) Operational fleet
(2) Equivalent car

Table 7.11.4 above shows a decrease in unit consumption in kliter/veh/year from 1978/79 to 1980 where it remain largely stable to 1987. This result implies that there is no or very little structural change/shift in the composition of the motor gasoline fleet over the period as well as negligible changes in the overall efficiency of the fleet. Details of calculations are shown in the annexes to this chapter.

The heavy truck was chosen as the reference vehicle for diesel-using road vehicles as the information on its unit consumption and annual mileage data was more reliable (taken from the Ministry of Transport's Axle load study). The resulting 'equivalent trucks' fleet is show in table 7.11.5 below.

Table 7.12.5

FLEET OF DIESEL VEHICLE, EQUIVALENT. HV. TRUCK AND UNIT CONSUMPTION

	HV TRUCK	BUS	BUS	SM TRUCK	SM TRUCK	MD TRUCK	MD TRUCK	CARS	CARS	TOTAL	TOTAL	DIESEL SALE MLITRE	UNIT CONSUMPTION KLITRE/VEH/YEAR		INDEX	INDEX
	(1)&(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)		(1)	(2)	(1)	(1)
YEAR																
1978	2453	8342	4285	31884	5817	14721	8401	23211	1973	72721	22929	805.41	10.78	35.13	100	100
1979	4417	8747	4492	33640	6138	16472	9400	27439	2332	86386	26780	862.90	9.99	32.22	93	92
1980	6165	10928	5613	37223	6792	19101	10901	30312	2576	98966	32047	935.04	9.63	29.74	89	85
1981	7582	11300	5804	39606	7226	20379	11630	30494	2592	105643	34835	1012.77	9.59	29.07	89	83
1982	8281	12392	6365	43247	7891	21703	12385	32029	2722	113541	37644	1059.97	9.34	28.16	87	80
1983	9633	13209	6785	45755	8348	22844	13037	33128	2816	120992	40619	1252.98	10.36	30.85	96	88
1984	10987	14483	7439	48310	8815	24424	13939	34718	2951	129426	44130	1171.30	9.05	26.54	84	76
1985	12013	15044	7727	52441	9568	26549	14638	36085	3067	138201	47013	1166.89	8.44	24.82	78	71
1986	12936	16012	8244	53992	9851	27793	15861	37458	3184	145115	50057	1283.30	8.84	25.64	82	73
1987	14608	17091	8778	52688	9613	30074	17163	37798	3213	149777	53375	1380.47	9.22	25.86	86	74

* (1) = Operational Fleet
(2) = Equivalent Truck

There appears to be a general trend in decreasing unit consumption as can be seen from the time series index for the fleet as well as 'equivalent trucks'. The index for the fleet showed a decline of unit consumption of about 15% for the period 1978 to 1987. The "equivalent truck" index, however, showed a more rapid decrease of an approximate total of 25% for the same period. This indicate that there is some structural change in the diesel of road fleet. An analysis of the index as shown in table 7.12.6 below indicates that the variation in efficiency fuel consumption due to change in composition of the fleet of diesel vehicles is about 15% over the that period.

A possible explanation could be that there is some fleet renewal but it is hard to say in quantitative terms. The share of heavy trucks was about 3% in 1978 and has increased to approximately 10% in 1987, an average growth rate of almost 22% per annum over the period. Meantime, the dominant small trucks category has decrease from a share of about 43% to 35% with an average growth rate of only 6% over the period. The other dominant vehicle type medium truck, maintained a share of about 20% through 1978 to 1987 with a growth rate of about 8% per annum. In can be inferred that the growing share of heavy trucks has brought about a newer fleet and plays a role in increasing the overall efficiency of the diesel road fleet as a newer fleet means the introduction of newer and more fuel efficient technology to the fleet.

Table 7.11.6

STRUCTURAL CHANGE IN DIESEL ROAD FLEET

YEAR	UNIT CONSUMPTION KLITER/VEH/YEAR		ICUt INDEX	ICUeg INDEX	ICUs
	FLEET	EQUIV. TRUCK	(FLEET)	(EQUIV HV TRUCKS)	
1978	10.8	35.1	100	100	100
1979	10.0	32.2	92.7	91.7	101.0
1980	9.6	29.7	89.3	84.7	105.5
1981	9.6	29.1	88.9	82.8	107.5
1982	9.3	28.2	86.6	80.2	108.0
1983	10.4	30.8	96.1	87.8	109.4
1984	9.0	26.5	84.0	75.6	111.1
1985	8.4	24.8	78.3	70.7	110.9
1986	8.8	25.6	82.0	73.0	112.4

ICUt = ICUeg x ICUs

7.11.4.2 Ratio of Number of Vehicles to Private Expenditure (Constant 1978 Ringgit)

The above ratio was calculated for the period 1978 to 1987 using the derived operational road fleet. This was done for the total Malaysian case only. The table below presents a summary of the calculations.

Table 7.11.7

Ratio of Number of Vehicles to Private Expenditure (Vehicles/Million Ringgit)

YEAR	Motorcycle Mogas	Cars Mogas	SM Trucks Mogas	SM Trucks Diesel	Total Mogas	Total Diesel	Total
1978	48.0	22.4	2.8	1.6	73.5	5.8	79.3
1979	47.5	25.1	2.7	1.6	75.7	5.8	81.6
1980	49.6	27.4	2.7	1.5	80.2	6.2	86.4
1981	32.4	29.1	2.8	1.5	84.9	6.8	91.7
1982	56.9	31.2	2.9	1.6	91.7	7.2	99.0
1983	61.8	33.6	3.1	1.7	99.2	7.6	106.8
1984	63.7	34.9	3.2	1.7	102.5	7.7	110.2
1985	68.3	37.2	3.5	1.8	109.8	8.0	117.8
1986	79.8	43.5	4.2	2.0	128.3	9.3	137.6
1987	80.1	43.9	4.1	3.9	129.1	9.3	138.4

The ratios showed a steady increase for the period 1978 - 1987 for the major vehicle types.

This is especially so for the motorcycles and cars which showed a rapid increase in this ratio at an average annual rate of 5.8% and 7.8% respectively. The ratios calculated for the other vehicle types showed relatively less changes over the same period. On a global basis, the ratio for gasoline vehicles has increased at an average annual rate of 6.5% and the equivalent figure for diesel vehicles was 5.3%, while the growth rate for the total is 6.4%.

7.11.4.3 Number of Vehicles per Household

The table below summarises the calculation of above ratio for the different vehicle types.

This ratio indicated that there has been a steady growth in vehicle ownership with a more rapid increase in the late 70's to the middle 80's. The rate of growth in ownership seems to have tapered off somewhat the last couple of years indicating that the level of ownership might be reaching some plateau.

Table 7.11.8 below presents the elasticity analysis of the road fleet

Table 7.11.8

ANNUAL GROWTH RATE AND ELASTICITY OF MALAYSIA'S ROAD FLEET

	GROTH RATES		ELASTICITIES *				
YEAR	PRIVATE * * EXPENDITURE	MOGAS FLEET	DIESEL FLEET	TOTAL FLEET	FLEET/EXP MOGAS	FLEET/EXP DIESEL	FLEET TOTAL
1978							
1979	10.8	14.1	11.9	14.0	1.3	1.1	1.3
1980	12.7	19.3	19.8	19.3	1.5	1.8	1.8
1981	5.1	11.3	14.7	11.6	2.2	1.4	1.1
1982	3.3	11.6	10.0	11.5	3.5	0.9	1.1
1983	3.2	11.6	8.1	11.3	3.6	0.7	1.0
1984	6.5	10.0	8.1	9.8	1.5	0.8	0.9
1985	0.5	7.7	5.4	3.5	14.3	0.5	0.7
1986	-10.0	5.2	4.4	5.1	-0.5	-0.4	-0.5
1987	2.6	3.3	2.4	3.1	1.2	0.2	0.3
1978-80	11.7	16.7	15.8	16.6	1.4	1.4	1.4
1980-85	3.7	10.4	9.2	10.3	2.8	2.5	2.8
1985-87	1.0	4.2	3.4	4.2	4.4	3.5	4.3
1980-87	1.5	8.6	7.5	5.9	5.9	5.2	5.6

Note :

* Elasticities calcuted for fleet and private expenditure

* * private expenditure growth rate in constant term.

Due to the rather short time series, it is difficult to conclude on any trends fromthe elasticity analysis. This problem is compounded by the recession in 1985. There seems to be a decreasing trend in the annual figures but the elasticities for the different periods imply a different story. Disaggregated to gasoline and diesel vehicles, the same trend is seen especially for the diesel fleet. The gasoline fleet shows some fluctuations in 1985 due to the economic recession when Malaysia experienced a negative 1% growth in GDP. Disaggregating further, the elasticities for the major vehicle types versus private expenditure was calculated and shown in table 9 below:-

Table 7.11.9

ANNUAL GROWTH RATE AND ELASTICITIES

	GRW RATE MOTORCY MOGAS ROAD	GRW RATE CAR MOGAS ROAD	GRW RATE CAR DIESEL ROAD	GRW RATE CAR TOTAL ROAD	GRW RATE PRI.EXP	ELAST MOTORCY MOGAS ROAD	ELAST CAR MOGAS ROAD	ELAST CAR DIESEL ROAD	ELAST CAR TOTAL ROAD
1978									
1979	9.6	24.5	18.2	24.2	10.8	0.9	2.3	1.7	2.2
1980	17.6	22.8	10.5	22.2	12.7	1.4	1.8	0.8	1.8
1981	11.0	11.5	0.6	11.0	5.1	2.2	2.3	0.1	2.2
1982	12.2	11.0	5.0	10.8	3.3	3.7	3.4	1.5	3.3
1983	12.1	11.0	3.4	10.7	3.2	3.8	3.5	1.1	3.4
1984	9.8	10.4	4.8	10.2	6.5	1.5	1.6	0.7	1.6
1985	7.8	7.3	3.9	7.2	0.5	14.5	13.5	7.3	13.3
1986	5.1	5.1	3.8	5.1	-10.0	-0.5	-0.5	-0.4	-0.5
1987	3.0	3.6	0.9	3.5	2.6	1.2	1.4	0.3	1.4
78-80	13.5	23.7	14.3	23.2		1.2	2.0	1.2	2.0
80-85	10.2	10.2	3.5	10.0		2.9	2.8	0.9	0.8
85-87	4.6	4.6	2.3	4.3		4.1	4.6	2.3	1.0
80-87	8.5	8.5	3.2	8.3		5.8	5.7	1.6	5.5

Table 7.11.10 :

Ratio of Number of Vehicles to Number of Households (Vehicle/Number of Households)

YEAR	MOTORCYCLES MOGAS	CAR MOGAS	TOTAL MOGAS	TOTAL DIESEL	TOTAL
1978	0.38	0.18	0.58	0.05	0.63
1979	0.40	0.21	0.64	0.05	0.69
1980	0.46	0.25	0.74	0.06	0.80
1981	0.49	0.27	0.79	0.06	0.85
1982	0.52	0.29	0.84	0.07	0.91
1983	0.56	0.30	0.90	0.07	0.97
1984	0.89	0.32	0.95	0.07	1.03
1985	0.63	0.34	1.01	0.07	1.08
1986	0.64	0.35	1.02	0.07	1.10
1987	0.64	0.35	1.03	0.07	1.10

This ratio indicated that there has been a steady growth in vehicle ownship with a more rapid increase in the late 70's to the middle 80's. The rate of growth in owmship seem to have tapered off somewhat the last couple of years indicating that the level of owmship migh be reaching some plateau.

7.11.4.4 Sectoral Account for Road Transport - 1987

A sectoral account was set up for the year 1987 with vehicle type and regional split. The sectoral account list 16 vehicle types disaggregated by the following regional basis where possible:-

- Peninsular Malaysia
- Kuala Lumpur (the Capital City of Malaysia in Peninsular Malaysia)
- Sarawak (a State in Borneo Island)
- Sabah (a State in Borneo Island)
- Total Malaysia.

The sectoral account for 1987 put the total energy consumption for the road transport sector at 3265 KTOE (262 PJ) for the whole of Malaysia. The breakdown of this consumption by regions are:-

	KTOE	PJ	% Share of fuel consumption	% Share of fleet
- Peninsular Malaysia	2231	217	68.3	89.4
- Kuala Lumpur	349	135	10.7	7.5
- Sarawak	277	132	8.5	5.8
- Sabah	266	262	8.1	3.5

The results shown above are only an indication of the share of energy consumption by the regional dis-aggregations. A split of the fleet by regions for some vehicle types are not available but fortunately these fall into the minority share vehicle types.

For motorcycles, the split by regions is as below:-

	KTOE	PJ	% SHARE OF FUEL CONSUMPTION	% SHARE OF FLEET
Peninsular Malaysia	786	35	94.2	94.2
Kuala Lumpur	45	2	5.4	5.4
Sarawak	41	2	4.9	5.0
Sabah	7	0	~ 1.0	~1.0

For cars (gasoline and diesel), the split by regions is as below:-

	KTOE	PJ	% SHARE OF FUEL CONSUMPTION	% SHARE OF FLEET
Peninsular Malaysia	1070	47	84.3%	84.4
Kuala Lumpur	141	6	11.1%	11.3
Sarawak	95	4	7.5%	7.5
Sabah	104	5	8.2%	8.1

Above tables shows that the Peninsula is by far the major consumer of energy in the road transport sector and that Kuala Lumpur alone has about the same level of energy consumption as either of the East Malaysian States of Sarawak and Sabah. This is also reflected by the share of the fleet by regions. About 82% of Malaysia's population lives in the Peninsula and with its relatively much better road network systems, road transport plays a vital role in the Peninsula and will continue to play a very important part in the near future. With this in mind, the progress of the road transport in the Peninsula bears close watching.

7.12 RAIL TRANSPORT ENERGY DEMAND

7.12.1 Data base

Data was mainly sourced from the following:-

- Ministry of Transport
- Malayan Railways

The year books from above agencies were used extensively and further data was collected via direct enquires.

The following was compiled in time series:-

- o Track (km)
- o Traffic - freight (KTON)
- o Traffic - passengers (KPersons)
- o Traffic - freight (MTKN)
- o Traffic - passengers (MPKM)
- o Fuel Consumption - Diesel (KLiter)

Diesel is the only fuel used by railways in the Peninsula and Sabah.

Time series 1975-1987 of above was available for the Peninsula while Sabah's data was only available for the period 1976-1985.

7.12.2 Past Evolution Analysis

Analysis was done within the framework of the P-1.1 project utilising the DBA/VOID package. A simple model was made linking to the database in DBA/VOID. This model essentially calculates from the primary data input, the following:-

- o Gross ton km hauled (freight and passenger)
- o Percentage share in freight and passenger traffic
- o Fuel consumption share for freight and passenger traffic
- o Intensity ratios GOE/TKM, GOE/GTKH
- o Unit consumption and activity effects

Details are presented in the annexes to this chapter.

7.12.2.1 Traffic

The passenger traffic has been increasing for the period 1975-1987, growing at an average rate of 2.9% per annum. Meanwhile the freight traffic has been growing at approximately 2.6% per annum. In terms of number of passengers carried, there has been an average growth of only 0.6% per annum and in terms of tonnage hauled, a decrease was recorded of about 5%. These figures reflect in a way the crisis within the rail transport sector in Malaysia where the Government has shown concern and taken steps to improve performance.

Gross ton km hauled data was calculated by hypothesis, using standard ratios as below:-

o Freight $$\frac{\text{Gross ton km hauled}}{\text{MTKM}} = 2.5$$

o Passenger $$\frac{\text{Gross ton km hauled}}{\text{MPKM}} = 0.8$$

A time series for GTKH was thus generated and presented in the annexes. The results showed that 70% of the rail traffic is for freight with passenger traffic accounting for the balance of 30%. This result is pausible as freight is usually more important in the rail transportation sector. In terms of growth, total rail traffic in GTKH has been increasing at about 2.7% per annum with freight growing at about 2.6% per annum and passengers at 2.9%.

Figure 7.12.1

Total Malaysia - Passenger
Activity & Unit Comsumption

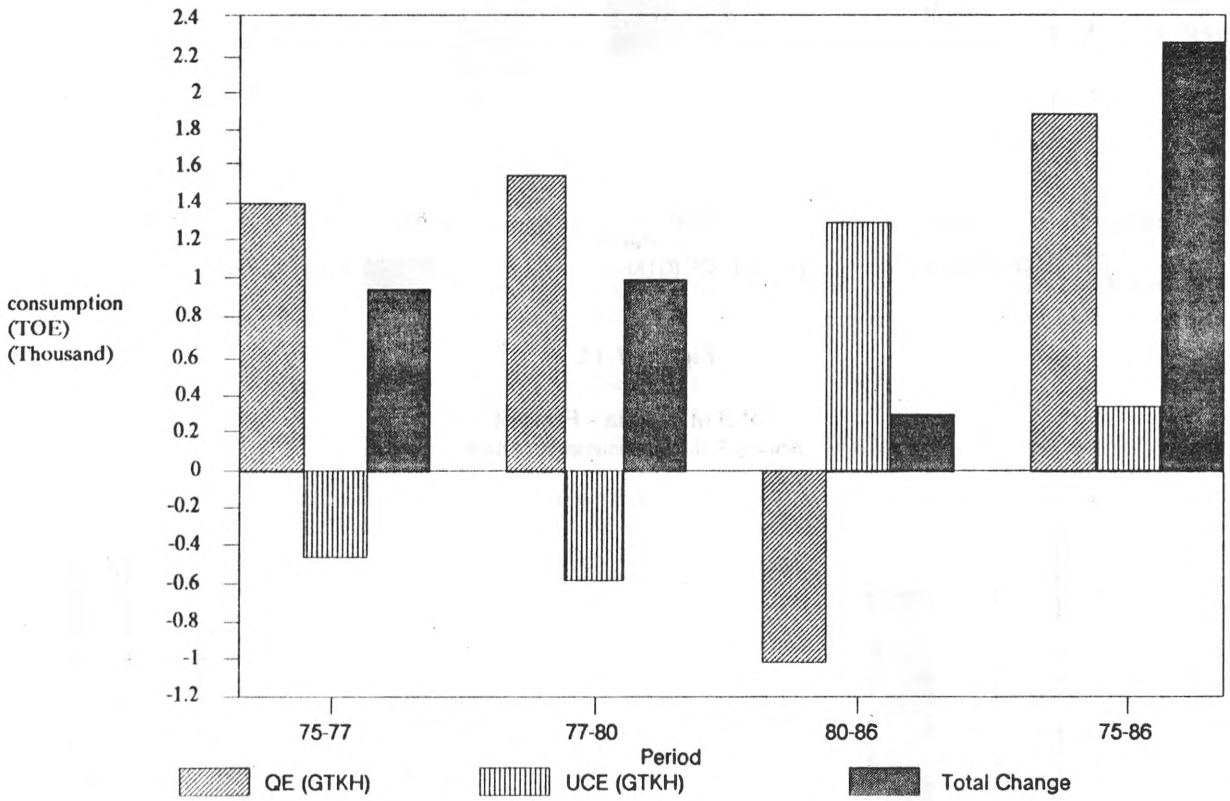


Figure 7.12.2

Total Malaysia - Freight
Activity & Unit Comsumption Effect

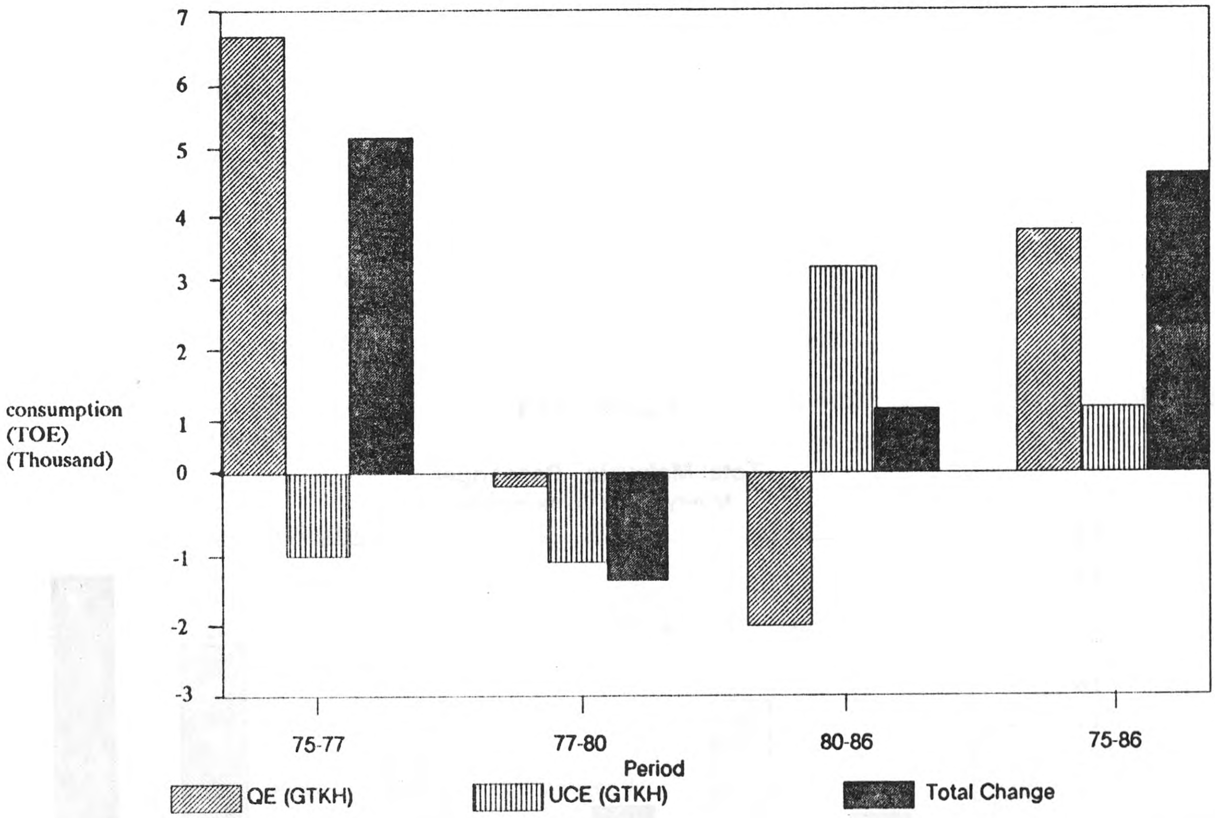
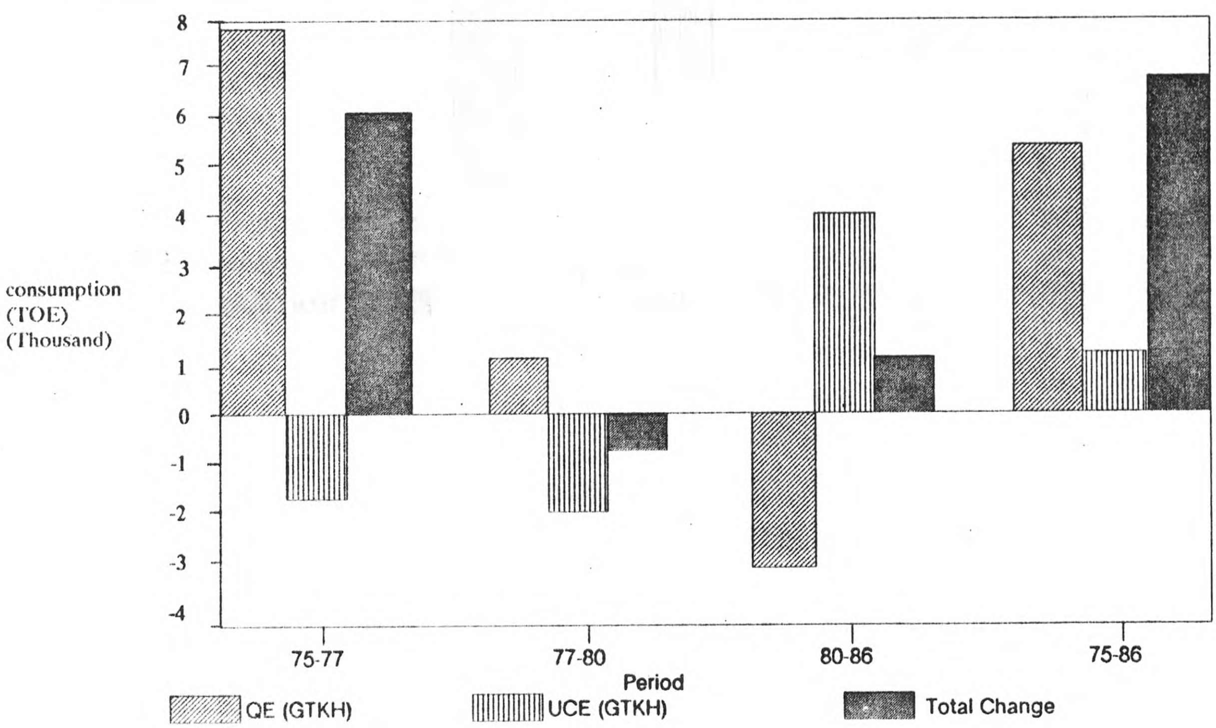


Figure 7.12.3

Total Malaysia - Freight
Activity & Unit Comsumption Effect



7.12.2.2 Energy Consumption

Diesel is the sole fuel used in rail transport in Malaysia. Diesel consumption has grown from 22,918 kliter (19 KTOE) in 1975 to 32,558 kliter (27 KTOE) representing a growth rate of approximately 3% per annum. The split of fuel consumption between freight and passenger was done via traffic share (that is via GTKH share). This hypothesis would then split the energy consumption similarly, that is at 70% and 30% for freight and passenger respectively.

7.13.2.4 Unit Consumption and Activity Effects

Unit consumption and activity effect was also calculated to gain further insight into the railways sector performance. Figures 7.12.1 to 7.12.3 presents the result of the analysis.

The results showed that the increase in energy consumption for the period under analysis (1975 - 1987), is largely due to increased activity with a much smaller increase in unit consumption. There is a slight difference when these effects are analysed for freight and passenger traffic, for period 1977 to 1980. Freight showed an increase during this period (1977 - 1980) with a decrease in unit consumption which, overall resulted in a decrease in fuel consumption. However, the passenger sector showed a similar increase in activity with a relatively smaller unit consumption improvement, resulting in an increase in fuel consumption. It is difficult to explain these trends especially so coupled by the poor peformance of the Malayan Railways. Economic, financial as well as management factors have different impacts on the whole railway transport sector and without going into detail management analysis, it is quite impossible to explain fully the trends seen in this analysis.

7.12.2.5 Energy Intensities

Energy consumption per unit traffic was calculated from the fuel consumption share described above.

For freight transport, GOE/TKM has shown a slight increase over the period studied with a reduction in 1978 to 1981. This trend is similar for the GOE/PKM. Details are shown in Table 7.12.1 below.

Table 7.12.1

Energy Intensities GOE/TKM & GOE/PKM

Year	GOE/TKM	GOE/PKM
1975	16.8	5.4
1976	16.3	5.2
1977	15.7	5.0
1978	14.8	4.7
1979	14.2	4.6
1980	14.6	4.7
1981	14.8	4.7
1982	15.3	4.9
1983	16.3	5.2
1984	17.1	5.5
1985	17.4	5.6
1986	17.6	5.7
1987	17.4	5.5

In terms of GOE/GTKH, the intensity also display the same trend with the ratio remaining largely stable except for some years in the middle of the period.

Table 7.12.2

GOE/GTKH - MALAYSIA

YEAR	GOE/GTKH
1975	6.7
1976	6.5
1977	6.3
1978	5.9
1979	5.7
1980	5.8
1981	5.9
1982	6.1
1983	6.5
1984	6.8
1985	6.9
1986	7.0
1987	6.9

Taken as a whole, the energy intensities appear to remain stable over the period 1975 - 1987.

7.13 AIR TRANSPORT

7.13.1 Past Data (1975-1987)

Collection and assembling of existing data for the period 1975-1987 on air transport with respect to energy consumption was conducted within the REDP P-I.I project. The data collected from various sources were compiled in time series (1975 - 1987) as follows:-

(i) Annual Yearbook of Transport Statistics published by the Ministry of Transport. Data available were as follows:-

a) passenger embark and disembark (Kpersons)
b) passenger international (Kpersons)
c) passenger domestic (Kpersons)

(ii) MAS Annual Report. Data available were as follows:-

a) total passengers carried by MAS (Kpersons)
b) passenger traffic (MPKM)
c) load factor (percent)
d) freight traffic (MTKM)
e) Revenue flown hours (MRINGGIT)
f) capacity in terms of ton. km (MTKM), seat.km (KSEATKM)

(iii) Data collected from MAS were as follows:-

a) MAS total jet fuel consumption (KTOE)
B) Jet fuel purchase in Malaysia (KTOE)
c) Jet fuel purchase outside Malaysia(KTOE)
d) Fleet of MAS airplanes

(iv) Other data were also obtained from the technical report done by Ministry of Transport.

7.13.2 Passenger and Freight Traffic

Total passenger and freight traffic for Malaysia is as shown in the table below.

Table 7.13.1:

Air Transport Traffic

YEAR	MPKM TRAFFIC PASS AIR JET FUEL	MTKM TRAFFIC FREIGHT AIR JET FUEL
1976	1869.214	40.723
1977	2170.665	56.866
1978	2459.516	82.028
1979	3061. 89	86.609
1980	4206.004	119.801
1981	4810.862	140.328
1982	5588.615	151.278
1983	5624.476	186.249
1984	6134.053	203.437
1985	6195.474	220.516
1986	6589. 99	298.832
1987	7828.266	363.966

Pasenger traffic accounted for 1.869 million in 1976 and increased to 7.828 million in 1987 registering an average annual growth rate of 13%. Freight traffic increased from 40.7 million ton in 1976 to 364.0 million ton in 1987 representing an average annual increase of 21%.

7.13.2 (a) Passenger Traffic (Domestic)

Passenger traffic for Malaysia (excluding Singapore) accounted for 3.4 million passenger in 1985. In absolute terms, traffic for Malaysia increased from 1.3 million in 1975 to 3.4 million in 1985, representing an average annual rate of increase is 10.9% as shown in the table below:-

Table 7.13.2:

AIR PASSENGER TRAFFIC FOR MALAYSIA 1975 - 1985

YEAR	(MPKM) ACTUAL MAS TRAFFIC	(%) AVERAGE ANNUAL GROWTH RATE
1975	1345.987	-
1976	1407.984	4.4
1977	1451.909	3.0
1978	1594.027	8.9
1979	1939.347	17.8
1980	2446.655	20.1
1981	2950.828	17.1
1982	3034.236	2.7
1983	3121.939	2.8
1984	3414.451	8.6
1985	3407.247	(0.2)

The highest average annual rate of increase were registered in 1979 and 1980 with 17.8% and 20.1% respectively. However, in the succeeding years the rate of increase was marginal and in 1985 showed a negative growth. This was due to the slowdown in economic activity in 1985 where Malaysia registered a negative GDP.

The major routes for the domestic air traffic are:-

Kuala Lumpur - Singapore
Kuala Lumpur - Penang
Penang - Singapore
Kuala Lumpur - Kota Bharu
Kuala Lumpur - Johore Bharu.

The above routes are the most dense air passenger traffic zones in Malaysia.

7.13.2 (b) **Freight Traffic (Domestic)**

Freight traffic for Malaysia (excluding Singapore) accounted for 26,261 tonnes of freight in 1985. In absolute terms, traffic for Malaysia increased from 10,244 tonnes in 1975 to 26,261 tonnes in 1985, representing an average annual increase of 8.6% over the period 1975-1985 as shown in the table below:-

Table 7.13.3:

AIR PASSENGER TRAFFIC FOR MALAYSIA 1975-1985

YEAR	(MTKM) ACTUAL MAS FREIGHT TRAFFIC	(%) AVERAGE ANNUAL GROWTH RATE
1975	10.244	
1976	13.383	23.6
1977	13.205	(1.3)
1978	13.275	0.5
1979	14.512	8.5
1980	18.120	19.9
1981	19.953	9.2
1982	21.305	6.3
1983	24.777	14.0
1984	26.437	6.3
1985	26.261	(0.7)

The major routes for the domestic freight traffic are similar to the passenger traffic.

7.13.3 Jet Fuel Consumption

The jet fuel consumption for Malaysia is compiled fromthe Energy Balance for the years 1978-1987 as shown below:-

Table 7.13.4:

Jetfuel Consumption

YEAR	TOTAL CONSUMPTION JETFUEL (KTOE)	ANNUAL GROWTH RATE (%)
1978	209	-
1979	202	-3.0
1980	250	+23.0
1981	279	+11.6
1982	342	+22.6
1983	335	-2.0
1984	368	+9.9
1985	386	+4.9
1986	427	+10.6
1987	434	+1.6

Total jet fuel consumption for Malaysia registered a drop of 3% and 2% in 1979 and 1983 respectively. For the other years, the jet fuel consumption showed an increase with the highest annual growth of 22.6% registered in 1982. Overall, the consumption has grown from 209 KTOE to 434 KTOE, increasing more than double the consumption for the period 1978-1987 with an average annual rate of increase at 6%.

It is to be noted that the jet fuel consumption taken from the Energy Balance did not include MAS refuelling outside the country.

7.13.4 Jet Fuel Consumption for MAS

The jet fuel consumption for the national carrier is compiled from MAS over the same period. Breakdown of purchase in Malaysia and outside Malaysia is as shown below:-

Table 7.13.5:

MAS Fuel Consumption

YEAR	KTOE CONSUMP MAS-TOTAL AIR JET FUEL	KTOE CONSUMP MAS-INT AIR JET FUEL	PERCENT SHARE MAS-INT AIR JET FUEL	KTOE CONSUMP MAS-DOM AIR JET FUEL	PERCENT SHARE MAS-DOM AIR JET FUEL	PERCENT CONSUMP MAS-INT AIR JET FUEL	PERCENT CONSUMP MAS-DOM AIR JET FUEL
1978	209	155	55	93	45	-	-
1979	239	113	47	126	53	-2.1	+34.3
1980	297	124	42	172	58	+9.7	+36.9
1981	325	124	38	200	62	0.0	+16.3
1982	373	192	51	181	49	+53.0	-9.6
1983	378	161	43	217	57	-6.2	+19.9
1984	441	194	44	246	56	+20.0	+13.6
1985	388	163	42	244	8	-15.7	-9.1
1986	427	193	45	233	55	+18.0	+4.2
1087	466	230	49	236	51	+19.1	+1.1

Share of jet fuel purchased by MAS outside Malaysia ranges from 38%-55%, while that for purchase in Malaysia ranges from 45-58%. International purchase of jetfule by MAS registered a drop in 1979, 1983 and 1985 while purchase within the country registered a drop in 1982 and 1985. It can be seen that more than 50% of the MAS fuel purchase is from Malaysia.

7.13.5 Past Trend Analysis.

Analysis was done within the framework of P-1.1 project utilising the DBA/VOID package. A single model was made in Lotus, linking to the database is DBA/VOID. The model calculates from the primary data input the following indicators for air traffic.

INDICATORS FOR TECHO-ECONOMIC ANAYLYSIS

Overall growth of airways traffic	(a)	CONSUMP/ PASS EMBARK AND DISEMBARK
	(b)	PASS EMBARK AND DISEMBARK/GDP
	(c)	CONSUMP/REVENUE FLOWN HOURS
	(d)	CONSUMP/PASS.KM
Growth of MAS	(e)	CONSUMP/TON.KM
	(f)	COMSUMP/TOTAL PASS AND FREIGHT
	(g)	TOTAL TON.KM

Details are presented in the following table below:-

Overall growth of airways traffic

(a) Year	Total Jet Fuel Consumption (KTOE) / Passengers embark and disembark (KPERSON)
1977	0.044
1978	0.036
1979	0.033
1980	0.031
1981	0.037
1982	0.035
1983	0.035
1984	0.038
1985	0.042

The energy consumption to traffic ratio, showed that there is a decreasing trend of 0.044 to 0.031 from 1977 to 1980 which is probably due to the efficent use of energy as well as the growth in passenger traffic over the period. In 1981, the ratio increased, and then remained stable for two succeeding years before increasing.

(b) Year	Passengers embark and disembark (KPERSON) / Gross Domestic Procuct (M10$)
1978	0.125
1979	0.136
1980	0.170
1981	0.238
1982	0.224
1983	0.213
1984	0.275
1985	0.248
1986	0.228

The relationship between economic growth and airways traffic is shown above. An increasing trend was registered from 1978 to 1981 due to the high economic growth in the country.

However, the traffic per GDP ratio decreased in 1982 - 1983. Thereafter, there is a sharp increase in 1984 with the recovery of the Malaysian economy and since then have stabilised.

Growth of MAS

(c) Energy efficiency of MAS

Year	Jet fuel consumption by MAS (KTOE) / Revenue flown hours (Mil$)
1978	0.434
1979	0.347
1980	0.303
1981	0.280
1982	0.289
1983	0.271
1984	0.280
1985	0.291
1986	0.298
1987	0.269

The energy efficiency of MAS has increased as shown by the decreasing trend of the above ratio from 1978 to 1983.

(d)

Year	Jet fuel consumption by MAS (KTOE) / Passenger.km (MPKM)
1978	0.085
1979	0.078
1980	0.071
1981	0.068
1982	0.067
1983	0.067
1984	0.072
1985	0.063
1986	0.065
1987	0.060

The jet fuel consumption ratio showed a decreasing trend for passenger traffic from 1978-1983 as the number of traffic increased each year. However, the ratio increased in 1984 due to the drop in the passanger traffic with the slowdown in economic activity in that year.

(e)

Year	Jet fuel consumption by MAS (KTOE) / Ton. km (MTKM)
1978	2.556
1979	2.765
1980	2.479
1981	2.318
1982	2.468
1983	2.035
1984	2.169
1985	1.761
1986	1.429
1987	1.282

As for freight traffic the ratio fluctuated, registering an increase 1979, 1982, 1984 and thereafter decreasing. However, the energy consumption has decreased significantly for freight traffic by more than half as compared to 1978.

(f) This ratio showed the total passenger and freight traffic carried by MAS. During the period 1978-1987, the consumption to traffic ratio has decreased from 0.670 to 0.424 with increased in passenger and freight traffic, in particular, during the last two years.

Year	Jet fuel consumption by MAS (KTOE) / Total ton. km (MTKM)
1978	0.670
1979	0.649
1980	0.578
1981	0.554
1982	0.557
1983	0.531
1984	0.556
1985	0.483
1986	0.466
1987	0.424

(g) This ratio showed the relationship between GDP and airways traffic (both for passenger and freight)

Year	Total Ton (MTKM) / GDP
1978	0.008
1979	0.009
1980	0.012
1981	0.016
1982	0.016
1983	0.016
1984	0.021
1985	0.019
1986	0.021
1987	0.029

7.13.6 Mas Fleet Status

Year	B747	DC10	A300B	B707	B737	F27	Otter	BN2	Total
1972	-	-	-	-	7	9	-	3	19
1973	-	-	-	1	7	10	-	4	22
1974	-	-	-	3	8	10	-	4	25
1975	-	-	-	3	9	10	-	4	26
1976	-	1	-	3	9	10	-	4	27
1977	-	2	-	3	9	9	-	4	26
1978	-	2	-	3	8	9	-	4	26
1979	-	2	-		9	10	-	4	28
1980	-	3	3	-	10	12	-	4	32
1981	-	3	3	-	11	12	-	4	34
1982	2	3	4	-	10	11	2	4	36
1983	2	3	4	-	10	11	4	-	34
1984	2	3	4	-	10	11	4	-	34
1985	2*	3	4	-	11	11	4	-	35
1986	3**	3	4	-	11	11	4	-	36

* B747-200
** B747-200(2), B747-300(1)

MAS fleet has expanded from a total of 19 aircrafts in 1972 to 36 aircrafts in 1986 as shown above. With the expansion in the fleet with bigger aircrafts as in B747, it is expected that MAS will be able to achieve higher energy consumption efficiency.

CHAPTER8

INDUSTRIAL SECTOR

CHAPTER 8.

INDUSTRIAL SECTOR

8.1. INTRODUCTION

The Industrial sector, for the purpose of the following analysis, comprises the manufacturing, mining and construction sub-sectors. Energy consumption in the industrial sector increased from 13,908 Tcal in 1978 to about 18,414 Tcal in 1985 at an average growth rate of 4.1% per annum.

The largest energy-consuming sub-sector within Industry is Manufacturing which accounted for 64.1% of industrial energy consumption in 1985. The Mining and Construction sub-sectors accounted for 17.3% and 18.6% (respectively) of industrial energy consumption in 1985.

The major fuels consumed in Industry are diesel oil, fuel oil and electricity which accounted for 44.2%, 20.4% and 20.2% respectively of industrial energy consumption in 1985. Charcoal consumption is significant only in the Basic Metal Industries sub-sector. Manufacturing had a share of 23.9 % in GDP while mining and construction contributed 12.7 % and 5.8 % respectively to GDP in 1985.

The analysis of industrial energy demand was based mainly on survey data from the Department of Statistics. It was decided that it would be neither worthwhile nor beneficial to carry out projections due to the large discrepancies that existed in the energy data base.

8.2. DATA AVAILABILITY

In order to derive energy coefficients, several observations on time series data on industrial energy consumption and output or value added should be made. The reliability of the coefficients obviously improves as the number of observations increases.

Industrial output and value added data is available on a yearly basis. The analysis carried out for the industrial sector was based on on value added data which had been converted to constant 1978 prices. However energy consumption data is available only for certain years. Data on energy products purchased by industrial sub-sectors (at 5 digit level) is available from the Department of Statistics based on their manufacturing establishment surveys. Surveys were carried out for the years 1978, 1979, 1983 and 1985. Data compiled in the survey forms included energy purchased by product and electricity generation within the establishment. Energy purchased by product was available both in actual quantities and in monetary value for petroleum products, charcoal, fuelwood, coal and electricity. Natural gas consumption was available only in monetary value.

Data on energy purchased by industrial establishments was given in original units such as barrels for petroleum products, litres for Lpg, kilograms for charcoal and firewood and kwhs for electricity. All data was converted to Teracalories.

Energy consumption in an industrial establishment is determined by the level of production and the process adopted. The level of consumption per unit output and the types of energy required are determined by facilities installed in the site and the technology of the production process. Such information can only be obtained through a detailed survey on energy consumption by production process and by temperature range.

A survey to gauge the pattern of energy use in industrial establishments was launched but the response could hardly be described as encouraging.

Two hundred survey forms were dispatched to manufacturing establishments which were selected based on either energy consumption levels or amount of value added. 30 forms were returned of which only about half were fully completed making it difficult to derive any energy coefficient figures which could be considered representative of the sub-sectors.

8.3. DATA DISCREPANCIES

It was found that value added figures for industrial sub-sectors contained in the national accounts were different from those obtained from Industrial establishments surveys compiled by Department of Statistics. It was decided to use the latter as data on energy purchased by industrial establishment was available from the same survey forms.

In some cases, it was possible to cross-check value added data with production of major products of a particular sub-sector as well as the unit price of the product.

In a few sub-sectors where energy data appeared to be unrealistic and could not be explained by variations in value added, simple interpolation was carried out based on the average-growth rate over the period of analysis. Generally however when both energy consumption and value added data were analysed together, the energy coefficients were found to be fairly comparable over analysis period.

8.4. STRUCTURAL SHIFT

As apparent in Table 8.1, value added of the industrial sector over the analysis period increased at about 7.5% per annum. Contribution to value added from the construction sector remained at about 15% throughout this period. The share of the manufacturing sector in value added increased from 47.8% in 1978 to 49.9% in 1985, while that of the mining sector declined from 37.2% in 1978 to 34.4% in 1985 mainly due to the sluggish tin-mining industry.

Table 8.1:

Structural Shift in the Industrial Sector,VA(M$), %

Year	Sub-Sector (ISIC)	Mining (2)	Manufacturing (3)	Contruction (5)	Total (M$)
1978		3912 (37.2)	5015 (47.8)	1572 (15.0)	10499
1979		4586 (37.1)	6020 (48.7)	1761 (14.2)	12367
1983		5342 (34.0)	7780 (49.5)	2598 (16.5)	15720
1985		5985 (34.4)	8679 (49.9)	2738 (15.7)	17402

N.B. 'M' denotes million

As shown in the following Table 8.2 the value added of the manufacturing sector has risen by 73 % during the period of analysis from 5015 M.Ringgit in 1978 to 8679 M.Ringgit in 1985. Major contributors to value added are the manufacture of food, beverage and tobacco subsector - ISIC 31, manufacture of chemicals and of chemical, petroleum, coal, rubber and plastic .

products ISIC 35 and the manufacture of fabricated metal products, machinery and equipment ISIC 38. The remaining sub-sectors contributed only (30 - 40)% of the the total value added. It appears that no major changes have taken place in the manufacture of food, beverage and tobacco subsector and manufacture of chemicals and of chemicals, petroleum, coal, rubber and plastic products subsector whilst minor changes have taken place in the manufacture of non-metallic mineral products subsector ISIC 36 and in the basic metal industries ISIC 37. Major changes have taken place in the textile, wearing apparel and leather industries ISIC 32, manufacture of wood, wood products including furniture subsector ISIC 33 and the manufacture of fabricated metal products, machinery and equipment ISIC 38. While textile, wearing apparel and leather industries and the manufacture of wood, wood products including furniture contributed only (5 - 9)% and (6 - 11)% respectively to sectoral value added, the manufacture of fabricated metal products, machinery and equipment accounted for (22 - 26) % of value added. Sectoral shift at the 5 digit level is dealt with under the individual sub-sector write-up.

Table 8.2:

Structural Shift in the Manufacturing Sub-Sector, %

Year/ISIC	31	32	33	34	35	36	37	38	39	3	VA
1978	21.8	8.5	11.0	5.0	22.0	5.4	3.3	22.4	0.6	1.0	5015
1979	24.5	7.5	10.6	4.5	21.6	4.7	2.5	23.7	0.6	1.0	6020
1983	21.2	5.6	8.4	5.4	21.1	6.7	4.3	26.4	0.9	1.0	7780
1985	21.7	5.1	6.4	5.3	23.9	7.0	3.9	25.9	0.8	1.0	8679

8.5. ENERGY INTENSITY

The energy intensity for the contruction sector is given in Table 8.2.1.

Table 8.2.1:

Energy Intensity for the Construction Sector1978 - 1985

Year	Tcal	GDP(CONSTANT '78) (M$)	Coefficients (Tcal/Mil. M$)
1978	1952	1,572	1.242
1979	1902	1,761	1.080
1981	2567	2,367	1.084
1982	2955	2,598	1.137
1983	3321	2,867	1.158
1985	3428	2,738	1.252

The energy intensity for the period 1979 - 1983 were relatively stable. The increase of 8.3% of the 1985 coefficient compared to the coefficient for 1983 can be interpreted as a result of increase in civil engineering construction by 7.1% in 1985 compared to 1983 which is more energy intensive compared to other type of activities in construction sector. However, energy coefficient, for the period 1978 to 1985 were still quite stable.

Energy Coefficient for mining sector is represented in Table 8.2.2. As shown in this table, the energy coefficient decreased significantly by 56% from 1.206 in 1978 to 0.531 in 1985. This due mainly to the drop in tin production from 62,700 tonnes in 1978 to only 36,900 tonnes in 1985, which is more energy intensive compared to the other minerals mining activities.

Table 8.2.2:

Energy Coefficient of Mining Sector

Year	Tcal	GDP-Cons.78 ($'000)	Coefficients (Tcal/$'000)
1978	4720	3,912	1.206
1979	4658	4,586	0.984
1980	4353	4,487	1.031
1981	4701	4,289	0.912
1982	4696	4,617	1.017
1983	3601	5,342	0.674
1985	3177	5,985	0.531

As shown in the Table 8.2.3 energy intensity of the manufacturing sector has declined from 1.443 Tcal/M$ in 1978 to 1.360 Tcal/M$ in 1985 . Since no major structural change took place this may. indicating that energy conservation, fuel substitution and production efficiency techniques have been gradually introduced. Fossil fuel intensity declined by 15 % whilst electricity intensity declined by 37 % over the same period indicating that electicity utilising processes have become more efficient.

Table 8.2.3:

Energy Intensity of Manufacturing Sector (V.AConstant 1978 prices)

	1978	1979	1983	1985
E/VA	1.443	1.298	1.370	1.360
FF/VA	1.205	0.942	0.773	1.020
EL/VA	0.464	0.414	0.375	0.291
VA (1,000M$)	5015	6020	7780	8679
E (Tcal)	7236	7815	10656	11806

8.6. OTHER INDICATORS

As shown in Table 8.2.4, Energy/GDP Elasticity increased from 0.25 in the period 1978 - 1979 to 0.66 in the period 1983 - 1985 indicating that industrial activity has become more energy-intensive in nature. Electricity/GDP Elasticity however seems to have experienced a marked decline from 1.31 in the period 1978 - 1979 to 0.15 in the period 1983 - 1985. Fossil fuel/GDP Elasticity has increased considerably from 0.21 in the period 1978 - 1979 to 2.86 in the period 1983 - 1985.

Table 8.2.4 :

Energy/GDP Elasticity in Industry

Year	1978	1979	1978/79	1983	1985	1983/85
GDP (Million $)	12,673	14,351	18,683	19,986		
Energy (Total-Tcal)	13,908	14,376	17,578	18,414		
Electricity (Gwh)	3,410	4,001	4,284	4,331		
Fossil Fuel (Tcal)	10,975	11,283	12,170	14,689		
% E/% GDP		0.254				0.657
% Elect/% GDP		1.309				0.1517
% FF/% GDP		0.212				2.861

8.7. ENERGY CONSUMPTION

As illustrated in Table 8.2.5, the largest energy-consuming sub-sector within Industry is the manufacturing sector which accounted for 52.0% of energy consumed in 1978 and 64.1% in 1985. The mining sub-sector accounted for 33.9% of industrial energy consumption in 1978 and only 17.3% in 1985 reflecting decreasing activity particularly in the tin-mining industry.

The construction sub-sector's share of Industrial energy consumption increased from 14.0% in 1978 to 18.6% in 1985.

The major fuel consumed in Industry is diesel oil which alone accounted for 54.8% energy consumed in 1978 and 44.2% in 1985, the drop presumably related to the removal of the diesel subsidy in 1979.

Fuel oil's share of industrial energy consumption increased from 12.3% in 1978 to 22.4% in 1985 indicating that some diesel oil to fuel oil substitution has taken place over this period. Electricity's share in the industrial energy mix has declined slightly from 21.1% in 1978 to 20.2% in 1985.

However these conclucsion are based on data contained in the Department of Stastitics' manufacturing survey which are dubios in nature and require verification.

The bulk of energy consumed in the mining sub-sector comprised diesel oil which accounted for 81.9% in 1978 and 81.5% in 1985. In the construction sub-sector, diesel was also the main fuel consumed accounting for 74.6% and 71.6% of energy consumption respectively in 1978 and 1985.

Table 8.2.5

Energy Mix in the Industrial Sector
TJ/(%)

	1978								1985							
	DO	MOGAS	KERO	FO	COAL	FF	ELECT	TOTAL	DO	MOGAS	KERO	FO	COAL	FF	ELECT	TOTAL
Mining	3862 (81.9)	47 (1.0)	*4 43 (0.9)	6 (0.1)	0 (0)	3958 (83.9)	761 (16.1)	4719	2595 (81.5)	24 (0.8)	*2 99 (3.1)	9 (0.3)	0 (0)	*3 2727 (85.7)	454 (14.3)	3181
Manufacturing	2298 (31.8)	268 (3.7)	*2 98 (1.3)	1613 (22.3)	149 (2.0)	*3 5234 (72.3)	2002 (27.7)	7236	3096 (26.2)	286 (2.4)	89 (0.7)	4070 (34.5)	684 (5.8)	8856 (75.0)	2950 (25.0)	11806
Construction	1456 (74.6)	230 (11.9)	2 (0.1)	95 (4.9)	0 (0)	1783 (91.3)	170 (8.7)	1953	2453 (71.7)	593 (17.3)	8 (0.7)	50 (34.5)	2 (0)	3106 (90.6)	321 (9.4)	3427
Total	7616 (54.8)	545 (3.9)	143 (1.0)	1714 (12.3)	141 (1.0)	10975 (78.9)	2933 (21.1)	13,908	8144 (44.2)	903 (4.9)	196 (1.1)	4129 (22.4)	686 (3.7)	*5 14689 (79.8)	3725 (20.2)	18414

*2
*3. does not include charcoal
*4. includes charcoal
*5. includes aviation and jet fuel
. includes charcoal

Table 8.2.6

Energy Mix in the Manufacturing Sector
TJ/(%)

	1978								1985							
ISIC	DO	MOGAS	KERO	FO	COAL	FF	ELECT	TOTAL	DO	MOGAS	KERO	FO	COAL	FF	ELECT	TOTAL
31	620 (50.0)	60 (5.0)	6 (0)	289 (23.5)	0 0	975 (78.5)	267 (21.5)	1242	937 (26.7)	68 (2.0)	7 (0)	1979 (56.7)	0 (0)	2991 (85.6)	504 (14.4)	3495
32	59 (9.8)	12 (2.0)	11 (1.9)	202 (33.6)	0	284 (47.3)	317 (52.7)	601	81 (10.2)	15 (2.0)	2 (0)	397 (50.2)	0 0	495 (62.4)	298 (37.6)	793
33	633 (77.3)	37 (4.5)	0	3 (0.4)		673 (82.2)	146 (17.8)	819	557 (66.2)	68 (8.0)	1 (0.1)	42 (5.0)	0	668 (79.3)	174 (20.7)	842
34	28 (12.3)	17 (7.4)	2 (0.9)	12 (5.3)		59 (25.9)	169 (74.1)	228	49 (19.0)	21 (8.1)	4 (1.6)	93 (36.0)	0 0	167 64.7	91 35.3	258
35	394 (39.6)	74 (7.4)	50 (5.0)	38 (3.8)	30 (3.0)	586 (58.9)	411 (41.2)	997	605 (38.8)	38 (2.4)	42 (2.7)	405 (25.9)	0	1090 (69.8)	471 (30.2)	1561
36	309 (21.0)	13 (0.9)	7 (0.5)	889 (60.4)	0	1218 (82.8)	253 (17.2)	1471	462 (18.7)	15 (0.6)	17 (0.7)	838 (33.9)	628 (25.4)	1961 (79.3)	512 (20.7)	2473
37	63 (5.0)	4.3 0.3	*1 810 (65.3)	142 (11.4)	79 (6.3)	1098 (88.3)	145 (11.7)	1243	226 (14.4)	6 (0.4)	*1 629 (40.0)	270 (17.1)	53 (3.4)	1184 (75.3)	387 (24.6)	1571
38	189 (30.4)	50 (8.1)	20 (3.2)	38 (6.1)	40 (6.4)	337 (54.3)	284 (45.7)	621	175 (22.3)	53 (6.8)	16 (2.1)	45 (5.7)	3 (0.4)	293 (37.3)	492 (62.7)	785
39	3 (18.2)	1 (12.4)	(0)	(0)	(0)	4 (30.9)	10 (69.1)	14	4 (15.5)	2 (6.7)	0 (0.3)	1 (2.5)	0 (0)	7 (25.7)	21 (75.0)	28
3	2298	268	98	1613	149	5234	2002	7236	3096 (26.2)	286 (2.4)	89 (0.7)	4070 (34.5)	684 (5.8)	8856 (75.0)	2950 (25.0)	11806

*1. includes charcoal

As shown in the tables (for Manufacturing Sector) in Appendix energy consumption in the manufacturing sector has risen about 63% from 7236 Tcal in 1978 to 11806 Tcal in 1985. This is mainly due to the increased energy consumption in the manufacture of food, beverage and tobacco subsector and the manufacture of non-metallic mineral products subsector of about 180 % and 68 % respectively. Value added has risen even higher by 73 % over the same period of time.

The main energy consuming sectors in 1978 in descending order are the non-metallic mineral products (20.3%), basic metal industries (17.2%), food, beverage and tobacco(17.2 %) and manufacture of chemicals and of chemical, petroleum, coal, rubber and plastic products subsector (17.2%). However this order has changed in 1985. The main energy consuming sectors were the manufacture of food, beverage and tobacco subsector (29.6%) followed by the manufacture of non-metallic mineral products (20.9%), basic metal industries (13.3%) and manufacture of chemicals and of chemical, petroleum, coal, rubber and plastic products (13.3%).

The energy mix in 1978 comprised mainly diesel oil (31.8%), electricity (27.6%), and fuel oil (22.3%) which together accounted for 82 % of energy consumption in the manufacturing sector.In 1985 this pattern had changed significantly. Diesel oil consumption had declined to 26.2 %, fuel oil increased to 34.5 % and electricity declined to 25 %. Substitution of fuel oil with diesel has taken place in the following subsectors - the manufacture of food, beverage and tobacco subsector, manufacture of wood, wood products including furniture, manufacture of chemicals and of chemical, petroleum, coal, rubber and plastic products, the manufacture of non-metallic mineral products and basic metal industries.

Diesel oil is used mainly in the manufacture of food, beverage and tobacco subsector, textile, wearing apparel and leather industries, manufacture of chemicals and of chemical, petroleum, coal, rubber and plastic products sub-sector and the manufacture of non-metallic mineral products sub-sector which together accounted for 83% of the manufacturing sector diesel consumption in 1985. Mogas contributes from (2.0 - 8.0)% to the energy consumption in each sub-sector. It is mainly used in manufacture of wood, wood products including furniture sub-sector and manufacture of paper and paper products, printing and publishing. Kerosene is mainly used in manufacture of chemicals and of chemical, petroleum, coal, rubber and plastic products where it accounted for 27 % of this sub-sector's energy consumption in 1985. Basic metal industries is the main user of charcoal and charcoal consumption has been included in the kerosene column. 40% of the total fuel consumption in basic metal industries in 1985 was charcoal. The main consumers of fuel oil are the manufacture of food, beverage and tobacco subsector followed by the manufacture of non-metallic mineral products. Both sub-sectors consumed about 70 % of the total fuel oil consumption in 1985. Coal is mainly used in the manufacture of non-metallic mineral products and basic metal industries. All sub-sectors used substantial amount of electricity with the main electricity users being the manufacture of non-metallic mineral products, the manufacture of food, beverage and tobacco subsector, the manufacture of fabricated metal products, machinery and equipment and manufacture of chemicals and of-chemicals, petroleum, coal, rubber and plastic products .

Comparison Between Industrial Sector Survey Dataand Industrial Energy Demand in The NationalEnergy Balance 1985.

Table 8.2.7:

Final Energy Demand in Industry*

	Survey Data (TJ)	Energy Balance (TJ)	Difference (%)
Diesel Oil	74,992	72,843	2.9
Fuel Oil	17,306	23,179	33.9
Electricity	16,358	19,874	21.5
Other Fuels	13,699	19,624	43.3
Total Energy	122,355	135,520	10.8

* Industry here refers to Manufacturing, Mining, Construction and Agriculture.

It can be seen that the difference between survey data and Energy Balance data on industrial energy consumption are comparable. The survey cover establishments which account for at least 90% of the value-added of the sub-sectors Manufacturing, Mining and Construction. It is important to take note that while data on the Manufacturing, Mining and Construction sub-sectors were obtained from industrial survey, figures on energy consumption in the agricultural sector were estimated purely on a theoretical basis.

Nevertheless the data appear to be fairly comparable, particularly in the case of diesel where the difference is only about 3.0%.

8.8. ELECTRICITY GENERATION FROM DIESEL

As outlined in the following table, out of 2298 Tcal of diesel consumed in the manufacturing sector in 1985 26.5 % was for electricity generation. The manufacture of food, beverage and tobacco subsector used 365 Tcal for electricity generation, accounting for 15,9% of total diesel consumption in the manufacturing sector and 59 % of diesel consumption of sub-sector the manufacture of food, beverage and tobacco subsector . The sub-sector manufacture of chemicals and of chemical, petroleum, coal, rubber and plastic products used 174 Tcal for electricity generation accounting for 7.6 % of total diesel consumption in the manufacturing sector and 44% of diesel consumption in sub-sector manufacture of chemicals and of-chemicals, petroleum, coal, rubber and plastic products.

Table 8.3 :

Electricity Generation From Diesel

ISIC	Total Diesel (Tcal)	Diesel for Generation of Electficity (Tcal)	%
31	620	365	59.0
32	59	0.8	1.3
33	633	33	5.2
34	28	0	0
35	394	174	44.2
36	309	25	81
37	63	3.1	4.9
38	189	72	3.8
39	3	0	0
3	2,298	608	26.4

Energy analysis of individual sub-sectors is described in the following paragraphs.

8.9. CONCLUSION

Analysis of energy demand in the industrial sector (excluding Agriculture) has clearly shown that the manufacturing sub-sector is the largest consumer accounting for 64% of energy demand in industry in 1985. Within the manufacturing sub-sector, the main energy consumers in 1985 were Food, Beverage and Tobacco ISIC (31), Non-Metallic Mineral Products ISIC (36) and Basic Metals ISIC (37).

The main fuels consumed in the manufacturing sub-sector were fuel oil, diesel oil and electricity accounting for 34.5%, 26.2% and 25% respectively of energy demand. Together these three fuels accounted for 85.7% of energy demand in this sub-sector.

The Mining and Construction sub-sector accounted for 17.3% and 18.6% respectively of industrial energy consumption. Within mining, diesel constitutes the main fuel accounting for 81.5% of energy demand in 1985. In the construction sub-sector, the main fuel consumed was also diesel oil which had a share of 71.6% in energy demand.

In 1985 the manufacturing sub-sector accounted for almost 50% of industrial value added followed by mining at 34.4% and construction at 15.7%. The contribution of manufacturing to industrial value added had increased by about 2% over the analysis period and is expected to increase further in future.

With the inclusion of Agriculture into the Industrial sector, it was possible to compare the data from the surveys with the National Energy Balance data on Industrial energy consumption as well as with the National Energy Planning Study (NEPS). It was found that whilst total industrial energy demand from the surveys in 1979 contituted around 82% of Energy Balance data for 1980, there was a huge discrepancy with

NEPS data. The 1979 survey data on industrial energy consumption amounted to only about 60% of 1980 NEPS data on industrial energy consumption.

The largest discrepancies between survey data and NEPSdata were in Manufacturing and Agriculture. Survey data for 1979 (which covered 90% value added of manufacturing sub-sector) indicated the energy consumed in the manufacturing sub-sector to amount to 30734 TJ, which represented less than a third of the amount estimated by NEPS for the manufacturing sub-sector in 1980.

In the case of the Agriculture sub-sector, the estimate made in this study on energy consumed in the Agriculture sub-sector was about 40% higher than the figure given in NEPS for the year 1980.

Survey data on the mining and construction sub-sectors however were quite close (within 10%) to the data given in NEPs on these sub-sectors.

There was no attempt to carry out projections of energy demand in the industrial sector because it was believed that it would have been a futile exercise since the data base itself requires extensive verification particularly in the case of the manufacturing sub-sector where the survey data on energy consumption seems to have grossly understated the amount of energy consumed.

Energy coefficients were calculated for each industrial group (5 digit) but in some cases, it was impossible to derive any conclusive results due to the inconsistency of the coefficients. The lack of sufficient time-series data (data for only 4 years was available) was another set-back.

Nevertheless, the analysis on energy consumption and value added of the industrial sector has been useful in that it has clearly revealed the problem areas in the data base which need to be seriously looked into if any future analysis were to be carried out. It needs to be emphasized that the existing data base on energy demand in the industrial sector needs to be reviewed and verified and the scope expanded through improved energy survey forms.

In the analysis period 1978 to 1985, natural gas did not figure significantly in the energy mix (except for the industrial group 35111) but will certainly be much more important in future. The survey forms should thus include 'purchase of natural gas' in addition to all other existing fuels.

A working mechanism should be established in order that relevant parameters could be automatically generated or a regular basis.

8.10. ANALYSIS AT 5 DIGIT LEVEL

8.10.1. FOOD, BEVERAGES AND TOBACCO

The sector food, beverages and tobacco, ISIC code 31 covers a wide range of subsectors such as slaughtering, preparing and preserving meat, dairy products, oil palm refineries, sugar refineries, vegetable and animal oils and fat, all types of beverages and tobacco products. The value added for this sector increased from 1092.967 million ringgit to 1884.715 million ringgit in constant 1978 price during the period 1978 - 1985, growing at 8.1% per annum. Table 8.5 shows the deflated value added figures in constant 1978 prices for the period 1978 - 1985. The gross output grew at 7.5% per annum or increased from 6067 million ringgit to 10042.035 million ringgit (in constant 1978 price) during the period 1978 - 1985.

Table 8.4:

DEFLATED VALUE ADDED TO CONSTANT 1978 PRICES

YEAR SECTORS	1978 (in M$)	1979 (in M$)	1983 (in M$)	1985 (in M$)
31	1093.0	1474.4	1652.8	1844.7
31152	520.9	571.9	385.1	520.6
31180	85.2	84.3	100.8	96.3
Others	486.9	818.2	1166.9	1227.8
32	427.9	441.3	426.2	439.8
32111	116.3	121.0	43.6	127.9
Others	311.6	320.3	382.6	311.9

The total energy consumption increased at 15.9% per annum, from 1242.8 tcal to 3495.5 tcal during period 1978 - 1985 as shown in Table 8.5 below. Fossil fuel accounts for 85.6% of total energy consumption and the remainder 14.4% comes from electricity. Diesel consumption accounted for the greater part of the total fossil fuel consumption for the years 1978 and 1979, with 63.6% and 66.6% respectively, but declined to 44.4% and 31.3% in 1983 and 1985 respectively. On the other hand, fuel oil consumption was very low contributing only 29.7% and 27.8% in 1978 and 1979 respectively to the total fossil fuel consumption, but later the percentage increased to 52.8% and 66.2% in 1983 and 1985 respectively. This clearly shows the substitution effect from diesel to fuel oil consumption taking place in this sector. Another feature is that of the total diesel consumed in this sector, 48.6% is used to generate electricity in 1978 and about 39% in 1985.

Table 8.5

Total Energy Consumption in Sectors 31 and 32

YEAR SECTORS	1978 in TCAL	1979 in TCAL	1983 in TCAL	1985 in TCAL
31	1242.8	1777.4	2859.0	3495.5
31152	422.4	535.7	1385.7	1593.6
31180	89.3	141.9	208.4	422.3
Others	731.1	1099.8	1264.9	1479.6
32	599.9	589.0	492.8	793.6
32111	167.6	192.5	60.4	411.8
Others	432.3	396.5	432.4	381.8

The total energy consumption increased at 15.9% per by value added increases from 1.137 TCAL/M$ in 1978 to 1.855 TCAL/M$ in 1985. The total energy consumed divided by gross output also shows an increasing trend from 0.205 TCAL/M$ in 1978 to 0.348 TCAL/M$ in 1985. There are shifts in energy intensity of the sub-sectors within this sector if we compare the figures given in Table 8.6 below. The intensity is increasing for the sub-sectors palm oil and sugar and and whereas in the case of other sub-sectors the intensity is decreasing starting from 1983.

Table 8.6

Energy Intensity

YEAR SECTORS	1978 in TCAL/M$	1 979 in TCAL/M$	1983 in TCAL/M$	1985 in TCAL/M$
31	1.137	1.205	1.730	1.855
31152	0.811	0.937	3.598	3.061
31180	1.047	1.684	2.068	4.385
Others	1.502	1.344	1.084	1.167
32	1.402	1.335	1.156	1.804
32111	1.441	1.590	1.384	3.222
Others	1.387	1.238	1.808	1.224

The actual electricity consumption (i.e. calculated by adding total electricity purchased and total electricity generated and subtracting total electricity sold) in this sector is 412.7 Gwh in 1978 and increased to 706.9 Gwh in 1985. But in order to avoid double counting, only electricity purchased is taken into account in deriving the total energy consumed by the sector. Table 8.7 below shows the difference in the four classifications of electricity purchased, electricity generated, electricity sold and electricity consumed for the sector 31.

Table 8.7

Electricity Consumption for Sector 31

YEAR SECTOR	1978 (in Gwh)	1979 (in Gwh)	1983 (in Gwh)	1985 (in Gwh)
Electricity Purchased	311.0	379.9	501.2	586.0
Electricity Generated	105.2	98.4	92.4	127.4
Electricity Sold	3.4	1.8	3.1	6.5
Electricity Consumed	412.8	476.5	590.5	706.9

The analysis at the five digit level are focussed only for the palm oil (31152) and sugar refining (31180) sectors.

Palm oil (31152)

Energy consumption in the palm oil sector (31152) covers palm oil processing and refining. The production of crude palm oil (CPO) increased from 1785.5 thousand tonnes in 1978 to 2188.4 thousand tonnes in 1979 (22.6% growth rate). However, the production of CPO fell from 3514.2 thousand tonnes in 1982 to 3018.3 thousand tonnes in 1983 (-14.0 growth rate for the year 1982 - 1983). For the whole period 1978 - 1985 the average annual of CPO production growth rate is 12.0 per cent. See table 8.8 below for the crude palm oil production figures. Whereas in terms of value added there is basically no change during the period 1978 - 1985.

Table 8.8:

Production of Crude Palm Oil

YEAR	Crude Palm Oil (in '000 metric tonnes
1978	1785.5
1979	2188.4
1983	3018.3
1985	3715.7

The total energy consumption of this sector increased at 20.9% per annum during the period 1978 - 1985 from 422.4 TCAL to 1593.5 TCAL. Fossil fuel accounts for 90.6% of the total energy consumed in 1985 and the remainder comes from electricity. Of the total fossil fuel consumed, fuel oil accounts for 72.9%, diesel26.8% and the remainder 3.0% mogas. One obvious trend is the decreasing percentage share of diesel consumption of the total fossil fuel consumption in this sector for the years 1978, 79, 83 and 85 and the percentage shares are 64.0%, 57.7%, 38.2% and 26.8% respectively for each year. On the other hand, the percentage shares of fuel oil of the total fossil fuel consumption in this sector are increasing from 33.3%, 39.8%, 60.0% and finally reaching 72.9% respectively for the same years. This might be the result of palm oil refineries switching over to fuel oil from diesel. Another characteristic is that more than 50% of the total diesel consumed in this sector is used for electricity generation during the period 1978 - 1985, except for 1983 where it reaches only 29.2%.

The energy intensity calculated by dividing total energy consumed by value added shows an increasing trend for the period 1978 - 1983 and declining slightly in 1985. The same trends are found in the coefficients calculated for fossil fuel divided by value added, electricity divided by value added and total energy consumed divided by production of crude palm oil. The main reason for the decline in 1985 is due to decline in the rate of growth of energy consumption compared to greater rate of growth in crude palm oil production.

Sugar (31180)

Energy consumption in the sugar sector (31180) mainly covers sugar processing and refining. The production of sugar increased from 583.8 to 591.0 thousand metric tonnes during the period 1983 - 1985. The sugar production growth rate is 0.6 percent per annum during the period 1983 - 1985. See table 10 below for the sugar production figures. The growth in terms of value added for the sector was 1.8% during the period 1978 - 1985, but for the period 1983 - 1985 there is a decline in value added which results in negative growth rate of 2.2% per annum.

Table 8.9:

Production of Sugar

YEAR	Sugar (in '000 metric tonnes)
1982	477.5
1983	583.8
1984	603.2
1985	591.0

The total energy consumption of this sector grew at 24.9% per annum during the period 1978 - 1985. Fossil fuel accounts for 96.2% and electricity for 3.8% of the total energy consumption of this sector in 1985. Fuel oil seems to be largest energy type consumed in this sector and growing at 32% per annum during the period 1978 - 1985. The total diesel consumption in the sector is fluctuating from 18 TCAL to 19 TCAL and if compared in terms of percentage contribution to the total fossil fuel consumption, it is actually decreasing from 24.6% in 1978 to only 4.7% in 1985.

The energy coefficient of total energy consumed divided by value added shows an increasing trend during the period 1978 - 1985 and almost doubled from 2.068 TCAL/M$ in 1983 to 4.385 TCAL/M$ in 1985. The coefficient of fossil fuel divided by value added shows the same trend and whereas the coefficient of electricity divided by value added did not change much staying around 0.194 GWh/M$ for the years 1979 and 1985 and slightly decreasing to 0.185 GWh/M$ in 1983. The coefficient of total energy consumed divided by production of sugar shows that the intensity had doubled from 0.357 TCAL per thousand metric tonne (TCAL/TMT) in 1983 to 0.715 TCAL/TMT in 1985.

8.10.2 TEXTILE AND APPAREL

The textile and apparel sector, with ISIC code 32 covers spinning and weaving, knitting, wearing apparels and foot wear except rubber and plastic foot wear. The total value added in constant 1978 price increased slightly from 427.9 million ringgit to 439.8 million ringgit during the period 1978 - 85, growing marginally at 0.4 percent per annum. The value added declined in 1983 to 426.2 million ringgit compared to 441.3 million ringgit in 1979. See table 8.4 above for the value added figures. On the other hand gross output increased thoughout the period 1978 - 1983 from 1309.0 million ringgit to 1453.8 million ringgit and decreasing slightly to 1448.9 million ringgit in 1985, resulting in a growth rate of 1.5% per annum for the period 1978 - 1985.

The total energy consumption increased from 599.9 TCAL in 1978 to 793.6 TCAL in 1985. Fossil fuel accounts for 62.4% of the total energy consumed in this sector and electricity accounts for the remainder 37.6% in 1985.

Fuel oil accounts for 80.1% of the total fossil fuel consumption in this sector followed by diesel 16.3%, mogas 3.1% and kerosene 0.5% in 1985. The energy intensity i.e. total energy consumed divided by value added of this sector shows an increasing trend from 1.402 TCAL/M$ in 1978 to 1.804 TCAL/M$ in 1985 but a decline from 1.335 TCAL/M$ in 1979 to 1.156 TCAL/M$ in 1983. The coefficient of total energy consumed divided by gross output also shows the same trend as described above, where by the coefficient is increasing from 0.458 TCAL/M$ in 1978 to 0.548 TCAL/M$ in 1985, except for the period 1979-1983 where it declined from 0.432 to 0.339 TCAL/M$. The energy intensity in this sector is increasing for the sub-sector 32111 compared to other sub-sectors except for the year 1983, which might be the result of the recession of Malaysian textile industry where the total energy consumed in the sub-sector 32111 went down considerably as shown in Table 8.5 above. Detailed analysis at the five digit level, was done only for the sector spinning and weaving (32111).

8.10.3. SPINNING AND WEAVING

The production of textile decreased from 207.9 million metres in 1978 to 189.6 million metres in 1985, resulting in a negative growth rate of 0.8 percent during the period. There is a small growth of 1.4% in value added of the sector for the period 1978 - 1985. See table 8.10 below for the textile production figures. However, the value added fell sharply from 121.0 million ringgit in 1979 to only 43.6 million ringgit giving a negative growth rate of 22.5% for the period 1979 to 1983.

Table 8.10:

Production of Textile

YEAR	Textile (in million metres)
1978	207.6
1979	211.9
1983	201.7
1985	196.5

The total energy consumption grew at 13.7% during the period 1978 - 1985. However, same as in the case of value added the total energy consumption declined substantially in 1983, giving a negatif growth rate of 25.2% for the period 1979 - 1983. Fossil fuel accounts for 52.7% of the total energy consumed in this sector and the remainder 47.3% comes from electricity consumption in 1985. Fuel oil accounts for 95.2% of the total fossil fuel consumption and diesel accounts for 4.1% in the year 1985.

The energy intensity of the total energy consumed divided by value added shows an increasing trend from 1.441 TCAL/M$ in 1978 to 3.222 TCAL/M$ in 1985, except for 1983 where the intensity declined to 1.384 TCAL/M$ compared to 1.590 TCAL/M$ in 1979.

8.10.4 MANUFACTURE OF WOOD AND WOOD PRODUCTS INCLUDING FURNITURE

33111 SAWMILLS

Table 8.11:

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL Fuel (Tcal)	ELECTRICITY Purchased (GWh)	TOTAL Energy (Tcal)
1978	539.473	48.057	580.8
1979	718.284	58.119	768.27
1983	587.055	58.063	636.99
1985	474.085	53.141	519.79

Table 8.12:

PRODUCTION OF SAWN TIMBER AND VALUE ADDED

YEAR	PRODUCTION OF SAWN TIMBER (1000 tonnes)	VALUE ADDED (Constant 1978)
1978	5905.2	332.36
1979	5953.9	381.16
1980	6237.1	
1981	5489.3	
1982	6241.4	
1983	7138.6	366.2
1984	5844.5	
1985	5574.7	259.24

Table 8.13:

INTENSITIES

YEAR	ENERGY INTENSITY		FOSSIL FUEL INTENSITY		ELECTRICITY INTENSITY	
	(Tcal/1000t)	(Tcal/M$)	(Tcal/1000t)	(Tcal/M$)	(GWh/1000t)	(GWh/M$)
1978	0.098	1.75	0.091	1.62	8.138	0.15
1979	0.129	2.02	0.121	1.91	9.762	0.16
1983	0.089	1.74	0.082	1.60	8.134	0.16
1985	0.093	2.01	0.085	1.83	9.533	0.21

Sawmilling pertains to the processing of logs into lumber and involves partitioning, ripping, trimming, drying and surfacing. Logs are partitioned into boards or plants by saws and ripped. Ripped boards are treated with chemicals and piled to dry either by air drying or kiln drying. Upon drying, the lumber is cut, shaped and resurfaced.

There are more than 900 sawmills operating in Malaysia. More than 90% of these mills are small, poorly equipped and operating with on average capacity of 24 tonnes of sawn timber per working day.

The larger mills, with an average production capacity of 50 to 100 tonnes per day constitute less than 10% of the total. Most of the medium-size sawmills are equipped with 50 or 60 inch breakdown saws with automatic log carriage. More mechanization has been introduced which has resulted in lower labour costs, precision cutting and high timber recovery rates.

About 50% of all sawmills in Peninsular Malaysia are equipped with drying facilities using their timber residues as fuel for steam generation. These sawmills are self-sufficient to heat their driers and have a surplus sold to households as cooking fuel or converted into charcoal in kilns adjacent to the mills. It is estimated that sawmills generate about 10% of their electricity requirements. It was reported in the NEPS (1985) that a growing number of integrated timber complexes use timber residues for electricity and heat generation.

This is apparent only for theperiod 1979 to 1983 when energy consumed per thousand tonnes of sawn timber declined by 31%. Fossil fuel used per thousand tonnes of sawn timber declined by 32% and electricity used per thousand tonned of sawn timber by almost 17%. These intensities however appear to have increased in the period 1983 to 1985.

Energy consumption has however shown a stable pattern in that about 91-92% of commercial energy requirements in the period 1978 to 1985 was met by fossil fuel (mainly diesel oil). The bulk of diesel consumption is probably for transportation of logs and sawn timber as well as for heat generation in driers or kilns and for electricity generation.

33112 PLYWOOD, HARDBOARD AND PARTICLE BOARD MILLS

Table 8.14

ENERGY CONSUMPTION

YEAR TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	92.65	80.720	162.072
1979	107.087	86.056	181.095
1983	144.437	105.690	235.330
1985	92.906	84.116	165.246

Table 8.15

ENERGY INTENSITIES

YEAR	VALUE ADDED (Constant 1978)	ENERGY INTENSITY (Tcal/M Rgt)	FOSSIL FUEL INTENSITY (Tcal/M Rgt)	ELECTRICITY INTENSITY (GWh/M Rgt)
1978	124.78	1,299	0.743	0.647
1979	150.669	1.202	0.711	0.571
1983	134.592	1.748	1.073	0.785
1985	119.176	1.387	0.780	0.706

There does not seem to have been any consistent trend in the energy required to generate a unit of value added. One reason could have been a shift in the share of individual products to this sector's overall value added.

Table 8.16

OUTPUT OF MAIN PRODUCTS

YEAR	Plywood & Particle Board (cubic metres)	PLYWOOD	VENEER SHEET & BLOCKBOARD	TOTAL
1978	486535			
1979	476700			
1980	476135			
1981	544730			
1982		562307	172868	735175
1983		619657	193364	813021
1984		530103	179971	710074
1985		497033	162461	659194

Table 8.17

ENERGY INTENSITIES

YEAR	ENERGY INTENSITY (Gcal/Cu.m)	FOSSIL FUEL INTENSITY (Gcal/Cu.m)	ELECTRICITY INTENSITY (MWh/Cu.m)
1978*	0.33	0.190	0.166
1979*	0.38	0.225	0.181
1983**	0.29	0.203	0.130
1985**	0.25	0.141	0.178

* Pertain to plywood and particle board
** Pertain to plywood, veneer sheet and blockboard

There seems to have been a decline in energy intensity from 1979. But it is difficult to draw any substantive conclusions as the production data pertain to a slighty different set of products in 1983 and 1985.

33200 FURNITURE AND FIXTURES EXCEPT PRIMARILY OF METAL

Table 8.18:

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	9.091	16.024	22.872
1979	8.845	14.158	21.021
1983	13.498	10.315	22.369
1985	54.344	16.576	68.599

Table 8.19:

ENERGY INTENSITIES

YEAR	VALUE ADDED (Constant 1978)	ENERGY INTENSITY (Tcal/M Rgt)	FOSSIL FUEL INTENSITY (Tcal/M Rgt)	ELECTRICITY INTENSITY (GWh/M Rgt)
1978	36.69	0.623	0.248	0.437
1979	40.241	0.522	0.220	0.352
1983	57.820	0.387	0.233	0.178
1985	73.580	0.932	0.739	0.225

Energy Intensity in terms of value added has declined in the period 1978 to 1983, with the bulk of it due to the reduction of almost 60% in electricity intensity.

However in the period 1983 to 1985 fossil fuel intensity seems to have trebled implying a drastic change in the manufacturing process which does not seem plausible in such a short time period.

8.10.5 MANUFACTURE OF PAPER AND PAPER PRODUCTS PRINTING AND PUBLISHING

34110 MANUFACTURE OF PULP, PAPER AND PAPERBOARD

Table 8.20

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	1.196	14.639	13.786
1979	0.930	20.139	18.250
1983	39.185	22.445	58.488
1985	49.980	23.237	69.964

Table 8.21

ENERGY INTENSITIES

YEAR	VALUE ADDED (Constant 1978) (Tcal/M Rgt)	ENERGY INTENSITY (Tcal/M Rgt)	FOSSIL FUEL INTENSITY (GWh/M Rgt)	ELECTRICITY INTENSITY
1978	5.940	2.321	0.201	2.464
1979	6.84	2.692	0.137	2.971
1983	10.324	5.665	3.796	2.174
1985	12.676	5.519	3.943	1.833

Energy intensity between 1979 and 1983 more than doubled attributed to the large increase in fossil fuel consumption from about 1 Tcal in 1979 to 39 Tcal in 1983 arising from the start up of the start up of the Sabah Pulp and Paper Mill.

Prior to the existence of the Sabah Pulp and Paper Mill, the domestic pulp and paper industry was much less energy-intensive than the pulp and paper industry in other countries.

The reason given in NEPS was that the share of the much less energy-intensive paper board industry in the value added of this sub-sector was much higher than that of pulp and paper.

In 1979, the negligible role of the most energy-intensive part of the sector, i.e. pulp and paper manufacturing, explains the raltively low share of fossil fuel (5%) in total energy consumption. In paper making, a typical ratio between process heat and electricity requirements is 4:1.

There has thus been a structural change in the mix of industries within this sub-group.

The energy inputs in this industry are mainly mechanical power for grinding and beating the raw materials and heat for cooking and drying the pulp product.

There are two distinct phases in the conversion of raw wood into the finished paper namely:

(i) the manufacture of pulp from raw wood; and

(ii) the conversion of pulp to paper itself.

In surveys of energy usage in the Paper and Pulp Industry in other countries, about 30 - 40% of energy used is in the form of electricity for electric motors while about 60 - 70% is for process heating (1000 - medium temperative).

34190 MANUFACTURE OF PULP, PAPER AND PAPERBOARD ARTICLES (nec)

Table 8.22

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	18.534	14.510	31.013
1979	22.443	16.950	37.030
1983	42.705	20.329	60.188
1985	60.924	28.884	85.764

Table 8.23

ENERGY INTENSITIES

YEAR	VALUE ADDED (Constant 1978)	ENERGY INTENSITY (Tcal/M Rgt)	FOSSIL FUEL INTENSITY (Tcal/M Rgt)	ELECTRICITY INTENSITY (GWh/M Rgt)
1978	15.810	1.962	1.172	0.918
1979	18.475	2.004	1.215	0.917
1983	27.581	2.182	1.548	0.737
1985	36.532	2.348	1.668	0.791

Energy itensity increased by almost 20% in the period 1978 to 1985 attributed to the increase in fossil fuel intensity. Electricity itensity however has declined by about 14%.

Table 8.24

OUTPUT OF SELECTED

YEAR	CARDBOARD & PAPERBOARD BOXES (thousand units)	FIREBOARD & CARTONS (thousand tonnes)
1978		
1979		
1980		
1981		
1982	105,764	51,843
1983	140,813	52,771
1984	162,821	67,938
1985	159,515	68,872

34200 PRINTING, PUBLISHING AND ALLIED INDUSTRIES

Table 8.25

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	24.190	162.867	164.256
1979	26.751	120.771	130.614
1983	35.226	45.680	74.511
1985	24.807	46.300	64.625

Table 8.26

ENERGY INTENSITIES AND VALUE ADDED

YEAR	VALUE ADDED (Constant 1978)	ENERGY INTENSITY (Tcal/M Rgt)	FOSSIL FUEL INTENSITY (Tcal/M Rgt)	ELECTRICITY INTENSITY (GWh/M Rgt)
1978	206.790	0.794	0.117	0.788
1979	214.970	0.608	0.124	0.562
1983	334.40	0.223	0.105	0.137
1985	361.035	0.179	0.069	0.128

There are about 2000 furniture manufacturing units in Peninsular Malaysia and they cater mainly to the domestic market. Energy itensity appear to have experienced a marked decline of 77.5% in the period 1978 to 1985. Fossil fuel itensity and electricity itensity declined by 41% and 83.8% respectively.

The mix of industries within this sub-sector could have undergone a shift to less energy-intensive activities but with higher value added. However such a large reduction in energy intensity is high improbable and could only be explained by inaccurate data reporting.

8.10.6 MANUFACTURE OF CHEMICALS AND OF CHEMICAL, PETROLEUM COAL, RUBBER AND PLASTICS PRODUCTS

35111 MANUFACTURE OF CHEMICALS AND INDUSTRIAL GASES WHETHER COMPRESSED, LIQUID OR SOLID STATE

Table 8.27

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	-	-	-
1979	-	-	-
1983	44.408	58.199	94.459
1985	24.327	49.589	66.974

Table 8.28

ENERGY INTENSITIES AND VALUE ADDED

YEAR	VALUE ADDED (Constant 1978) (Tcal/M Rgt)	ENERGY INTENSITY (Tcal /M Rgt)	FOSSIL FUEL INTENSITY (GWh/M Rgt)	ELECTRICITY INTENSITY
1978	-	-	-	-
1979	-	-	-	-
1983	523.575	0.180	0.085	0.111
1985	950.735	0.070	0.026	0.052

Energy intensity in terms of value added declined substantially by 61% from 1983 to 1985 with fossil fuel intensity reduced by 69% and electricity intensity by about half.

This sector includes the processing of gas for domestic use and for exports. They include the MLNG plant in Sarawak and the gas processing plant in Peninsular Malaysia in the both of which came on stream in the period 1983 to 1984.

The drop in fossil fuel and electricity intensity is probably attributed to increased usage of natural gas. Natural gas consumption is not reported in the Department of Statistics survey forms.

35119 MANUFACTURE OF OTHER BASIC INDUSTRIAL CHEMICALS EXCEPT PERTILIZERS

Table 8.29

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	-	-	-
1979	-	-	-
1983	82.777	64.203	132.992
1985	170.704	86.808	245.359

Table 8.30

ENERGY INTENSITIES AND VALUE ADDED

YEAR	VALUE ADDED (Constant 1978)	ENERGY INTENSITY (Tcal/M Rgt)	FOSSIL FUEL INTENSITY (Tcal/M Rgt)	ELECTRICITY INTENSITY (GWh/M Rgt)
1978	51.910	-	-	-
1979	55.317	-	-	-
1983	27.727	4.977	2.985	2.316
1985	81.098	3.025	2.105	1.070

Electricity required to generate a unit of value added has halved from 1983 to 1985 while fossil fuel intensity declined by 19%. Energy intensities declined by 39%. There has probably been a shift towards less energy (in particular, electricity) intensive - type chemicals in this period. The sub-sector '35119' includes production of inorganic chemicals and organic chemicals (or petrochemicals).

The major inorganic chemical products include caustic soda, chlorine and related products, sulphuric acid and its derivatives and phosphoric acid.

Organic Chemicals, often termed petrochemicals, are chemical materials that use hydrocarbons as raw materials. In the period up to 1985, the Country's petrochemical industry was and virtually non-existant except for the local polymerisation of polyvinyl chloride and polystyrene from imported monomers and local production of methanol, polyster staple fiberes and urea-formaldehyde resins.

In the chemical industry large differences between the energy intensities of the various sub-groups exist which can be explained by differences in the type of chemical products manufactured. Temperature levels vary enormously but high temperature uses are dominant. About two third to four fifth of thermal energy is on the average provided by steam.

The rise in energy costs after 1979 would probably have led to some cost-saving measures. Facilities in the 'inorganic chemicals' industry are rather old since energy is usually the biggest cost item for chemical plants, up rading of old and inefficient plants would probably have taken place. Technology transfer and process improvements would have taken place in companies with majority foreign ownership.

35510 TYRE AND TUBE INDUSTRIES

Table 8.31

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	49.676	51.173	93.685
1979	69.513	30.780	95.984
1983	98.650	71.647	160.266
1985	157.196	58.429	207.445

Table 8.32

PRODUCTION OF TYRES AND TUBES

YEAR	PRODUCTION OF PNEUMATIC TYRES (thousand)	PRODUCTION OF INNER TUBES (thousands)	PRODUCTION OF TYRES & TUBES (thousands)
1978	4638	5793	10431
1979	4657	6099	10756
1983	4262	4939	9201
1985	3622	5848	9570

Table 8.33

ENERGY INTENSITIES

YEAR	ENERGY INTENSITY (Gcal/1000)	FOSSIL FUEL INTENSITY (Gcal/1000)	ELECTRICITY INTENSITY (MWh/1000)
1978	8.981	4.762	4.906
1979	8.923	6.463	2.862
1983	17.418	10.722	7.787
1984	21.677	16.426	6.105

Table 8.34

ENERGY INTENSITIES AND VALUE ADDED

YEAR	VALUE ADDED (in const. 1978 M Rgt)	ENERGY/ VALUE ADDED	FOSSIL FUEL VALUE ADDED	ELECTRICITY VALUE ADDED
1978	111.570	0.840	0.445	0.459
1979	113.479	0.846	0.613	0.271
1983	169.029	0.948	0.584	0.424
1985	133.961	0.549	0.173	0.436

* Due to the heterogeneous nature of the product, energy intensity should be based on weight rather than on number of units produced. Data on tonnage produced was not available.

Energy consumed per thousand 'tyres and tubes' almost doubled from 1979 to 1983 due to large increases in both fuel oil and electricity consumption. In the same period, value added increased by almost 50% and energy consumed per unit value added increased only by 12%.

At the same time, the number of tyres and tubes produced declined by 14%. The production of tyres and tubes has become more energy-intensive in nature due to the types of tyres and tubes produced over the years.

The production of tyres and tubes involves two major processing steps which are the mixing of softened dry rubber with chemicals and filling materials and the final vulcanization. Mixing and vulcanization under pressure require mainly process heat and electricity.

35591 RUBBER REMILLING AND RUBBER LATEX PROCESSING

Table 8.35

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	264.360	90.791	342.440
1979	280.874	83.030	352.280
1983	288.549	91.805	367.501
1985	285.988	98.219	370.456

Table 8.36

PRODUCTION OF RUBBER (TONNES)

YEAR	RUBBER RSS	STANDARD MALAYSIAN RUBBER	PROCESSED LATEX	TOTAL
1978	89.76	407.01	171.30	668.07
1979	82.45	410.10	170.26	662.81
1983	65.81	489.25	188.64	743.73
1985	67.10	532.37	199.38	798.85

Table 8.37

ENERGY COEFFICIENTS

YEAR	OVERALL ENERGY INTENSITY (Tcal/1000t)	FOSSIL FUEL INTENSITY (Tcal/1000 t)	ELECTRICITY INTENSITY (GWh/1000 t)
1978	0.513	0.396	0.136
1979	0.531	0.424	0.125
1983	0.494	0.388	0.123
1985	0.469	0.358	0.123

Table 8.38:

ENERGY INTENSITY AND VALUE ADDED

YEAR	VALUE ADDED (in constant 1978 M Rgt)	ENERGY/VALUE ADDED (Tcal/M Rgt)	FOSSIL FUEL VALUE ADDED	ELECTRICITY VALUE ADDED
1978	300.530	1.139	0.880	0.302
1979	332.988	1.058	0.843	0.249
1983	202.874	1.811	1.422	0.453
1985	150.604	2.460	1.899	0.652

While energy consumed per thousand tonnes of product had declined by about 10% in the period 1978 to 1985 due to both declining fossil fuel and electricity intensities, energy required to generate a unit of value added has more than doubled.

Table 8.39

UNITVALUE OF RUBBER EXPORTS

YEAR	UNIT VALUE OF RUBBER EXPORT (sen/kg)
1978	223.1
1979	271.5
1980	302.7
1981	250.0
1982	192.7
1983	234.4
1984	230.8
1985	191.8

Value Added of this sector has halved between 1978 and 1985 although the Unit (FOB) price of rubber has only decreased by 13.9% in the same period. Diesel Oil constitutes the main fossil fuel used and the removal of the diesel subsidy in 1979 would have increased energy costs and thereby reduced value added.

The main energy requirements in the processing of rubber occur in two processing steps:

(i) Forming and cutting of the raw material (either latex concentrate or in solid block form as SMR) by mechanical devices which require electricity;

(ii) Drying of both SMR and latex using mainly diesel, partly firewood and minor amounts of fuel oil before 1980 and later increasing amounts of fuel oil.

In NEPS, it was noted that specific consumption of electricity had declined due to better equipment and this seems to be correct based on the statistics for the period 1978 to 1985 which indicate that electricity intensity declined by about 10%. The decline in energy intensity of this sub-sector indicates increased efficiency in energy use.

One Reason could be a change in process technology. Smaller estates commonly use box-drying method which was reported in NEPS to require 12 gallons of diesel per tonned. The tunnel drying process which requires about 9 gallons of diesel per tonne was increasingly introduced in the larger estates.

The switch from box-drying to tunnel drying would have led to a decline in specific fossil fuel consumption.

35599 MANUFACTURE OF OTHER RUBBER PRODUCTS

Table 8.40:

ENERGY CONSUMPTION

Year/ Type	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	39.210	31.379	66.196
1979	41.791	34.925	71.826
1983	196.528	45.792	235.909
1985	138.789	39.138	172.448

Table 8.41:

ENERGY INTENSITIES AND VALUE ADDED

Year	VALUE ADDED (Constant 1978 M Rgt)	ENERGY/VALUE ADDED (Tcal/M Rgt)	FOSSIL FUEL/ VALUE ADDED (Tcal/M Rgt))	ELECTRICITY/ VALUE ADDED (GWh/M Rgt)
1978	56.500	1.172	0.694	0.555
1979	64.442	1.115	0.649	0.542
1983	106.810	2.209	1.840	0.429
1985	103.172	1.671	1.345	0.379

Table 8.42

PRODUCTION OF SOME RUBBER PRODUCTS

	RUBBER SHEETS (Tonnes)	RUBBER COMPOUNDS (Tonnes)	RUBBER BANDS (Tonnes)	FOAM RUBBER PRODUCTS (Tonnes)	RUBBER GLOVES (1000 pairs)	CATHERI (1000's)
1978	3171	10,140		6329		
1979	3345	10;881		6632		
1983	3973	11,516	3887	6371	197,785	
1985	3728	10,188	3502	5424	255,45014,241.6	14,241.6

Energy intensity or energy required to generate a unit of value doubled between 1979 and 1983 while fossil fuel intensity increased by almost three times in the same period. Both fuel oil and diesel oil consumption increased substantially between 1979 and 1983 due probably to a change in the product mix of this sector with greater production of certain products such as rubber gloves and catherer.

Electricity required to generate a unit of value added declined by 32% between 1978 and 1985 probably a result of both the introduction of new technology and the change in the product mix.

35600 MANUFACTURE OF PLASTIC PRODUCTS N.E.C.

Table 8.43

ENERGY CONSUMPTION

YEAR/ TYPE	FOSSIL FUEL (Tcal)	ELECTRICITY PURCHASED (GWh)	TOTAL ENERGY (Tcal)
1978	24.739	62.952	78.878
1979	24.892	87.828	100.424
1983	31.659	116.066	131.476
1985	50.595	130.332	162.681

Table 8.44

ENERGY INTENSITIES AND VALUE ADDED

YEAR	VALUE ADDED (Constant 1978)	ENERGY INTENSITY (Tcal/M Rgt)	FOSSIL FUEL INTENSITY (Tcal/M Rgt)	ELECTRICITY ITENSITY (GWh/M Rgt)
1978	95.860	0.823	0.258	0.657
1979	115.081	0.873	0.216	0.763
1983	150.786	0.872	0.210	0.770
1985	168.302	0.967	0.301	0.774

Table 8.45

OUTPUT OF SELECTED PLASTIC PRODUCTS

YEAR	Plastic Bags & Sacks (tonnes)	P.V.C. Pipes (tonnes)	Plastic Bottles & Household Wares (tonnes)	TOTAL
1982	38,173	13,405	11,292	66743
1983	40,951	20,740	13,683	75374
1984	41,666	14,493	13,774	69933
1985	41,516	18,669	13,875	74060

Table 8.46
ENERGY COEFFICIENTS

YEAR	ENERGY COEFFICIENT Gcal/tonnes	FOSSIL FUEL COEFFICIENT (Gcal/tonnes)	ELECTRICITY COEFFICIENT (MWh/tonnes)
1978	1.182	0.371	0.943
1979	1.332	0.330	1.165
1983	1.880	0.453	1.660
1984	2.197	0.683	1.760

Assuming that the selected products account for the bulk of production in this sector, the manufacture of plastic products seems to have become more energy intensive in nature with average electricity consumed per unit product increasing by 87% in the period 1978 to 1985 and average fossil fuel required increasing by 84% in the same period.

Energy intensity in terms of value added generated remained at about the same level until the period 1983 ot 1985 when it increased by about 11%.

8.11 ANALYSIS AT 2 DIGIT LEVEL

8.11.1 MANUFACTURE OF WOOD AND WOOD AND CORK PRODUCTS AND MANUFACTURE OF FURNITURE AND FIXTURES (33)

Table 8.47

VALUE ADDED IN '33' SECTOR (%)

SUB-SECTOR	1978	1979	1983	1985
33111	60.3	59.8	56.2	46.7
33112	22.6	23.7	20.7	21.5
33200	6.7	6.3	8.9	13.3
OTHERS	10.4	10.2	14.2	18.5
TOTAL VALUE ADDED (M$)	551.00	637.034	651.569	555.207

The contribution of 'sawmills' (33111) to value added of this sector has declined significantly, with much of the decline occurring in the period 1983 to 1985. The 'Plywood, Hardboard and Particle board mills' (33112) has more or less maintained its share while 'Manufacture of furniture and fixtures '(33200) experienced a doubling in their contribution to the value added of this sector.

Table 8.48

ENERGY CONSUMPTION OF '33' SECTOR (TCal)

SUB-SECTOR	1978	1979	1983	1985
33111	560.802	768.266	636.989	519.786
33112	162.072	181.095	235.330	165.246
33200	22.872	21.021	22.369	68.599
OTHERS	52.053	57.296	83.416	88.076
TOTAL	818.799	1027.678	978.104	841.707

Sub-Sector '33111' (Sawmills) is the largest energy consumer within the '33' sector and accounted for 62% of energy consumption in 1985 and 47% of value added in the same year.

The energy intensity in this sector has increased slightly by 2% in the period 1978-1985 due to the increase of 19% in electricity intensity as a result of the structural shift in this sector. Fossil fuel intensity however has declined slightly by less than 2%.

Table 8.49

ENERGY INTENSITIES IN THE '33' SECTOR

YEAR	ENERGY/ VALUE ADDED (Tcal/M Rgt)	ENERGY/PRODUCTION VALUE (Tcal/M Rgt)	FOSSIL FUEL/ VALUE ADDED (Tcal/M Rgt)	ELECTRICITY/ VALUE ADDED (GWh/M Rgt)
1978	1.49	0.44	1.22	0.307
1979	1.61	0.46	1.36	0.289
1983	1.50	0.48	1.22	0.333
1985	1.52	0.48	1.20	0.364

8.11.3
MANUFACTURE OF CHEMICALS AND OF CHEMICAL, COAL, RUBBER AND PLASTIC PRODUCTS (35)

Table 8.54

VALUE ADDED IN '35' SECTOR

SUB-SECTOR	VALUE ADDED (M Rgt)			
	1978	1979	1983	1985
35111	-	-	523.575 (31.9%)	950.735 (45.9%)
35119	51.910 (4.7%)	55.317 (4.3%)	27.727 (1.7%)	81.098 (3.9%)
35510	111.570 (10.1%)	113.479 (8.7%)	169.029 (10.3%)	133.961 (6.5%)
35591	300.530 (27.3%)	332.988 (25.7%)	202.874 (12.3%)	150.604 (7.3%)
35599	56.500 (5.1%)	64.442 (5.0%)	106.810 (6.5%)	103.172 (5.0%)
35600	95.860 (8.7%)	115.031 (8.9%)	150.786 (9.2%)	168.302 (8.1%)
Others	(44.1%)	(47.4%)	(28.1%)	(23.3%)
TOTAL	1100.770	1297.725	1642.835	2070.545

Table 8.55:

ENERGY CONSUMPTION OF THE '35' SECTOR (Tcal)

YEAR/ SUB-SECTOR	1978	1979	1983	1985
35111	-		94.459	66.974
35119	-		137.992	245.359
35510	93.685	95.984	160.266	207.445
35591	342.440	352.280	367.501	370.456
35599	66.196	71.826	215.300	172.448
35600	78.878	100.424	131.476	162.681
OTHERS	416.208	489.177	369.347	335.246
TOTAL	997.407	1109.691	1476.341	1560.609

Table 8.56

ENERGY INTENSITY OF THE '35' SECTOR

	FOSSIL FUEL/ VALUE ADDED (Tcal/M$)	ELECTRICITY/ VALUE ADDED (GWh/M$)	ENERGY/ VALUE ADDED (Tcal/M$)	ENERGY PRODUCTION VALUE (Tcal/M$)
1978	0.53	0.44	0.91	0.22
1979	0.52	0.39	0.86	0.21
1983	0.58	0.37	0.90	0.19
1985	0.53	0.26	0.75	0.18

It is interesting to note that in the '35' group, sub-sector '35111' accounted for 46% of value added in 1985 and only 4.3% of energy consumption. '35111' includes the MLNG plant in Sarawak which generates particularly high value-added due to the export value of the LNG. The main fuel used to run the LNG plant is natural gas which has not been included in the Department of Statistics survey forms.

In terms of structural change in the '35' group of industries, the '35111' sub-sector's contribution to value added increased dramatically from nil in 1978 to 46% of value added in 1985. The industries in '35111' came on stream in 1983.

The '35600' group (manufacture of plastic products n.e.c.) has maintained its share of value added and accounted for 8.1% in 1985. The third largest contributor to value added of this group is the '35591' sub-sector (rubber remilling and rubber latex processing) accounting for 7.3% in 1985 which was a substantial drop from the 27.3% in 1978 due probably to both the decline in rubber prices and the rise in diesel price (after removal of the subsidy on diesel).

Energy Intensity of this sector declined by about 18% with much of the decline occurring between 1983 dan 1985. This could be explained by increasing gas use in this period in the '35111' sub-sector which ahs not been included in the data supplied by the Department of Statistics. While fossil fuel intensity has remained at about the same level, electricity intensity declined by 41% probably due to the significant structural shifts which have occurred in this sector.

The share of '35510' (Tyre and Tube Industries) in value added peaked in 1983 and declined to 6.5% in 1985. These shifts in the relative share of sectoral value added would have affected energy intensity as shown in the table above.

8.11.2 MANUFACTURE OF PAPER AND PAPER PRODUCTS AND 'PRINTING, PUBLISHING AND ALLIED INDUSTRIES

Table 8.50

VALUE ADDED OF '34' SUB-SECTORS

SUB-SECTOR	CONTRIBUTION TO VALUE ADDED (%)			
	1978	1979	1983	1985
34110	2.3	2.5	2.5	2.7
34190	6.2	6.8	6.5	7.9
34200	81.6	79.1	79.4	78.1
OTHERS	9.9	11.6	11.6	11.3
TOTAL VALUE ADDED (M$)	253.44	271.82	421.1	462.195

The main contributor to value added of this sector is the 'Printing, Publishing and Allied Industries' (34200) which accounted for 78% of value added in 1985.

'Pulp, Paper and Paperboard' (34110) and 'Pulp, Paper and Paperboard Articles' (34120) accounted for 2.7% and 7.9% respectively of value added.

Table 8.51

ENERGY INTENSITIES

YEAR	ENERGY/ VALUE ADDED (Tcal/M Rgt)	ENERGY/PRODUCTION VALUE (Tcal/M Rgt)	FOSSIL FUEL/ VALUE ADDED (Tcal/M Rgt)	ELECTRICTIY/ VALUE ADDED (GWh/M Rgt)
1978	0.90	0.38	0.23	0.78
1979	0.77	0.31	0.25	0.60
1983	0.56	0.23	0.36	0.23
1985	0.56	0.26	0.36	0.23

Energy Intensity in terms of value added has declined by 38% in the period 1978-1983 due to the sharp decrease (70%) in electricity intensity. Fossil Fuel intensity has increased by 57%.

Table 8.52

ENERGY CONSUMPTION IN THE '34' SUB-SECTORS (Tcal)

SUB-SECTOR	1978	1979	1983	1985
34	227.701	208.267	234.306	258.305
34110	13.786	18.250	58.488	69.964
34190	31.013	37.030	60.188	85.764
34200	164.300	130.614	74.511	64.625
OTHERS	18.602	22.373	41.119	37.952

Table 8.53

VALUE ADDED IN '34' SUB-SECTOR (M $)

SUB-SECTOR	1978	1979	1983	1985
34	253.44	271.82	421.1	462.195
34110	5.94	6.84	10.324	12.676
34190	15.81	18.475	27.581	36.532
34200	206.79	214.97	334.40	361.035

While value added of '34200' has increased by 75% in the period 1978 to 1985, energy consumption increased by only 13.4% in the same period. This could be a reflection of the trend towards better quality products incorporating more value added without requiring increased energy intensity.

8.11.3 MANUFACTURE OF NON-METALIC MINERAL PRODUCT EXPCET PRODUCTS OF PETROLEUM AND COAL (36)

Structural Shift

Table 8.57

Structural Shift Within Sector 36 (%)

YEAR	CERAMICS	CEMENT	OTHER	TOTAL
1978	18.1	29.2	52.8	100
1985	18.1	41.8	40.1	100

From R.Table 8.57 it is clear that move emphasis has been placed on the cement sector in 1985. It's contribution to the sectoral value added has increased almost 45% whilst the contribution from the ceramic industries has stabilised around 18%.

Energy Intensity

Table 8.58

Energy Intensity - sector 36

YEAR	E/VA (Tcal/M$)	FF/VA (Tcal/M$)	EL/VA (GWh/M$)
78	5.472	4.531	1.095
79	5.430	4.380	1.221
83	5.004	4.098	1.053
85	4.063	3.223	0.978

Table 8.58 clearly shows that energy consumption per unit of value added has been declining over the period of analysis. The electricity intensity has stabilized in the range of (1.0 - 1.2) Gwh/M$. Therefore improvements in the energy intensity is due to efficient utilization and substitution of fossil fuel, mainly in the cement subsector as decribed in the following paragraphs.

Cement Sub-sector 36921:

Cement production has gradually increased at an average annual rate of 5% whilst energy consumption increased at 5.4% p.a over the same period.

Table 8.59

Cement Production

Year	Production	('0.00 metric tonnes)
78	2197	
79	2265	
83	3281	
85	3128	

Table 8.60

Energy Consumption

Year	Energy Consumption (Tcal)	Value Added (M$)
78	936	78
79	964	93
83	1503	208
85	1350	254

Energy consumption per unit of value added fellby 56% over the period of 1978 - 1985 and the consumption per unit of production has stabilized in the range of 426 - 432 Gcal/'thousand metric ton indicating an increased substitution of cheap fuel.

Table 8.61

Energy Intensity

Year	E/VA (Tcal/M$)	FF/VA (Tcal/M$)	EL/VA (Gwh/M$)
78	11.9	9.6	2.7
79	10.4	8.1	2.6
83	7.2	5.5	2.0
85	5.3	3.7	1.8

Energy consumption in the Cement Industries consists mainly of electricity to drive crushing and grinding equipment and fuel (fuel oil, coal or gas) used in firing the kiln. Total energy requirement of the dry kiln process is about (70 - 75)% of the wet kiln process. Some figures are given below:-

Energy source	Dry process	Wet process
Electricity (kwh/tonne)	90 - 95	100 - 130
Fuel Oil (bbls/tonne)	0.6	0.8

There is a gradual decrease in the fossil fuel intensity. A big drop has been observed between 1979 - 1983. This indicates the beginning of the shift from wet process to dry process and the substitution of coal for oil in kiln firing. The electricity intensity has also decreased over the same period indicating the same. Wide variation of electricity use is also expected in this sub-sector depending on the type of mills, the type of clinker used and the fineness of the final product. The shift to dry process has brought about reduction in energy consumption despite increased production. Substitution of coal is clearly shown in the following table:-

Table 8.62:

Fuel Mix (Tcal)

Year	Diesel Oil	Fuel Oil	Coal
1978	16	740	-
1979	17	736	-
1983	24	297	825
1985	25	305	620

Bricks & Tiles Subsector (36910):

This sub-sector comprises the production of bricks, floor and roofing files, clay pipes and so on. Tiles were the dominant product before 1982, whereby there was an increased production of tiles. From 1982 onwards dominant product has been shifted to earthern bricks and cement roofing tiles. Production has decreased by 7.5% in 1985 in line with a similar trend in the cement subsector since both are connected to the construction industry.

Table 8.63:

Production Data

Year	Dominant Product	Quantity (units)
78	Tiles	50413000
79	"	57404000
83	Earthern Bricks and Cement	636384000
	Roofing Tiles	588516000

This Industry needs particularly thermal energy for firing and drying. Studies indicate that thermal energy requirement constitute about 95% of the total energy demand of which 75% is met by firewood and 20% by diesel and fuel oil. The sector comprises many small scale industries which use fuel wood. When non-commercial energy is taken into account the energy coefficient stands to be highest in the manufacturing about 0.55 TJ/M$.

Table 8.64:

Energy Consumption

Year	Energy Consumption (Tcal)	Value Added (M$)
1978	177	49
1979	190	57
1983	364	96
1985	426	111

Commercial energy consumption has increased by 140% during 1978 - 1985. However the value added-intensity has stabilised between 3.3 - 3.9 Tcal/M$ over the same period. Low electricity coefficient clearly shows that electricity does not play a major role in the production. Major fuels are diesel and fuel oil.

Table 8.65:

Energy Intensity

Year	E/VA (Tcal/M$)	FF/VA (Tcal/M$)	EL/VA (Gwh/M$)
78	3.6	3.4	0.31
79	3.4	3.1	0.30
83	3.8	3.6	0.24
85	3.9	3.6	0.25

SUB SECTOR 37: BASIC METAL INDUSTRIES

Structural Shift (%)

Table 8.66:

Structural Shift Within Sub-sector 37

Year/ISIC	37101	37109	37102	37	VA(M$)
1978	32.7	31.1	36.2	100	166
1979	26.8	40.0	33.2	100	152
1983	20.3	44.4	35.3	100	338
1985	32.7	41.1	26.2	100	343

Value added of the iron and steel basic industries has more than doubled during the analysis period. The other iron sectoral value added, increasing from 31% in 1978 to 41% in 1985 whilst the contributions from foundries has declined from 36% to 26%. The basic iron and steel industries has maintained it's contribution at 33%. The table clearly shows a step change in the primary iron and steel industries from 1983 to 1985. This could have been as a result of the on-coming of the Perwaja steel mill.

Energy Intensity

Table 8.67:

Energy Intensity - Sector 37

Year	E/VA (Tcal/M$)	FF/VA (Gwh/M$)	EL/VA	(including charcoal)(Tcal/M$)
1978	7.488	6.614	1.018	
1979	7.842	6.750	1.270	
1980	4.988	4.177	0.941	
1985	4.574	3.458	1.297	

Table 8.67 clearly shows the downward trend in the energy intensity which is mainly due to the variations in the fossil fuel consumption like utilization og gas etc. since electricity intensity has stabilized between 0.9 - 1.3 Gwh/M$.

Iron and Steel Sub sector (37101)

The iron and steel sector comprises the basic industries of iron and steel production, which process raw materials to semi-finished products either in an integrated iron and steelwork or by processing of semi-finished products to final products.

The level and composition of energy used depends largely on the type of steel products and the technology. Various unit operations, type of fuel used and some typical data are listed below:-

Unit Operation	Fuel type	Typical data (literature survey)
Raw material processing (crushing).	Electricity	
Sintering.	Electricity charcoal fuel oil or blast furnace gas.	
Blast Furnace. coke.	charcoal	
Shaft Furnace.	gas.	13Gj/tonne.
Converter.	electricity.	50kwh/tonne.
Electric Furnace.	electricity.	930kwh/tonne.
Casting	electricity.	
Reheating. blast furnace gas.	Fuel oil blast	6GJ/tonne.
Rolling mill.	electricity.	0.6GJ/tonne.
Steel Plant.		21GJ/tonne.

The products of this sector are shown in the table below. The product breakdown and prime products has been changed from 1983 onwards. Iron and steel bars and rods are the major products.

Table 8.68:

Energy Intensity

Year	E/VA (Tcal/M$)	FF/VA (Tcal/M$)	EL/VA (Gwh/M$)
1978	19.577	17.923	1.930
1979	23.529	21.005	2.917
1983	15.670	14.400	1.472
1985	8.670	6.714	2.253

As explained under sub-sector 36, the impact of gas utilization in Perwaja steel mill is clearly shown in Table 8.68. This new steel mill also gets electricity supply at special rates that this will obviosly will distort the overall scenario.

The production of basic metal and steel products (reported in terms of tonnes) has declined only by 3.5% over the period of 1978 - 1985. Also not much of price changes have taken place except between 1979 to 1983 (Table 8.70).

Table 8.69:

Basic Metal and Metal Products

	1978	1979	1983	1985
Iron foundries and iron and steel basic shapes (tonnes) 1	156984	166831		
Structural shapes and complete steel structures (tonnes) 2	14413	12486		
Bars and rods for reinforced concrete (tonnes) 3	240331	244133	33350	22981
Iron and steel drums ('000 unit)	2093	2227	2084	2449
Tin cans and metal boxes (million units)	368	450	372	432
Other metal products ($'000)	77887	79061		
Aluminium, brass, copper and pewter products ($'000)	49187	61282		
Iron and steel bars and rods (tonnes) 4			306426	323387
Galvanised iron sheets (tonnes)			52323	51014

Table 8.70:

Prices of Steel Bars in per tonne

Year	Price Range (i.e for different type of products, $/tonne)
1978	610 - 690
1979	610 - 750
1982	827 - 1092
1983	891 - 1035
1985	891 - 1035

Other Steel and Basic Industries (36109)

Table 8.71:

Energy Intensities

Year	E/VA (Tcal/M$)	FF/VA (Tcal/M$)	EL/VA (Gwh/M$)
1978	0.9808	0.779	0.244
1979	1.393	1.000	0.456
1983	1.720	0.911	0.937
1985	2.149	1.405	0.865

Not much variation is observed in the intensities. Small variations are probably due to lower price increments compared with production increment.

8.11.4 MANUFACTURE OF FABRICATED METAL PRODUCTS, MACHINERY AND EQUIPMENT

Structural Shift

Table 8.72:

Structural Shift (%)

Year/ISIC	38329	Others	38
1983	45.9	54.1	100
1985	45.7	54.3	100

The semiconductor sub-sector contributed 46% of the value of Manufacture of Fabricated Metal Products (except machinery and equipment) sector. No sectoral shift is observed. Semiconductor manufacturing is a relatively new industry. Semiconductor components were considered as prime products only from 1983 onwards and no data is available prior to that year.

Energy Intensity

Table 8.73:

Energy Intensity - 38

Year	E/VA (Tcal/M$)	FF/VA (Tcal/M$)	EL/VA (Gwh/M$)	VA (M$)
1978	0.553	0.301	0.293	1123
1979	0.409	0.183	0.263	1424
1983	0.430	0.176	0.295	2058
1985	0.350	0.131	0.255	2244

Energy intensity in general has declined over the period of analysis. Obviously this is due to a decline in the fossil fuel intensity. One reason for this decline is the introduction of the semiconductor industry in the early 1980's. This is clearly shown by the increase in electricity intensity between 1979 - 1983. Value added had increased tremendously during the same period. Incremental use of fossil fuel was far too small compared with the increments in value added.

Semi conductor and other electronic components and communication equipment) and apparatus. (38329)

Production of semiconductors has declined from 1594million units in 1983 to 1464 million units in 1985 by 8%. Energy consumption has declined by 12.7% and value added increased by 8.6% during the same period. The fossil fuel coefficient is very small indicating no significant contribution towards the total fuel consumption. The energy per unit of value added has gone down by 19.4% whilst the energy per unit of production has declined by 5%. Introduction to automated processes has increased energy efficiency as well as reduced the labour requirement and therefore has brought down the energy requirement per unit of value added.

Table 8.74:

Energy Coefficient

Year	Production of Semiconductors mil. units	Energy Consumption (Tcal)	Energy/ Production (Tcal/mil. units)
1983	1594	292	0.183
1985	1464	255	0.174

Table 8.75:

Value Added Intensity

Year	E/VA (Tcal/M$)	FF/VA (Tcal/M$)	EL/VA (M$)
1983	0.309	0.017	0.340
1985	0.249	0.018	0.268

8.11.5 OTHER MANUFACTURING INDUSTRIES

Energy Intensity

Table 8.76:

Energy Intensity Sector 39

Year	E/VA	FF/VA	EL/VA
78	0.451	0.139	0.363
79	0.423	0.116	0.353
83	0.427	0.109	0.369
85	0.402	0.103	0.347

Table 8.77:

Energy Consumption

Year	Energy Consumption (Tcal)	Value Added (M$)
78	13.7	26.9
79	15.5	284
83	28.9	521
85	28.5	609

Table 8.78:

Fuel Mix

Year	DO (Tcal)	FO (Tcal)	EL (Gwh)	FF (Tcal)
78	2.5	0	11.0	4.2
79	2.9	0	13.0	4.3
83	4.7	0.6	25.0	7.4
85	4.5	0.9	24.6	7.3

This sector uses more electricity than fossil fuel. Energy consumption has increased by 108% and value added by 126%, indicating an increase in energy efficiency in this sector. The energy consumption per unit of value added has declined by 11%. The electricity coefficient has stabilized in the range of 0.347 - 0.369.

8.12 CONSTRUCTION SECTOR

8.12.1 Background

The construction sector contributed about 4.2%, 4.6% and 4.1% to the real Gross Domestic Product (GDP) in 1976, 1980 and 1985 respectively. Total employment of the sector amounted to 270,000, which contribute about 6% of the total employment in 1980 and increased to 429,400 (8%) in 1985. (See Appendix I and II of Construction Sector)

Period 1976 -1980

This is a boom period for the construction sector. Between 1976 and 1980, output of this sector which expanded at an average rate of 13.1% per annum was in fact higher than the other sectors of the economy. This increase was largely due to the construction boom in response to demand for housing which rose rapidly, aided by improved conditions in the mortgage and real estate market. Non-residential construction also increase significantly resulting from implementation of major public sector infrastructural projects and construction investment associated with private sector manufacturing activities.

Period 1981 - 1984

The construction sector experienced a marginal slowdown in activity for period 1981 - 1984. Average growth in value added for that period was 9.3% compared with 13.1% for period 1976 - 1980. This is mainly due to the slowdown in public sector expenditure on infrastructure projects, the completion or near completion of several large public sector infrastructure projects and sluggish activity in residential housing. Except for 1983, residential construction activity was generally sluggish for period 1981 - 1984. In 1984 for example, the survey of housing starts in Kuala Lumpur, Seberang Prai, Klang and Shah Alam showed an aggregate decline of 29.4% in housing starts (in terms floor area of residential building) compared with a sharp growth of 60.7% in 1983. The number of housing completed also declined by 8.4% from 92,573 units in 1983 to 84,765 units in 1984. (Refer to Appendix II). The slowdown in the construction of residential houses reflected mainly sluggish demand especially for higher priced houses mainly due to higher interest rates on end-financing for medium and higher cost houses and continued imposition of a partial freeze on Government housing loans.

The focus on construction activity for period 1981 - 1984 however, was in non-residential commercial construction. In urban centres thoughout the country, and particularly in Kuala Lumpur, a large number of project involving the construction of high-rise office complexes, shopping centre and hotel were implemented during this period. The housing start survey conducted by Central Bank showed that the built-up area in these cities increased by 50.7%, 33.9% and 41.1% respectively for 1982, 1983 and 1984.

Period 1985 - 1987

The construction sector experienced a decline in activity for period 1985 - 1987. Value added in this sector declined by 5.4% in 1987, compared with a decline of 14% in 1986 and 8.4% in 1985. The downturn in activity was evident in all types of construction. Lack of effective demand has led to a decline in the construction of residential houses and condominiums, especially for higher priced houses, while the excess supply of office space and the slack in business investment were responsible for the steep drop in the construction of commercial buildings.

Residential construction activity remained sluggish mainly due to decline in nominal income, continuing high interest rates on end-financing for medium and higher cost houses and the imposition of a partial freeze on Government loans. On the supply side, excess in unsold houses and condominiums has discouraged developer to develop new projects. The Central Bank's survey on construction starts in Kuala Lumpur, Seberang Prai, Klang and Shah Alam, indicated an aggregate decline of 40.9% in housing starts in 1987 (in terms of floor area for residential), compared with a decline of 6.7% in 1986.

8.12.2 Energy Consumption

The major fuels consumed by the construction sector were diesel, petrol and electricity, which comprise more than 90% of the total energy consumed in the construction sector during 1978 - 1985 period. The total diesel, petrol and electricity consumption in 1978 - 1985 is represented in table E.5.1. As shown in that table, diesel has the largest share comprising in the range of 70 - 76% of the total energy consumption during the period 1978 - 1985, followed by petrol at 11 - 17% and electricity with 6.5 - 9.4%. Other fuels consumed were fuel oil, kerosene, firewood and lubricant (non-energy).

Table 8.79:

Energy Consumption of the ConstructionSector 1978 - 1985.

	1978	1979	1980*	1981	1982	1983	1985
Diesel (TJ)	6094	5798	6114	8091	9425	10584	10266
%	74.6	72.8	71.5	75.3	76.2	76.1	71.6
Petrol (TJ)	963	1248	1499	1625	1836	2162	2484
%	11.8	15.7	17.5	15.1	14.8	15.6	17.3
Electricity (TJ)	710	750	790	833	878	926	1345
%	8.7	9.4	9.2	7.7	7.1	6.7	9.4
TOTAL (Including Other Fuels)(TJ)	8172	7963	8546	10743	12367	13898	14346

Source: * From NEPS and the rest from
Department of Statistics and Mines Department

The Table shows that, total energy consumption in construction sector has increased significantly by 31% from 8172 TJ in 1978 to 10743 TJ in 1981. This is mainly due to increased construction activities during this period. Subsequently, Gross Domestic Product (real GDP) for construction sector increased by 51% from $1522 million and $2367 million during the same period. However, the total energy consumption has increased marginally by 3% from 13898 TJ in 1983 to 14346 TJ in 1985 as a result to the slowdown in construction activities especially in housing sector.

Diesel consumption has increased significantly at a rate of 16.2%, for the period 1979 - 1983 and dropped slightly by 3% in 1985. However consumption of other fuels such as fuel oil, petrol and electricity showed a large increase by 69%, 15% and 45% respectively in 1985 compared to 1983. This is mainly due to the drop in residential and non-residential construction activities (which consumed more diesel) but increased civil engineering and special trade construction activities which consumed more fuel oil, petrol and electricity.

8.12.3 Energy Coefficient

The total energy coefficient for the same period are given in Table 8.80

Table 8.80:

Malaysia: Energy Coefficient for the Construction Sector 1978 - 1985

	TJ	GDP (CONSTANT '78) (Million M$)	Coefficients (TJ/Mil. M$)
1978	8172	1,572	5.2
1979	7963	1,761	4.5
1981	10743	2,367	4.5
1982	12367	2,598	4.8
1983	13898	2,867	4.8
1985	14346	2,738	5.2

Source : Dept. of Statistics, Mines Dept. and Economic Report.

The total energy consumption coefficient for the period 1979 - 1983 were relatively stable. The increased of 8.3% of the 1985 coefficient compared to the coefficient for 1983 can be interpreted as a result of increased in civil engineering construction by 7.1% in 1985 compared to 1983 which is more energy intensive compared to other type of activities in construction sector. However, energy coefficient, for the period 1978 to 1985 were still quite stable.

8.13 MINING

8.13.1 Background

The mining sector comprises the production of petroleum and gas, tin, copper, bauxite, iron ore and other minerals. This sector contributed about 10% to real Gross Domestic Product (GDP) in 1975 and 1980 and increased slightly to 10.5% and 11.1% in 1985 and 1986 respectively. Total employment in this sector has dropped significantly from 80,100 persons in 1980, which was about 2% of the total employment in Malaysia to 36,500 persons (0.6% of total employment) in 1986. This is mainly due to decline of employment in tin industry from 39,009 persons, which is about 49% of the total employment in mining sector to 11,797 persons (32% of total employment in mining sector) in 1986 (Refer to Table 8.81).

Table 8.81:

Employment in Mining Sector

Year	Mining Sector	Tin Mining	(%)1
1980	80,100	39,009	(49)
1981	75,800	35,198	(46)
1982	69,300	28,432	(41)
1983	49,900	25,641	(51)
1984	47,200	23,623	(50)
1985	44,400	16,829	(38)
1986	36,500	11,797	(32)

Note: 1 Percentage of total employment in mining sector
Source: Economic Report 1985/86 & 1988/89

The mining sector was largely dominated by crude oil which accounted for 77.4% of the value added of the sector in 1985 and increased to 79.9% in 1987. This was followed by tin, accounting for 13.5% in 1985 and declined to 10.4% in 1987 Gas accounting about 4.5% in 1985 and increased to 6% in 1987.

This sector recorded a growth rate of 8.3% per annum during 1976 - 1980 which is slightly lower than the real GDP growth of 8.4% per annum. However, this high growth performance was not sustainable during the 1980s when output of this sector grew by 5.9% between 1981 - 1985 and 3.7% per annum during 1986 - 87.

Nevertheless, the value added share of the mining sector to GDP had risen rapidly from 5.8% during 1976 - 1980 to 10% in 1980s, mainly due to increasing contribution of petroleum production as tin output declined with the depleting resources and the rising cost of production. The collapse of the International Tin Council (ITC) buffer stock operations following the suspension of trading in the London Metal Exchange in October 1985, further reduce the output of tin. Hence the production of tin which remained high at about 62,000 tonnes between 1976 - 1979 have been on a downtrend since 1980. By 1986, productions of tin had declined to 29,133 tonnes and the number of mines in operation had fallen from 852 in 1980 to 197 in 1986. (Refer to Table 92). Malaysia's share in World output also declined from 30.8% in 1980 to 20.8% in 1985.Of the total output in .pa 1985, gravel pump mines accounted for 50.2%, dredges 30.6% and others 19.2%. (Refer to Appendix IV of Mining Sector)

The output of crude oil, on the other hand accelerated rapidly despite the declining trend in world crude oil prices with the increase in exploration and development activities and the increased financing needs of the Government. Crude oil production had increased significantly from an average of 189,500 barrels per day (bpd) in the period 1976-1980, to 367,500 bpd in 1981-1985 and about 500,000 bpd since 1986. The gross production of natural gas also increase rapidly from 258.2 million standard cubic feet per day (mmscfd) in 1980 to 1,557 mmscfd in 1987.

Other minerals produced during the period 1980 -1985, accounted for a very small share of the output of the mining sector. The more important ones include copper, bauxite and iron ore. Copper output from the mine at Mamut, Sabah increased gradually from 114,000 tonnes in 1980 to 128,880 tonnes in 1982, but declined to 125,000 tonnes in 1985. Bauxite production from the sole mine in Johore declined from 920,000 tonnes in 1980 to about 540,000 tonnes in 1985. Output of iron ore mined in the States of Johor, Kedah, Pahang and Perak recorded a decrease from 371,200 tonnes in 1980 to 230,000 tonnes in 1985.

8.13.2 Energy Consumption

The major fuels consumed by the mining sector were diesel and electricity, comprising in the range of between 95% - 98% of total energy consumption of the sector during 1978 - 1985 period. Other fuels consumed were aviation and jet fuel, petrol, fuel oil, kerosene and petrol. Diesel and electricity consumed during 1978 - 1985 period is shown in Table 8.82. Diesel is the largest fuel consumed which accounted in the range between 78% - 82% of the total energy consumption during the period 1978 - 1985. The diesel consumption has dropped by 32.8% from 16165 TJ in 1978 to 10861 TJ in 1985 implying a growth rate of - 5.5% over the period Electricity consumption also dropped significantly by 40% from 3187 TJ in 1978 to 1900 TJ in 1985. This is mainly due to the drop in output of tin mining industry by 41% from 62,700 tonnes in 1978 to only 36,900 tonnes in 1985 (growth rate of - 6.9%).

Table 8.82:

Diesel and Electricity Consumption In Mining Sector

	Diesel (TJ)	% Share	Electricity (TJ)	% Share	Total[1] (TJ
1978	16165	81.8	3187	16.1	19,754
1979	15823	81.2	3222	16.5	19,494
1980*	14376	78.9	3395	18.6	18,220
1981	15851	80.6	3169	16.1	19,674
1982	15988	81.3	2850	14.5	19,655
1983	12090	80.2	2280	15.1	15,071
1985	10861	81.7	1900	14.3	13,296

Note: 1 Including other fuels

Source: * From NEPS and the rest from Dept of Statistics and Mines Dept.

The fuel consumption in the mining sector for the period 1978 - 1985 were still dominated by tin mining industry although its share has decreased quite significantly. The share of fuel consumption in tin mining industry was about 83%, 70% and 67% respectively for 1978, 1983 and 1985 although its contribution to the Gross Domestic Product was less compared with oil and gas industry. The share of the oil and gas sector consumption which was about 13%, 22% and 25% in 1978, 1983 and 1985 respectively was still less although its share has increased significantly for the period 1978 - 1985. (Refer to Table 8.83)

Table 8.83:

Energy Consumption in Mining Sector (TJ)

	Tin	% share	Oil & Gas	% share	Total
1978	16,557	83.8	2607	13.2	19,754
1983	10,519	69.8	3342	22.2	15,071
1985	8,927	66.9	3530	26.5	13,296

Source : Department of Statistics and Miners Dept.

8.13.3 Energy Consumption in tin mining

The total diesel and electricity consumption for 1978 - 1985 period is represented in Table 8.84.

Table 8.84:

Energy Consumption of the Tin Mining Sector (TJ)

	Diesel	Electricity
1978	13,573	2869
1979	13,406	2829
1980	12,625	2664
1983	8,458	1900
1985	7,297	1487

Diesel and electricity consumption has decreased significantly by 46 per cent and 48 per cent respectively in 1985 compared with 1978 mainly due to the drop of tin mines in operation from 936 in 1978 to 279 in 1985, (refer to Table 8.85). Tin production also dropped from 62,700 tonnes in 1978 to 36,900 tonnes in 1985.

Table 8.85:

Number of Tin Mines In Operation 1978 - 1985

At end of the period	No. of Tin Mines in operations
1978	936
1979	873
1980	847
1981	708
1982	625
1983	547
1984	449
1985	279

Source : Mines Department.

8.13.4 Energy Consumption in Oil and Gas Mining

Energy consumption data for oil and gas are only available for 1978, 1983 and 1985. The major fuel consumed in oil and gas mining were diesel and aviation turbine fuel. The main uses of diesel are pumping and electricity generation on the oil drilling and production rigs. The consumption of aviation turbine fuel was mainly for helicopter operation services for offshore work. Total diesel and aviation turbine fuel consumption for 1978, 1983 and 1985 are represented in Table 93.This table shows that, diesel and aviation turbine fuel accounted for 98.0% of the total fuel consumed in 1978, 97.2% in 1983 and 96.9% in 1985. Other fuels including lubricant (non-energy) petrol and fuel oil.

Table 8.86:

Energy Consumption For Oil and Gas
(TJ)

Year	Diesel	AV. Turbine	Other fuels	Total
1978	2389 (92.9%)	167 (5.1%)	51 (2%)	2607
1983	2839 (84.9%)	410 (12.3%)	93 (3%)	3342
1985	3023 (85.6%)	396 (11.2%)	111 (3%)	3530

Source : Dept. of Statistics, and Mines Dept.

8.13.5 Energy Consumption in Other Mining

Fuels consumption in other mining namely copper, bauxite and iron ore were very small for period 1978 - 1985 compared to total fuels consumed in mining sector (Refer to Table 8.87)

Table 8.87:

Energy Consumption in Bauxite, Iron Ore and Copper
(TJ)

1978	203 (1.0%)
1980	237 (1.3%)
1983	801 (5.3%)
1985	874 (6.6%)

Note

(%) percent of total energy consumed in mining sector

Source : Mines Dept. and Statistics Dept.

8.13.6 Energy Coefficient

Energy Coefficient for mining sector is represented in Table 8.88. As shown in this table, the energy coefficient decreased significantly by 56% from 5.0 in 1978 to 2.2 in 1985. This due mainly to the drop in tin production from 62,700 tonnes in 1978 to only 36,900 tonnes in 1985, which is more energy intensive compared to the other minerals mining activities.

8.13.7 Energy Coefficient of tin mining.

Diesel and electricity coefficient are represented in Table 8.89 and 8.90.

Table 8.88:
Energy Coefficient of Mining Sector

	TJ	GDP-Cons. 78 (M$'000)	Coefficients (TJ/$'000)
1978	19,754	3,912	5.0
1979	19,494	4,586	4.2
1980	18,220	4,487	4.1
1981	19,674	4,289	4.6
1982	19,655	4,617	4.3
1983	15,071	5,342	2.8
1985	13,296	5,985	2.2

Source: Dept. of Statistics, Mines Dept. and Economic Report

Table 8.89:

Diesel coefficient of tin mining

	Diesel Consumption (TJ)	Tin production (tonnes)	Coefficient (TJ/tonnes)
1978	13,573	62,650	0.2166
1979	13,406	62,995	0.2128
1980*	12,625	61,404	0.2056
1983	8,458	41,367	0.2045
1985	7,297	36,884	0.1978

Source: NEPS and the rest from Dept. of Statistics and Mines Dept.

The consumption coefficient for diesel in 1978 and 1979 were very stable. The coefficient showed a decrease of 3.3% in 1985 as compared to 1983. This can be interpreted as a result of energy conservation and to the use of more efficient equipment and also the closing down of number of tin mines which were not very profitable as a result of the drop of tin prices. However, the consumption coefficient for electricity was quite constant for the period 1978 - 1985 (refer to Table 8.90).

Table 8.90:

Electricity Coefficient of tin mining

	Electricy Consumption (TJ)	Tin Production (tonnes)	Coefficient (TJ/tonnes)
1978	2869	62,650	0.0457
1979	2829	62,995	0.0449
1980	2664	61,404	0.0434
1983	1800	41,367	0.0435
1985	1487	36,8849	0.0403

Source : Dept. of Statistics and Mines Dept.

8.13.8 Energy Coefficient In Petroleum Mining Industry

Energy coefficient in petroleum mining industry which was about 0.000250, 0.000182 and and 0.000165 in 1978, 1983 and 1985 was considered very low as compared to energy coefficient in tin mining (which was about 0.26 in 1978 and 0.25 in 1985). This implies that petroleum mining industry is much less energy intensive compared to the tin mining industry.

Table 8.91:

Energy Coefficient of Petroleum Industry

Year	Energy Consumption (TJ)	Crude Oil Production (tonnes)	Coefficient (TJ/tonnes)
1978	2607	10,417,000	0.000250
1983	3342	18,394,000	0.000182
1985	3530	21,439,000	0.000165

Source : Dept. of Statistics, Mines Dept and Economic Report

CHAPTER 9

AGRICULTURE SECTOR

CHAPTER 9

AGRICULTURE SECTOR

9. CROPS, FISHING AND FORESTRY

9.1 INTRODUCTION

The Agriculture Sector is categorised by macroeconomic subsectors. Past energy demand data for this sector is scarce: thus much information is estimated. The estimations are made separately for each of the 3 subsectors:

- Crops
- Fishing
- Forestry

Each subsector is analysed in accordance with its particular database, prepared within the scope of the ESCAP/REDP P-1.1 Study and available as of December 1988. The methodology applied in the estimation processes and the approach to the analyses differ between the 3 subsectors and are discussed in their respective sections.

9.2 CROPS

9.2.1 Rubber

The main energy uses are on estate transport and all operations related to new planting and replanting of rubber trees.

Replanting and new planting activities during the period 1978 and 1982 remained almost constant averaging about 42,000 hectares. From 1983 onwards, the hectarage declined reaching to 17,670 hectares in 1986. Table 9.1 shows the total hectarage for new planting and replanting of both estates and smallholdings.

Table 9.1 :

Hectarage of Estates and Smallholdings, New Planting (NP) and Replanting (RP), 1978 - 86

	Estates			Smallholdings			Total		
	NP	RP	Total	NP	RP	Total	NP	RP	Total
1978	660	7350	8010	24100	12800	36900	24760	20150	44910
1979	1460	5560	7020	14800	13700	28500	16260	19260	33520
1980	820	7100	7920	18400	14500	32900	19220	21600	40820
1981	1840	7450	9290	13300	21700	35000	15140	29150	44290
1982	2670	7490	10160	12100	22900	35000	14770	30390	45160
1983	2920	6260	9180	12200	2300	14500	15120	8560	23680
1984	1890	5290	7180	7600	18900	26500	9490	24190	33680
1985	400	2940	3340	4400	10800	15200	4800	13740	18540
1986	50	3020	3070	1300	13300	14600	1350	16320	17670

In terms of hectarage, the total area under rubber declined from 40,820 hectares in 1980 to 18,540 hectares in 1985. The smallholding hectarage decreased from 33,000 hectares in 1980 to 15,200 hectares in 1985, while the estate sector declined from 7,920 hectares to 3,340 hectares over the same period. This decline was caused mainly by the conversion of rubber into other crops.

Diesel use is related to new planting and replanting of rubber trees. Specific energy consumption of diesel per hectare amounts to 0.052 TJ/ha (as in NEPS-based on 1978 energy consumption of 2,344.9 TJ/44910 ha)

	Diesel Consumption (TJ)	Total hectarage (ha)	Change in hectarage %
1978	2344.9	44910	-
1979	1854.6	35520	-21.0
1980	2122.6	40820	+12.9
1981	2302.1	44290	+ 8.5
1982	2348.3	45190	+ 2.0
1983	2307.8	44380	- 1.8
1984	1751.3	33680	-24.1
1985	964.1	18540	-45.0
1986	918.8	17670	- 4.7
1987	910.0	17500	
1988	884.0	17000	

The total new-planting hectarages showed a decreasing trend over the 1978 - 1986 period which decline from 15,120 hectares in 1983 to 1,350 hectares in 1986 and registered a drop of 91%. The total replanting hectarages also showed a declining trend from 29,260 ha to 16,320 ha over the same period and registered a drop of 44%. The decrease in these activities also led to a decrease in the diesel consumption from 2,307 TJ in 1983 to 918.8 TJ in 1986, a decline of 60% over the period.

Since the new planting and replanting hectarages are not available for 1987 and 1988, it is assumed that the decline in the total hectarage follows the trend of the 3 preceeding years, i.e. 1984, 1985 and 1986. The hectarages for 1987 and 1988 is obtained graphically by projecting a smooth curve through the 1984, 1985 and 1986 values and extending the curve to 1987 and 1988. This approximation gives the estimated hectarages of 17,500 for 1987 and 17,000 for 1988.

It is assumed that motor petrol/diesel ratio (0.06% diesel share) will remain constant. Motor petrol consumption in 1980 amounted to 131 TJ (based on NEPS).

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Motor Petrol Consumption (TJ)	145	114	131	143	146	143	109	60	57	55	53

The use of lubricants was assumed with 5% of total diesel and petrol used (based on NEPS).

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Lubri-cants Consump-tion(TJ)	124	98	113	122	125	122	93	51	49	48	47

Electricity in the rubber sector was used mainly in rubber processing on estates. It is expected that the share of hectarage and output of the estates in the total is shifting in favour of rubber smallholdings sector. Electricity consumption was assumed to grow at 75% of the growth of rubber output. This takes into account the amount of rubber processed on estates is declining and that electricity savings will take place. Therefore, electricity consumption is derived by escalating the previous year electricity consumption with 75% of the growth rate of value added between 1978 to 1980.

	1979	1979	1980	1981	1982	1983	1984	1985	1986
Value Added	2585	2439	2382	2354	2370	2445	2392	2279	2394
Elec-tricity consumption (TJ)	388.8	386.5	377.61	373.17	375.71	387.60	379.20	379.20	379.20

The total energy consumption in the rubber sector can be summarised as follows:-

	Diesel	Motor Petrol	Lubricants (TJ)	Electricity	Total
1978	2344.9	145	124	388.8	3002.7
1979	1854.6	114	98	386.5	2453.1
1980	2122.6	131	113	372.6	2832.6
1981	2303.1	143	122	373.17	2941.3
1982	2348.3	146	125	375.71	2995.0
1983	2307.8	143	122	384.6	2960.0
1984	1751.3	109	93	379.2	2332.5
1985	964.1	60	51	379.2	1454.3
1986	918.8	57	49	379.2	1393.2
1987	910.0	55	48	379	1392
1988	884.0	53	47	379	1363

Sources:-

1. National Energy Planning Study, 1985
2. Ministry of Primary Industry.

9.22 Oil Palm

In oil palm plantations energy is required for cultivation and transportation of fresh fruits bunches from field to palm oil mills. Besides electricity three other types of fuel are required to perform these activities, namely diesel oil, motor petrol and lubricants. The total consumption of each fuel type can be estimated based on the hectarage of the crop.

The total planted hectarage increased steadily from 850,000 ha in 1978 to 1.685 million ha in 1987. The corresponding palm oil yield increased from 1,785 million tonnes to 4,532 million tonnes. The world market is for this oil is growing steadily despite the recent anti palm oil campaign of the US, and it is expected that the trend of hectarage growth of the 1978 - 87 era will continue in the next ten years. A crude palm oil production tonnage of 4,550 million is assumed for 1988.

Diesel is required to generate energy for transportation and cultivation. Diesel for cultivation is assumed to be 30% of diesel used in transportation. Generally the demand for diesel will rise and fall with the increases and decreases in the output of fresh fruit bunches or to a certain extent, crude palm oil. The production of fresh fruit bunches and crude palm oil will be determined by the total hectarage of harvested area. Harvested area is assumed to be 73.6% of planted areas. Since data on crude palm oil is readily available, projection of diesel requirement based on it is the preferred method.

Diesel for transport has been estimated to be 24 litres for every tonnes of crude palm oil produced. Column (2) of table I.2 shows the total crude palm oil production in tonnes per year from 1978 to 1987. Based on these assumptions the total diesel consumption for transportation can be estimated. This is shown in column (3) and in column (4) is its energy equivalent in terajoule.

Diesel consumption for cultivation is assumed to be 30% of the diesel used for transportation. This is shown in column (5). Column (6) is its energy equivalent in terajoule.

Table 9.2:

Diesel Consumption

Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
Year	+Crude Palm Oil Production (tonne)	Total Diesel Consumption for Transport in Million (24.0L/t)	Total Diesel Consumption for Transport in TJ (0.0429)	Diesel Consumption for Cultivation in TJ (30% of Col. 4)	Total Energy Consumption in TJ
1978	1,785,525	42.853	1821	546	2367
1979	2,188,439	52.523	2232	670	2902
1980	2,575,865	61.821	2627	788	3415
1981	2,824,464	67,787	2880	864	3744
1982	3,514,169	84,340	3548	1064	4612
1983	3,018,333	72,440	3078	923	4001
1984	3,175,739	89,178	3789	1137	4926
1985	4,133,394	99,201	4215	1265	5480
1986	4,543,884	109,053	4634	1390	6024
1987	4,532,235	108,774	4622	1387	6009
1988	4,550,000	109,208	4640	1392	6032

\+ Source: Palm Oil Basic StatisticsMinistry of Primary Industries

Motor petrol is assumed to be used in farm transport and it is related to harvested hectarage. Harvested hectarage is assumed to be 73.6% of planted hectarage. In each hectarage 0.0003 TJ of energy is required for transportation. The estimated motor petrol consumption is shown in Table 9.3.

Table 9.3:

Motor Petrol Consumption

Year	Planted Area (hectarage)	Harvested Area (.736)	Energy Consumption (0.0003 TJ/ha)
1978	852,979	627,792	188
1979	938,863	691,003	207
1980	1,023,306	753,153	256
1981	1,140,538	839,436	251
1982	1,200,104	883,277	265
1983	1,258,009	923,895	277
1984	1,349,192	993,006	298
1985	1,468,214	1,080,606	324
1986	1,599,311	1,177,093	353
1987	1,685,581	1,240,588	372
1988	1,700,000	1,251,200	375

\+ Source: Palm Oil Basic Statistics
Ministry of Primary Industries

Lubricants Consumption is assumed to be 5% of motor petrol and diesel use. The estimation of its consumption in energy equivalent is shown in Table 9.4.

Table 9.4:

Lubricants Consumption

Year	Lubricants, 5% of diesel use (TJ)
1978	118
1979	145
1980	171
1981	187
1982	231
1983	200
1984	246
1985	274
1986	301
1987	300

Electricity Consumption based on National Account Statistics, amounted to 259.2 TJ in 1979. Unlike for diesel, motor petrol and lubricants, electricity consumption could not be identified by type of use. Since the electricity consumption data is available only for a few years, it is not possible to establish the relationship between electricity consumption and palm oil output. For lack of a more reliable method of estimating electricity consumption, the assumption that electricity consumption increases at the rate of 50% of the growth of palm oil output has been used. Table 9.5 is derived base on this assumption.

Table 9.5:

Electricity Consumption

Year	Output (tonnes)		Electricity Consumption(TJ)	
1978	1,785,525		232.9	
1979	2,188,439	17.7% increase	259.2	8.85% increase
1980	2,575,865		282.1	
1981	2,824,464		295.7	
1982	3,514,169		331.8	
1983	3,018,333		308.4	
1984	3,175,739		316.4	
1985	4,133,394		364.2	
1986	4,543,884		382.3	
1987	4,532,235		381.3	
1988	4,550,000		381.7	

9.2.3 PADI

Energy is utilised in padi cultivation in the form of diesel and lubricants to propel farm tractors, cultivators and combine-harvestors. Irrigation pumps however are largely electrically driven. Tractor fuel requirements vary with the degree of mechanization. Padi hectarages can be classified into three types based on different stages of mechanization:-

(i) non-mechanized;
(ii) partially mechanized e.g. mechanization of soil preparation;
(iii) fully mechanized.

Padi irrigation can be classified by the degree of irrigation:-

(i) irrigated, 1 crop/year
(ii) irrigated, 2 crops/year
(iii) non-irrigated

The hectarage of irrigated padi area of about 340,399 ha. in 1980 was almost all partially mechanized. Non-irrigated padi area of 183,291 ha. which are rain-fed area was assumed to be 20% partially mechanized in 1980. Fully mechanized padi area was assumed to be 30% of double-cropped irrigated area in 1980.

Table 9.6:

Irrigated and Non-irrigated Padi Areas, 1978-1986
Padi Areas (planted)(hectares)

						Irrigated[2]	
Year	Total[1]	1 Crop	2 Crops	Non-Irrigated[2]	Total	1 Crop	2 Crops
1978	438,540	335,340	103,200	153,489	285,051	217,971	67,080
1979	554,780	331,500	223,280	194,173	360,607	215,475	145,132
1980	523,690	319,390	204,300	183,291	340,399	207,604	132,795
1981	515,080	316,150	198,930	180,278	334,802	205,498	129,305
1982	588,870	376,685	212,185	206,104	382,766	244,845	137,920
1983	569,451	395,575	173,481	199,308	370,143	257,124	112,763
1984	540,871	349,299	191,572	189,305	351,566	227,044	124,522
1985	561,174	364,543	196,631	196,411	364,763	236,953	127,810
1986	614,886	429,265	185,621	215,210	399,676	279,022	120,654
1987	650,000			227,500	422,500		
1988	700,000			245,000	455,000		

Notes:-

1 Source: Ministry of AgricultureTotal padi areas excluding hill padi
2 Based on recommendation of Drainage and Irrigation Department (DID) that in 1985, about 65% of total padi area is being irrigated. Therefore, 65% is applied for all padi hectares throughout the years.

Diesel Consumption based on NEPS for tractors is as follows:-

	Tractor type and tractor hours per ha.			Diesel oil Requirements	
	37 kw	75 kw	Total	kwh/ha	kg/ha
Partial Mechanisation	5 hrs	-	5	140	34
Full Mechanisation	4 hrs	6	10	450	108

+ Engine loading : 0.75
+ Calculated at : 6.24 kg/kwh

Irrigation water is applied prior to planting and during the growth period of padi in order to cope with dry weather spells. Under these condition, irrigation rate requirements are in the range of 1500-2500 cu.m/ha. Irrigation water distribution is based on gravity flow systems and pump stations. Most padi irrigation areas are in wide, flat plains, so that the average manometric height is rather low.

Table 9.7 shows the diesel and lubricants requirements of mechanised padi farming.

TABLE 9.7:

Estimated Evolution of Mechanizied Padi and Related Tractor Fuel Requirements

Planted area (hectares)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
(i) Mechanization level and type of padi farming											
Irrigated, 1 crop/year	217,971	215,475	207,604	205,498	244,845	257,124	227,044	236,953	279,022	290,000	305,000
Irrigated, 2 crops/year	67,080	145,132	132,795	129,305	137,920	112,763	124,522	127,810	120,654	124,000	125,000
Non-irrigated, low land	153,489	194,173	183,291	180,278	206,104	199,308	189,305	196,411	215,210	236,000	270,000
Total	438,540	554,780	523,690	515,080	588,870	569,451	540,451	561,174	614,886	650,000*	700,000*
Diesel oil required 1000 t(0.034t/ha)	14.9	18.8	17.8	17.5	20.0	19.4	18.4	19.1	20.9	22.1	23.8
(ii) Full mechanization Irrigated, 2 crops/year	20,124	43,540	39,839	38,792	41,376	33,829	37,357	38,343	36,196	38,256	41,199
Diesel oil required 1000 t	2.2	4.7	4.3	4.2	4.5	3.7	4.1	4.2	4.0	4.3	4.55
(iii) Total diesel Oil Required (TJ)	727	999	939	922	1,041	982	956	990	1,058	1,122	1,205
(iv) Lubricants (TJ) (5% of Diesel)	36	50	47	46	52	49	48	50	53	56	60

Assumptions used as per NEPS, 1985
1. Irrigated padi area is assumed fully partially mechanised
2. Non-irrigated padi area is assumed 20% partially mechanised
3. Fully mechanised padi area is assumed to be 30% of double cropped irrigated area.

* Projected from the hectarage of 1984, 1985, 1986.

Electricity for irrigation water pumping may be estimated using the following basic data:

- irrigation rate demand : 2,000 as cu.m/ha
- manometric height : 2 m
- Electric energy requirement for pumping :
  - o 14 kw/cu.m/sec per m manometric height
  - o 14 km for 3,600 cu.m/m manometric height

Hence the specific electricity requirement amounts to:

(14/3.600) x (2,000 x 2) = 15.5 kwh/ha

Estimated electricity requirements of pump station for padi irrigation is shown below:

	Irrigated area (ha)	Electricity Demand (Gwh)
1978	285,051	4.39
1979	360,607	5.55
1980	340,399	5.23
1981	334,802	5.15
1982	382,766	5.88
1983	370,143	5.70
1984	351,566	5.70
1985	364,763	5.60
1986	399,676	6.15
1987	414,000	6.37
1988	430,000	6.62

The total energy consumption in padi cultivation can be summarised as follows:-

	Diesel	Lubricant	Electricity (TJ)	Total
1978	727	36	4.39	767.39
1979	999	50	5.55	1,054.55
1980	939	47	5.23	994.55
1981	922	46	5.15	973.15
1982	1,041	52	5.88	1,098.88
1983	982	49	5.70	1,036.70
1984	956	48	5.41	1,009.41
1985	990	50	5.60	1,045.60
1986	1,058	53	6.15	1,117.15
1987	1,122	56	6.37	1,184.37
1988	1,205	60	6.62	1,271.62

Sources:-

1. **National Energy Planning Study, 1985**
2. **Ministry of Agriculture**
3. **Drainage and Irrigation Department**

9.3 FISHING

9.3.1 Database

The database for the fishing sub-sector was setup based on available data from the Annual Fisheries Statistics published by the Department of Fisheries, Ministry of Agriculture for the years 1980 to 1986. Four tables were designed for energy consumption estimation for the fishing sub-sector:-

(a) The fishboat table contains the stock of boats; categorised in terms of size (tonnes) and further broken down in terms of fishing gears. This table was designed similar to the table structure of the fishing statistic publication for easy data entry.

(b) The fishday table contains the fishing days spent by each of the categories in table "fishb". The days are taken to be the average fishing days for all boat sizes except for trawl net and in some years Purse Seine and Purse Seine Anchovy which differs for different boat size categories.

(c) Fishland contains the fish landings for fishing activities in Malaysia. The data on fish landings were broken down into Peninsular Malaysia, Sabah and Sarawak. No breakdown by either boat size or fishing gears were designed for fish landing. A total figure for each region was placed into the data bank.

(d) The data on stock of fishing boats 'ss-fish' are not disaggregated into such a detail as for Peninsular Malaysia. The table was designed to accomodate total figures for non-powered, outboard and inboard boats. The table was designed separately, mainly due to the level of disaggregation of the data available.

9.3.2 Methodology and Assumptions

A pure technical method was applied for the estimation of energy consumption in the fishing sub-sector, relating the stock of boats to the installed engine capacity and fishing patterns (time). The following assumptions were adopted for the estimation of fuel consumption.

(a) Larger boats will install larger engines. This assumption enables the relation betweeen boat size and horsepower in terms of stock of boats and the relation enables the estimation of average horsepower for each boat size category. Based on the assumption above a relationship between size and engine horsepower installed in terms of stock can be established, using a matrix of boatsize and horsepower. The linkage between horsepower and tonnage will give a rough estimate on the engine horsepower for a range of boat sizes. This disaggregation of horsepower and tonnage gives a more accurate estimation of average horsepower. Accuracy however is very much affected by the horsepower data which were given in ranges rather than in absolute figures. Average horsepower was taken to be the mid-point of the range multiplied by the number of boats in each horsepower range and divided by total number of boats in the boat size category and for boats of 350 hp and above the minimum horsepower value was used in the calculation.

(b) The fishing time was estimated to be the average of the fishing hours for 1980 and 1982, assumed to be equal for all years. Two different sets of fishing hours for trawl net fishing and the use of fishing hours for trawl net fishing and the use of fishing gears respectively were adopted:-

- o Trawl net fishing requires more energy for travelling to fishing sites about 30 miles from sea front) and also for trawling purposes. The calculation indicates an average of 7.7 hours per day.

- o The energy consumption for other fishing fears are basically for travelling to the fishing grounds. The fishing time for Purse Seine fishing hours for 1982 shows on the average 2 hours per day.

(c) No data on engine efficiencies were available for estimation except from NEPS which has adopted a *0.28* lit/kWh for diesel consumption, which when converted will give the engine efficiency of 10.02%. The efficiency adopted by NEPS were also used for the fuel consumption estimation in this case.

9.3.3 Fuel Consumption Estimate

Trawl boats have the biggest share of fuel in the overall fishing activities in Peninsular Malaysia. Due to the different fishing time for different fishing methods, "lotus" was used due to its flexibility to change the different fishing hours for trawl net and other fishing gears.

The energy consumption and specific energy consumption per boat for the years 1980, 1981, 1985 and 1986 are summarised in table 9.8.

Table 9.8:

Energy Consumption for Inboard Boats in Peninsular Malaysia

Year	A Consumption (TJ)	B Number of inboard boats	A/B Consumption per boat
1980	23,767	18,433	1.284
1981	24,816	18,585	1.335
1985	25,174	15,324	1.642
1986	25,286	14,626	1.727

The number of boats decreased from 18,433 in 1980 to 14,626 in 1986. This is due to the reduction in small fishing boats and also the transition from smaller boats to bigger boats and thus bigger horsepower as shown in table 9.9. The specific consumption per boat gradually increased from 1.284 units in 1980 to 1.727 unit in 1986.

The increase in specific consumption ratio could be the result of the transition from smaller boats to bigger boats as seen from table 9.9, which enable fishermen to go further into the sea.

Table 9.9:

Stock of Boats in Terms of Horsepower (HP)

Horsepower	1980	1981	1982	1985	1986
Less than 5	999	908	726	388	335
5 - 9	3,324	3,101	2,396	1,452	1,236
10 - 19	3,319	3,328	3,219	2,948	2,677
20 - 39	6,811	7,255	7,400	6,043	5,600
40 - 59	965	971	1,171	1,443	1,798
60 - 99	493	459	398	498	406
100 - 149	1,137	1,038	893	638	588
150 - 249	1,307	1,445	1,600	1,710	1,684
250 - 349	75	75	71	190	302
350 Above	3	5	-	14	
TOTAL	18,433	18,585	17,875	15,324	14,626

The energy consumption of inboard boats for the States of Sabah and Sarawak were calculated based on the following assumptions:

(a) The average horsepower were taken to be the same as that for Peninsular Malaysia for their corresponding years.

(b) The number of days for fishing activities were taken to be an average of the inboard boats in Peninsular Malaysia excluding trawl net fishing.

(c) The fishing time was taken to be 2 hours per day.

The consumption for inboard boats for the years 1978 to 1986 is shown in the table I.10 below:-

Table 9.10:

Energy Consumption for Inboard Boats(Sabah & Sarawak)

Year	No. of Boats	Average (hp)	Average Days	Consumption (TJ)
1980	5,560	42.73	176	2,245.0
1981	6,738	43.72	195	3,084.2
1985	8,235	53.87	166	3,953.8
1986	8,598	57.05	152	4,003.1

The average horsepower for outboard boats in Peninsular Malaysia was checked for the years 1980, 1981 and 1985 and was found to be 4 to 6 hp increasing from 4.3 hp in 1980 to 5.88 hp in 1985. As the fishing days for each of the fishing gear categories for inboard boats are available, the same number of fishing day was used for estimating the energy consumption of outboard boats. The same efficiency and fishing hours adopted in inboard boats are used for the estimates for outboard boats.

The fuel consumption for outboard boats for Peninsular Malaysia is as described in the table 9.11 below:-

Table 9.11:

Energy Consumption of Outboard Boats in Peninsular Malaysia

Year	Av. Hp.	No. of Boats	Consumption TJ
1980	4.33	6,585	321.47
1981	4.61	7,368	389.31
1985	5.88	6,751	407.98
1986	6.90	6,864	475.79

The estimates for energy consumption of outboard boats for Sabah and Sarawak followed the assumptions adopted for Peninsular Malaysia. The fishing times were taken to be common for all years and for all boats. An average number of fishing days per year, similar to those for Peninsular Malaysia are shown in table 5. An average of 2 hours per day was adopted for the duration of fishing. The engine efficiency of 10% was also adopted.

The energy consumption for Sabah and Sarawak for outboard boats is listed in table 9.12 below.

Table 9.12 :

Energy Consumption for Outboard Boats in Sabah and Sarawak

Year	Av. Hp.	No. of boats	Av. Day	Consumption TJ
1980	4.33	4841	176	198.08
1981	4.61	4855	190	228.32
1985	5.88	5504	154	267.59
1986	6.90	7315	160	433.59

9.3.4 Diesel Consumption (Malaysia)

Diesel consumption for Malaysia is mainly by inboard boats. Diesel consumption for the years 1980, 1981, 1985 and 1986 are given in table 9.13 below.

9.13.

Diesel Consumption (Malaysia)

Year	A No. of Boats	B Diesel Consumption TJ	B/A Boat Consumption Ratio
1980	23993	26013	1.084
1981	25323	27900	1.102
1985	23559	29128	1.236
1986	23224	29189	1.261

The estimated figures above were found to be almost twice that of NEPS' estimated diesel consumption for Malaysia for 1980 and 1981. The discrepancy was due to NEPS adopting an average engine capacity of 26 KW engine or 34.87 hp. while the estimation above adopted an average horsepower of 57.1 hp.

9.3.5 Petrol Consumption (Malaysia)

Outboard boats are powered primarily petrol-driven engines. Kerosene consumption is negligible and no breakdown of Petrol and Kerosene consumption figures for outboard engines are attempted. Table 9.14 shows the petrol consumption of fishing boats in Malaysia.

Table 9.14:

Petrol Consumption (Malaysia)

Year	No. of Boats	Energy Consumption (TJ)	Energy Consumption NEPS
1980	11426	519.55	473
1981	12223	617.63	460
1985	12255	675.67	-
1986	14179	909.38	-

9.3.6 Summary of Energy Consumption in Fishing

Table 9.15 below, show the total energy consumption in fishing and its component sources of energy:-

Table 9.15:

Energy Consumption for Fishing (Malaysia)

Year	Diesel	Motor Petrol	Lubricants	Total
1978	25,900	454	1,318	27,672
1979	26,300	500	1,340	28,140
1980	26,012	519	1,327	27,858
1981	27,900	618	1,426	29,944
1982	27,600	636	1,412	29,648
1983	28,000	680	1,434	30,114
1984	28,450	728	1,459	30,637
1985	29,128	675	1,490	31,293
1986	29,189	909	1,505	31,601
1987	29,750	870	1,531	32,151
1988	30,150	912	1,553	32,615

* Energy consumption figures were derived for the years 1980, 1981, 1985 and 1986 as underlined. For the other years, the energy consumption figures for each of the component forms was obtained by using the line of best fit to approximate the quantities.

No data is available for electricity consumption although it should be noted that refrigeration and ice-making plants associated with fish preservation would be depending on electricity as the source of energy. Compared to the total energy consumption this figure could be small.

9.3.7 Energy Ratio

The energy ratio could be related to the number of boats or the fish landings. It would be more accurate to relate the energy ratio to the number of boats for fishing activities in Malaysia. However, for estimation purposes it is sufficient to relate the energy consumption to output of the fishing activities. The summary of energy (TJ) to output (tonnes) ratios are shown in the Table 9.16.

Table 9.16:

Energy Consumption to Output

Year	Energy Consumption (TJ)	Fishlanding (tonnes)	TJ/Tonne Ratio
1980	26533	735,467	0.0361
1981	28518	757,349	0.0377
1985	29804	577,253	0.0516
1986	30198	564,347	0.0535

The bulk of the energy consumed for fishing activities in Malaysia are by inboard boats. A change in fuel consumption pattern in inboard boats will give a greater impact on the amount of energy demand for fishing activities than outboard boats. In all the years considered, outboard boats consumed only 2% of the combined energy consumption.

In 1980 and 1981 the number of inboard boats shows a shift from small to boats of medium size (20 - 29 hp) and larger size (150 - 249 hp). The larger boats enabled fishermen to venture further and to sea which increases fuel consumption. In 1985 average boat size increased further and larger inboard boats (150 - 249 hp) accounted for the increase in energy consumption.

The shift from small inboard boats to larger inboard boats and the change in fishing patterns (fishing further out to sea) changed the energy ratio from 0.03 TJ/tonne to about 0.05 TJ/tonne in 1980 and 1986 respectively.

These energy ratios may be used for forecasting the energy consumption for fishing activities in Malaysia. The ratio may be adjusted to reflect the development of fishing activities in the future.

A higher fishlanding is expected with increased exploitation of offshore fishing. The government is promoting deep sea fishing intensively. These would imply the following:-

- o More shift from smaller inboard to larger inboard boats will be expected.
- o Fishermen will go further out to sea which will increase specific consumption of boats.

The above should be considered closely for adjustment of the energy ratio for forecasting.

9.4 FORESTRY

9.4.1 Introduction

The estimation of the energy requirements in Forestry and Logging is based on the NEPS report. This is the only source of information available so far for this purpose.

9.4.2 Petroleum Products Requirement

The estimation of the requirements of petroleum products is made in two steps:-

(a) Using the NEPS estimate of the energy consumption required in the production of sawlogs during the period 1977-1980, derive an average energy coefficient by dividing the total energy by the quantity of log produced each year and obtain the average coefficient over the period.

(b) apply the coefficient as obtained in (a) above, and applying it to the quantity of sawlogs produced annualy during subsequent years to obtain the estimated energy consumption or each of the years.

The past consumption data for diesel, motor petrol, and lubricant from 1978 to 1982, as calculated by NEPS are as shown in Table 9.17 below.

Table 9.17:

Forestry and Logging Consumption of Petroleum Products, 1978-1982

Year	Diesel Fuel		Motor Petrol		Lubricants		Total	Log	
	TJ	%	TJ	%	TJ	%	TJ	Production (000 cm)	Coefficient
1978	3,793	85.6	443	10	196	4.4	4,436	38,466	0.156
1979	4,554	86.9	446	8.5	242	4.6	5,242	28,702	0.183
1980	3,466	66.1	473	11.3	248	5.9	4,187	27,916	0.150
1981	3,903	84.9	460	9.9	238	5.2	4,601	30,655	0.150
1982	4,648	87.0	417	7.8	276	5.2	5,341	32,577	0.174

Using the above information as a base and, the log production figures from Ministry of Primary Industry, the Energy requirements from 1983 - 1988 are calculated as follows:-

The total energy production for each year from 1983 to 1988 was derived from multiplication of log production for each year to the average energy coefficient derived from NEPS (0.163). The share of diesel, motor petrol and lubricants were determined by using their average shares from 1978 to 1982 excluding 1980 which exhibits unreasonable variance from the other years. (The average share of Diesel, Motor Petrol and Lubricants for the years 1983 to 1988 were 86.10%, 9.05%, 4.85% respectively as shown in Table 9.18. Table 9.18:

Table 9.18:

Forestry and Logging Consumption of Petroleum Product, 1983-1988

Year	Diesel Fuel		Motor Petrol		Lubricants Total			Log	
	TJ	%	TJ	%	TJ	%	TJ	Production	Coefficient (000 cm)
1983	4,602	86.10	483	9.05	253	4.85	5,345	32,794	0.163
1984	4,363	86.10	459	9.05	246	4.85	5,067	31,088	0.163
1985	4,345	86.10	457	9.05	245	4.85	5,046	30,957	0.163
1986	4,192	86.10	441	9.05	236	4.85	4,869	29,867	0.163
1987	4,998	86.10	525	9.05	282	4.85	5,805	35,614	0.163
1988	5,048	86.10	531	9.05	284	4.85	5,863	35,970	0.163

9.4.3 Electricity Requirements

Based on NEP's the electricity consumed by this sector in 1978 amounted to 15.5 TJ. It was assumed that the electricity consumptions will develop in line with the projected growth of sawlog outputs. Therefore, the electricity consumption for each year is derived by multiplying the total electricity consumption in 1978 with the ratio of log production in that particular year and log production in 1978, and is tabulated below in Table 9.19.

Table 9.19:

Forestry and Logging Electricity Consumption 1978 - 1988

Year	Log Production (000 cm)	Electricity Requirements (TJ)
1978	28,685	15.5
1979	28,762	15.5
1980	27,916	15.1
1982	30,388	17.6
1983	32,724	17.7
1984	32,794	16.8
1985	31,088	16.7
1986	30,957	16.7
1987	29,869	16.1
1988	35,614	19.2

9.5 CONCLUSION

In agriculture, energy consumption has been increasing steadily over the period 1978 to 1988. The total energy consumption for the agricultural sector increased from an estimated 37,004 TJ to 45,976 TJ, an overall increase of some 24% (See Table 9.20). The overall increase in consumption of diesel oil for the agricultural sector in the same period is some 23%. The increase in energy consumption in the form of motor petrol, lubricants and electricity is only 1%.

Diesel oil is the largest source of energy, supplying, in 1988, 90% of the energy consumed by the agricultural sector. Motor petrol accounted for 4% of the energy consumption while lubricants and electricity contributed 5% and 1% respectively of the energy consumed.

The fishing subsector consumed 69.6% of the diesel oil used in the agricultural sector in 1988 while the crops and forestry subsectors utilised 18.7% and 11.7% respectively of the diesel oil consumed by the sector.

The crops subsector consumption of diesel oil increased by some 49% in the period 1978-1988 whereas the fishing and forestry subsectors diesel oil consumption increased by some 16% and 33% respectively.

Within the crop subsector diesel oil consumption is highest for oil palm accounting for 62% of the energy consumption in 1988 as compared to 12% for padi and 9% for rubber, as shown in Table 9.21.

Diesel oil is also the major fuel used in the forestry subsector with a 86%. The other fuels are motor gasoline and electricity.

The scarcity of energy demand data is the major handicap to energy demand analysis in this sector. Organisation for data collection has to virtually start from scratch and would require much effort and coordination to be fruitful. Work on this matter is continuing.

Due to the largely estimated and derived data, the study team felt it not appropriate to forecast on such a base. However, when the database is verified in future work, projections can then the made.

Table 9.20:
SUMMARY OF ENERGY CONSUMPTION BY SECTORS (TJ)

Year	Crops				Fishing				Forestry				Total
	Diesel	Motor Petrol	Lubricants	Electricity	Diesel	Motor Petrol	Lubricants	Electricity	Diesel	Motor Petrol	Lubricants	Electricity	
1978	5,439	333	378	626.4	25,900	454	1,318	NA	3,793	443	196	15.5	37.0
1979	5,756	321	293	651.8	26,300	500	1,340	NA	4,554	446	242	15.5	38,5
1980	6,476	387	331	660.3	26,012	519	1,327	NA	3,466	473	248	15.1	38,0
1981	6,968	394	355	673.9	27,900	618	1,426	NA	3,903	460	238	17.7	40,9
1982	8,001	411	408	712.7	27,600	636	1,412	NA	4,648	417	276	17.7	42,4
1983	7,291	420	371	698.1	28,000	680	1,434	NA	4,602	483	253	17.7	42,1
1984	7,633	407	417	700.8	28,450	728	1,459	NA	4,363	459	246	16.8	42,7
1985	7,434	384	375	748.8	29,128	675	1,490	NA	4,345	457	245	16.7	43,1
1986	8,001	418	403	767.5	29,189	909	1,505	NA	4,192	441	236	16.7	43,9
1987	8,041	427	404	766.7	29,750	870	1,531	NA	4,998	525	282	16.1	43,3
1988	8,121	428	427	767.3	30,150	912	1,553	NA	5,048	531	284	19.24	45,9

* excluding lubricants

Table 9.21:

SUMMARY OF ENERGY CONSUMPTION, CROPS (TJ)

Year	Rubber				Oil Palm				Padi				
	Diesel	Motor Petrol	Lubricants	Electricity	Diesel	Motor Petrol	Lubricants	Electricity	Diesel	Motor Petrol	Lubricants	Electricity	TOTAL
1978	2,345	145	124	389	2,367	188	118	232.9	727	NA	36	4.36	6398.26
1979	1,855	144	98	387	2,902	207	145	259.2	999	NA	50	5.55	6758.75
1980	2,122	131	113	373	3,415	256	171	282.1	937	NA	47	5.23	7521.33
1981	2,302	143	122	373	3,744	251	187	295.7	922	NA	46	5.15	8035.85
1982	2,348	143	125	375	4,612	265	231	331.8	1,041	NA	52	5.88	9121.68
1983	2,308	143	122	384	4,001	277	200	308.4	982	NA	49	5.70	8409.10
1984	1,751	109	93	379	4,926	298	246	316.4	956	NA	48	5.41	8740.81
1985	964	60	51	379	5,480	324	274	364.2	990	NA	50	5.60	8566.80
1986	919	57	47	379	6,024	353	301	382.3	1,058	NA	53	6.15	9178.45
1987	910	55	48	379	6,009	372	300	381.3	1,122	NA	56	6.37	9234.67
1988	884	53	47	379	6,032	375	320	381.7	1,205	NA	60	6.62	9316.32

* excluding lubricants