THE ENERGY STUDIES ON THE CENTRE OF ACADEMIC AND INFORMATION SYSTEM (CAIS) BUILDING UNIMAS

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This project report attached hereto, entitle " The Energy Studies On The Centre of Academic And Information System (CAIS) Building UNIMAS" prepar d and submitted by MOHAMMAD RODZI BIN HAJI OMAR in partial fulfilment of the requirements for the Bachelor Degree Of Engineering with honours (Mechanical Engineering and Manufacturing System) is hereby accepted.

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THE ENERGY STUDIES ON THE CENTRE OF ACADEMIC AND INFORMATION SYSTEM (CAIS) BUILDING UNIMAS

MOHAMMAD RODZI BIN HAJI OMAR

A dissertation submitted
in partial fulfillment of the requirements for the degree
of Bachelor of Engineering (Hons) in
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Thank you ALLAH .....for blessings, helping and for constantly giving me strength to move on strongly

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ABSTRACT

The main objective of this study was to investigate the effect of outside and inside temperature, the exterior and interior surfaces of the building such as walls, windows, roofs, doors and the occupant's load. It also investigated the various type of materials effect on the buildings' element. The data such as area, volume, temperature inside, temperature outside and thermal transmittances (U) of the building are collected and then transferred to energy analysis program for further analysis. A prediction program designed specifically for this project had been written to identify the optimum and to limits the electricity cost so that the energy can be reduced without any problems. The analysis shown that the asbestos-cement shingles can be used to saves up to 32% percentage of energy on a day. On the contrary, the used of triple glazed for windows does achieve the overall efficiency of electricity cost. Thus, the construction of building with smailer coefficient of U can reduced the energy consumption thereby minimize the electricity cost. Based on the result also, the used of poured concrete have been suggested in order to save the electricity cost of the building.

ABSTRAK

Objektif utama kajian ini adalah untuk mengenalpasti kesan suhu luaran dan suhu dalaman dan kehadiran manusia didalam bangunan CAIS di Unimas. Ia juga mengkaji kesan pelbagai jenis komposisi yang digunakan terhadap elemen-elemen yang ada pada bangunan. Data-data seperi keluasan, isipadu, suhu dalaman, suhu luaran dan terma-terma transmisi (U) pada bangunan diperolehi dan diaplikasikan di dalam program analisis tenaga untuk kajian selanjutnya. Program yang telah dibina digunakan untuk mengenalpasti keadaan optimum dan mengehadkan penggunaan tenaga agar tenaga dapat dijimatkan tanpa pelbagai masalah. Kajian ini telah mengenalpasti bahawa penggunaan tenaga dapat dijimatkan pada 32% sehari dengan menggunakan *asbestos-cement shingles* mengikut jenis komposisi yang digunakan. Dalam pada itu juga, penggunaan tiga lapisan tetingkap juga dapat mengurangkan penggunaan kos tenaga yang baik berbanding dengan penggunaan satu lapisan tetingkap. Justeru, dengan menggunakan terma-terma transmisi (U) yang lebih rendah dapat mengurangkan penggunaan tenaga dan sekaligus menjimatkan kos. Berdasarkan kepda keputusan yang diperolehi, penggunaan *poured concrete* juga dapat menjimatkan penggunaaan tenaga pada sesebuah bangunan.

CONTENTS

Contents

Contents

INDEX OF FIGURES

INDEX OF TABLES

NOMENCLATURE

A	Area of the components to heat flow [m^2]
E	The energy of the air conditioning [J or Nm]
h_c	The heat transfer coefficient [W/ m^2 K]
k	The thermal conductivity of material [W/m °C or W/m K]
L	The component thickness [m]
Q_F	The fabric heat loss [W]
Q_i	The input heat loss [W]
Q_o	The output heat loss [W]
Q_V	The ventilation heat loss [W]
R	The thermal resistance [m^2 K/ W]
T_{AC}	The air conditioning temperature [K or °C]
T_{in}	The inside temperature [K or °C]
T_{out}	The outside temperature [K or °C]
U	The thermal transmittance [W/ m^2 K]
V	The volume of building [m^3]

Greek Letter

ρ The mean demnsity of air [J/kg K]

Chapter 1

Introduction

1.1 Energy and life

Energy is important to human's life. Energy cannot be destroyed but energy can be transferred to give the human's comfort. Whether it is renewable, exhaustible and inexhaustible sources, the energy provided us with a great service and usage such as transportation, run the industrial machines, electricity, lighting, air conditioning and also space heating. Million years ago people use the fire to cooking, heating, lighting and it is estimated that a daily average of 4000 kilocalories or 16.4 MJ is being used. Nowadays throughout the rapidly transition in industrial and development, the world-consumed energy could extend more than 90,000 kilocalories or 378 MJ daily. [Robert, 1995]. Energy used is rapidly emerged in each year. **Figure 1.1** shown the energy consumption used in United States of America, China, Germany, England, India and other countries by 1998.

1.2 Energy Scenario

An energy resource such as inexhaustible, exhaustible and renewable gives an important point to human's life. The energy resources such as petroleum and natural gas cannot be sustained any, thus world today have to find other sources of energy to replace the existing energy resources. Figure 1.2 shows the annual energy consumption per capita of

some of the larger World Bank member countries. It shows a very large difference between the low-income countries to the high-income economies.

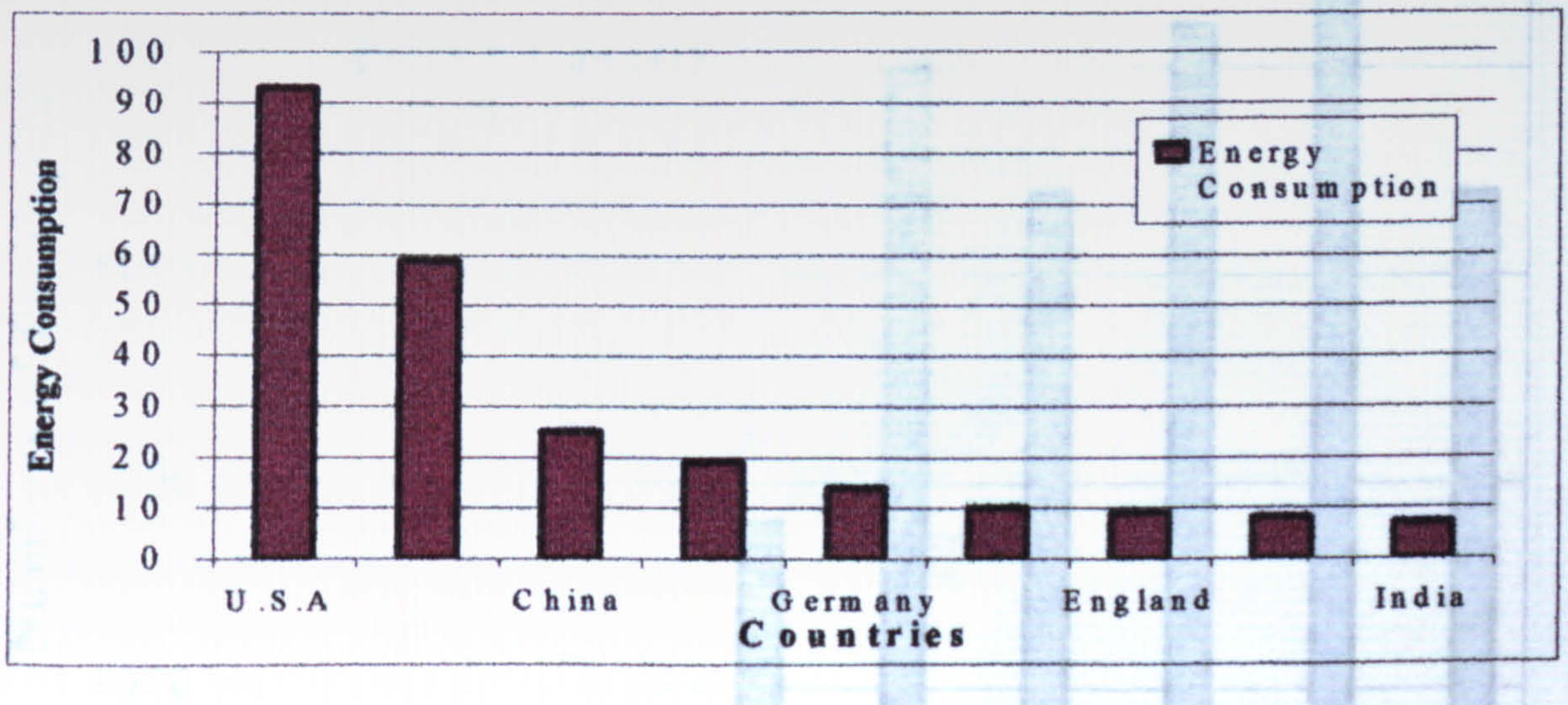

Figure 1.1 Energy consumption by country 1988 [Robert, 1995]

It can be concluded that the most energy is consumed by United State of America, Japan, Canada, and Norway. The industrialized countries such as United States of America need a lot of energy for industrial factory, city's living, food, and transportation and also to commercial and residential building.

The pie chart in **Figure 1.3** shows the energy consumption by types of usage in United States of America. From the figure it shows that almost 90% of the energy came from exhaustible fuel.

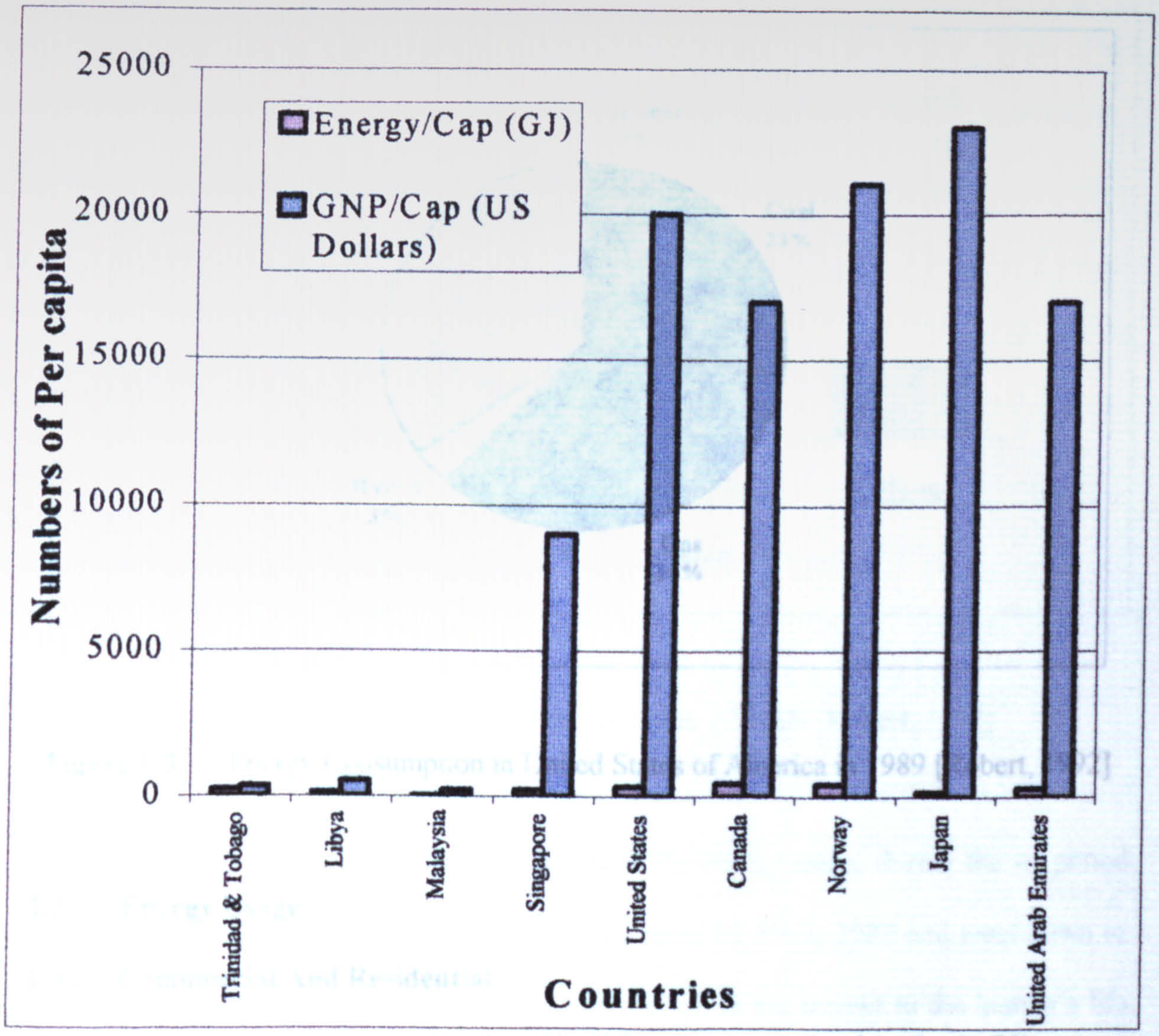

Figure 1.2 The annual energy consumption per capita versus Growth National Product per capita [Roger, 1992]

The energy demand is rapidly increasing each year and the use of energy resources can affect the environment. The increase of use fossil fuels probably also increased the earth's temperature and causes the global climate. Now, more than 5 billion tones of carbon dioxide scattered in earth's atmosphere. The increase in global temperatures can effect the agricultural production, local temperature and also increase higher ocean water levels.

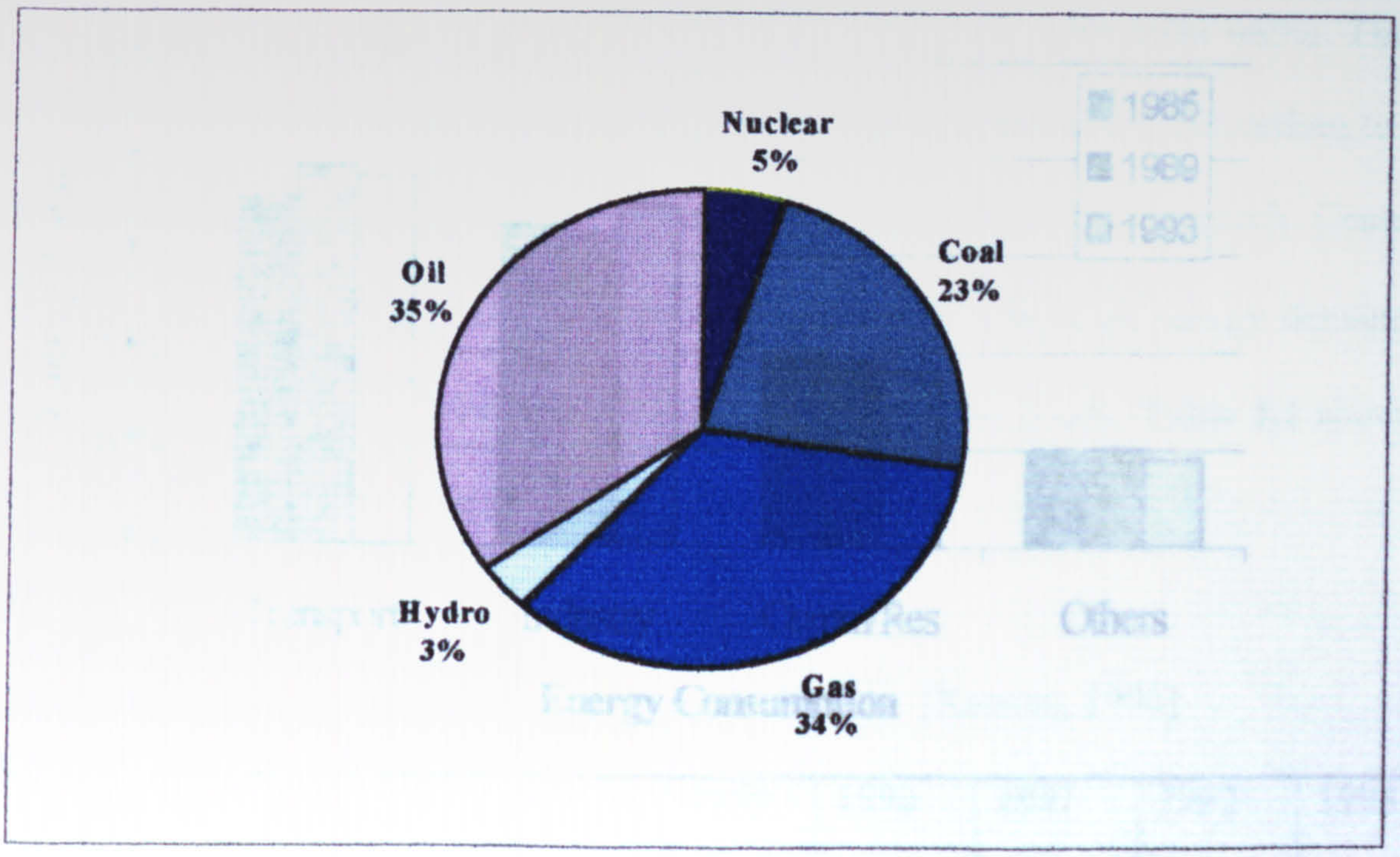

Figure 1.3 Energy Consumption in United States of America in 1989 [Robert, 1992]

1.3 Energy Usage

1.3.1 Commercial And Residential

The energy usage in commercial and residential sector is confered in the building area. The electrical appliances such as rice cooker, is used in residential sector but the electrical energy is used to manufacture the rice cooker contributes to the consumption in industrial sector. Meanwhile the energy used to carry the appliances is included in transportation sector. **Figure 1.4** shows the share of energy sector usage in 1983, 1985 and 1993 in ASEAN.

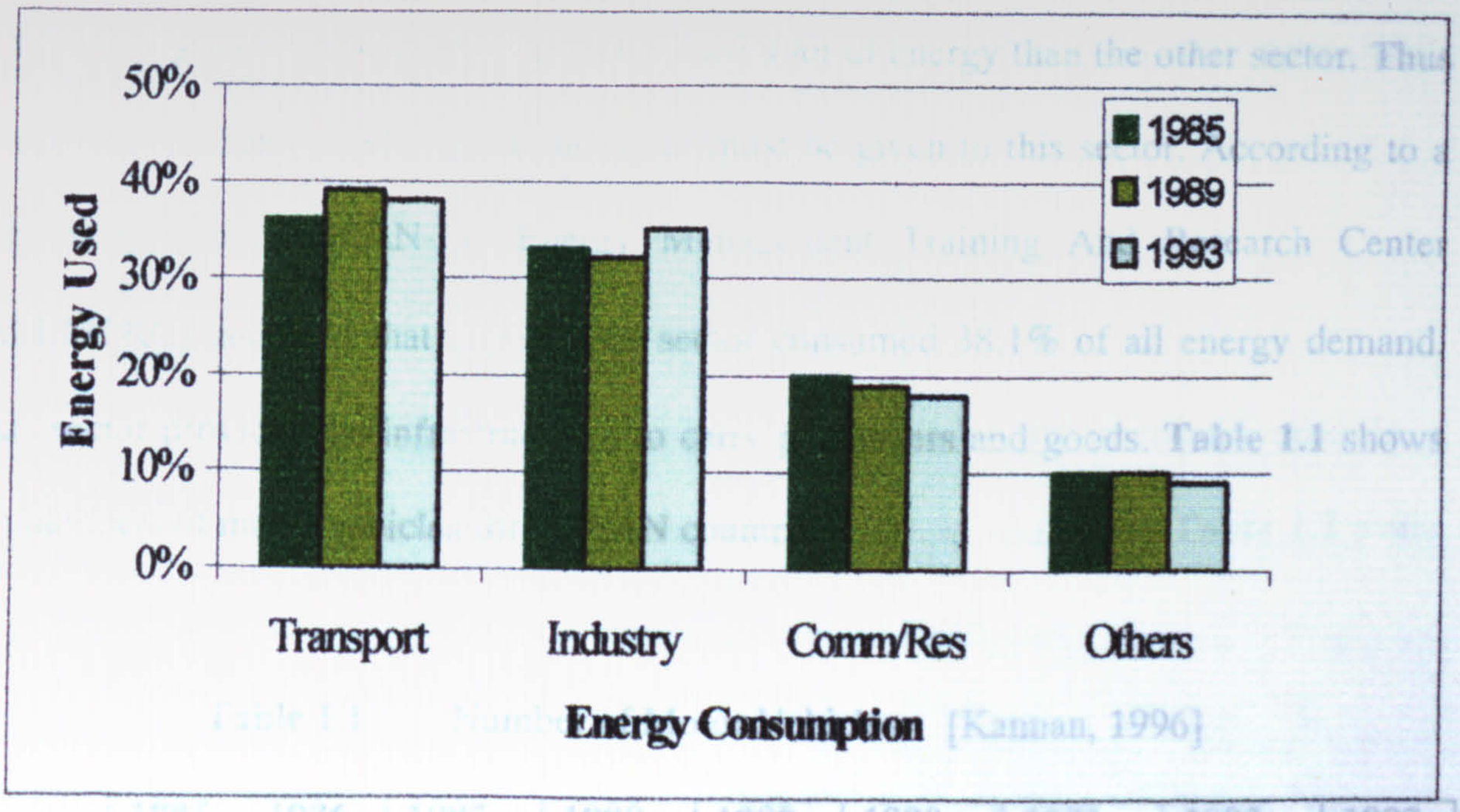

Figure 1.4 Share of sector energy use in ASEAN [Robert, 1992]

There had been minor changes in ASEAN's energy usage during the of period 1985-1993. The **Figure 1.4** shows the share increased by 3% in 1989 and went down to 2% in 1993. The purpose of using this energy is to gives the benefit to the human's life such as cooking, lighting and various electrical appliances. Meanwhile for the commercial including the offices and shops, the energy is used to air-conditioning the space, lighting and also to run the office's electrical appliances such as computers, television, and printer. However, the most energy usage in the buildings is to give a cooling the space in the office.

1.3.2 Transportation

From the **Figure 1.4** transportation sector used a lot of energy than the other sector. Thus the attention of energy efficiency measures must be given to this sector. According to a survey by, from ASEAN-EC Energy Management Training And Research Center (AEEMTRC) indicated that in 1993 the sector consumed 38.1% of all energy demand. This sector provides the infrastructures to carry passengers and goods. **Table 1.1** shows the numbers of motor vehicles for ASEAN countries

Table 1.1 Number of Motor Vehicles [Kannan, 1996]

	1985	1986	1987	1988	1989	1990	1991	1992	1993
BRUNEI	95425	100888	105963	110747	118113	126588	134903	144159	153351
INDONESIA	6856317	7321771	7981480	7770949	8291908	8889022	9582136	10482307	NA
MALAYSIA	NA	NA	4404656	4782916	5071786	546229	5917695	NA	NA
PHILIPHINES	1120172	1185832	11776753	1270483	1421464	1620242	1715366	1879563	NA
SINGAPORE	486760	473659	471124	491808	520537	542352	559304	557584	584332
THAILAND	NA	NA	NA	6045474	NA	7592085	8481025	9595190	NA
ASEAN	-	-	-	20472377	-	24233018	26390431	-	-

The number of motor vehicles in ASEAN increased from about 20.5 million to 26.4 million from 1988 to 1991. **Figure 1.5** shows the energy use in transport sectors per Capita. As a whole, the total amount of energy used per overall population for this sector in 1993 was 0.12 TOE (tonne-of-oil equivalent) with a growth of 71% from that of 1985. In average, the ASEAN members consumed about 0.4 TOE per capita and only 22% growth in the same year except for Brunei. The rest of the countries' per capita consumption each was less than average value. Since the energy demand in this sector