MALAYSIAN HOUSEHOLD ELECTRICITY CONSUMPTION: OPPORTUNITIES FOR DEMAND SIDE MANAGEMENT

BY

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The undersigned certify that they have read, and recommend to the Faculty of Environmental Design for acceptance, a Master's Degree Project entitled **Malaysian Household Electricity Consumption: Opportunities for Demand Side Management** submitted by Sheila C. McDougall in partial fulfillment of the requirements for the degree of Master of Environmental Design.

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ABSTRACT

MALAYSIAN HOUSEHOLD ELECTRICITY CONSUMPTION:
OPPORTUNITIES FOR DEMAND SIDE MANAGEMENT

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Prepared in partial fulfillment of the requirements of the
Master of Environmental Design degree in the
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This Master's Degree Project outlines the unprecedented economic growth in the Asia Pacific region and its corresponding impact on electricity consumption and energy related environmental issues. The importance of Demand Side Management (DSM) as a means to minimize electricity consumption and mitigate the associated environmental consequences is emphasized.

The Malaysian domestic sector is the focal point of the research. DSM instruments, which have been used successfully in other parts of the world, are assessed for their suitability for application in the Malaysian domestic sector. A participatory approach is used to solicit the views of all key stakeholders who would be affected by the actions that are proposed. The nation's development goals, Malaysian citizens' values and the economic, environmental and social benefits of DSM are considered in the analysis. Based on this analysis, guidelines for implementing DSM in the Malaysian domestic sector are presented.

Recognizing that constraints exist that will affect the timing of implementation of DSM in the Malaysian domestic sector a four phased DSM programme is proposed. In addition, institutional responsibilities and an implementation schedule are detailed. DSM instruments, which complement the dynamic economic growth experienced in Malaysia, are recommend for implementation. The timely and strategic introduction of domestic sector DSM is encouraged in order to ensure that Malaysia's current "window of opportunity" is capitalized upon. The overall goal of this planning endeavour is to assist Malaysia in fostering a position as a leader in economic development and a promoter of sustainable development.

Key Words: conservation, consumption, demand side management, electricity, electrical power, energy, environment

EXECUTIVE SUMMARY

Energy demand in the Asia Pacific Region is growing at unprecedented rates. Electricity consumption has grown at a higher rate than other energy sources. Limited electrical infrastructure has resulted in regular power failures in many Asian countries. Some experts predict that energy supply and limited electrical infrastructure will place constraints on the region's economic growth and prosperity. This has resulted in Demand Side Management (DSM) gaining recognition for its ability to minimize consumption levels and mitigate the environmental impacts associated with electricity consumption.

Malaysia is part of the economic transformation of the Asia Pacific Region. With a defined development strategy embedded in "Vision 2020," Malaysia is being converted into a global centre of large scale investment, development and trade. Rapid industrialization, increasing urbanization and demographic factors have contributed to pressures on limited electrical infrastructure. The implementation of DSM in all sectors of the Malaysian economy is viewed as being beneficial. The domestic sector has largely been excluded from efficiency improvements to-date, although this sector is now identified as a priority.

In order to analyze the situation and arrive at recommendations for implementing DSM in the domestic sector, data was collected through literature review, personal observation, interviews with regional energy experts and interaction with Malaysian citizens during focus group discussions.

The researcher found that although there are many instruments available for pursuing energy efficiency and conservation, the introduction of DSM in the domestic sector will be challenging for three reasons. Firstly, a lack of understanding of the

concepts of energy efficiency and the objectives of DSM exists amongst the general public. Secondly, the Malaysian government is promoting consumption as it wants its people to have the same level of comfort as the developed countries. Many people have interpreted this to mean the continued consumption of all goods and services including electricity. Thirdly, as a newly industrialized country, Malaysia is faced with many challenges associated with rapid development and economic growth. This, coupled with the fact that there are limited human resources with expertise in this area, places constraints on how, when and to what extent concepts such as domestic sector DSM can be introduced.

In recognition of these pressures and challenges, a four phase approach to implementing domestic sector DSM is proposed. The phases include:

1) policy and preparation

2) promotion

3) practices and

4) refinement.

1) A national Energy Conservation Policy is necessary to communicate to all citizens that DSM is consistent with the nation's development goals as stated in "Vision 2020." A policy would serve as the foundation from which other initiatives are driven. Preparation is required to bring energy efficient goods and housing designs to Malaysian markets. Effort to initiate product efficiency standards and energy efficiency labelling is a critical component of this phase. Design competitions are a viable means of introducing product efficiency standards. Housing and landscaping competitions will serve to introduce Malaysians to this option for conserving energy. Financial incentives,

in the form of research grants to manufacturers and developers, are advisable to help offset the research and development costs associated with bringing energy efficient products and housing to market. Training of personnel to manage a domestic sector conservation programme should also be addressed as a component of this phase.

2) Promotion is required to increase citizen awareness and knowledge of the concept of DSM and its benefits. Initially promotional efforts will have to focus on energy saving habits. As energy efficient appliances and housing become readily available in the Malaysian market place, promotional efforts will have to be expanded to address such issues as payback periods and life cycle costing so that people are educated on the benefits associated with owning these items. When promoting energy efficient goods marketers should appeal to the social responsibility, the personal savings, the "high tech" quality and the prestige associated with ownership of the energy efficient product or home. Television advertisements and notes included with utility bills were identified as the preferred methods of communicating with the public and creating the market for energy efficient goods.

3) The practice phase will see the wide-spread introduction of energy efficient products and housing. These areas are emphasized as they reflect two dynamic growth areas to which Malaysians were receptive. The introduction of retrofitting initiatives is not recommended during the initial phases of implementing DSM because Malaysian citizens were not receptive to this means of reducing electricity consumption.

4) In the final phase, domestic sector DSM should be evaluated for its effectiveness so necessary revisions can be made. A review of tariff structures may be appropriate at this time. If tariff structure revisions are deemed to be necessary to

promote conservation they should be introduced only after people have been educated on the rational use of energy and after the methods and means of using energy efficiently are available.

The Ministry of Energy, Telecommunications and Posts should assume the roles of pro-active promoter of policy and coordinator of energy efficiency efforts. A committee, comprised of members of concerned agencies and others, could be established to work towards the common goal of the rational use of energy. Tenaga Nasional Berhad is a candidate to actively promote DSM and to work with manufacturers and developers to bring to market energy efficient products and housing designs.

The timely and strategic introduction of DSM instruments has the potential to yield substantial electricity savings. While the people who participated in the focus groups stated that they did not want to curtail using the appliances they had worked hard to own, they noted that they would act responsibly in their use of electricity. Domestic sector DSM initiatives should be introduced on a timely basis to maximize the "window of opportunity" that is currently available.

While there will be challenges and barriers to be overcome, Malaysia's firm commitment to Demand Side Management would help Malaysia foster a position both as a current leader in economic development and a promoter of sustainable development.

TABLE OF CONTENTS

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APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ASEAN	Association of Southeast Asian Nations
Bakun	Bakun Hydroelectric Project
DSM	Demand Side Management
EPZ	Export Production Zone
ESCAP	Economic and Social Commission for Asia and the Pacific
Gas Malaysia	Gas Malaysia Sendirian Berhad
GWh	Gigawatt-hours
kWh	Kilowatt-hours
MR	Malaysian Ringit
MW	Megawatts
Petronas	Petronas Petroliam Nasional Berhad
Sikap	Sikap Power Sendirian Berhad
Syarikat	Syarikat Yeoh Teong Lay
Tenaga	Tenaga Nasional Berhad

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1. REVIEW OF STUDY METHODS

1.1 RATIONALE FOR THE STUDY

The past decade of economic growth in the Asia Pacific Region[1] has been accompanied by a corresponding increase in demand for all forms of energy. Associated with the increased demand for energy are supply shortfalls due to infrastructure constraints and environmental problems relating to both energy supply systems and consumption externalities.[2] These issues have resulted in energy-environment issues becoming the focus of attention in a growing number of national, regional and international forums (Ramani et al, 1992).

Malaysia is no exception to the energy supply and environmental problems that plague the Asia Pacific Region. The rising demand for electrical energy in Malaysia and the impacts associated with its consumption are not new issues. The implications of energy consumption levels in the region are already very clear (Tyler, pers. comm.). Traditionally governments in the region have been preoccupied with ensuring energy supply is adequate to maintain economic growth. While the construction of additional energy supply infrastructure is still of paramount importance, what is emerging is a renewed interest in the role that Demand Side Management (DSM) practices can play. DSM is now perceived by many as an integral part of energy planning.

The economic, environmental and social benefits of DSM are gaining recognition amongst Malaysian policy makers. Energy management appears to be one of the most

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1 The Asia Pacific Region includes East Asia, Southeast Asia, South Asia and Australasia.

2 Externalities imply that a side effect, either positive or negative, is imposed upon persons not directly involved in the original action. An example of an externality associated with energy consumption is the deterioration in air quality attributed to the burning of fossil fuels.

cost-effective ways to curb the growth in demand, permitting the deferral of new infrastructure (Mohanty, pers. comm.). Attention is being focused on how to implement successfully DSM initiatives in all sectors of the economy since an all-pronged approach to implementation of DSM is desirable (Jaafar, pers. comm.).

In Malaysia, the transportation and residential sectors have been excluded from efficiency improvements to date although these sectors have been identified as priorities for the future (Department of Electricity Supply, 1993). As the domestic sector has been recognized as a priority area, there is a need to gain a greater understanding of Malaysian citizens' knowledge of the concept of electricity conservation and an understanding of what types of DSM activities they would be willing to participate in in order to reduce their electricity consumption. A comprehensive understanding of these issues will help foster the implementation of DSM practices that are in keeping with the lifestyles of Malaysian citizens and, therefore, increase the probability of success.

1.1.1 OBJECTIVES OF THE STUDY

In order to develop a response to the situation of increasing electricity consumption in the domestic sector, there is a need to assess the present situation, understand the demographic and structural transitions taking place, and solicit citizen and expert views on conservation and DSM. The objectives of this study were to gain a greater insight into:

- the current electricity consumption of Malaysian households
- current and emerging consumer preferences and the impacts these preferences will have on electricity consumption

- citizens' knowledge of the concept of conservation and electricity related environmental issues and
- the attitudes of Malaysian citizens with respect to electricity conservation and DSM programmes.

This data is then used to:

- assess the relevance of common DSM instruments for application in the Malaysian domestic sector and
- propose a plan of action for implementing DSM in the Malaysian domestic sector.

1.1.2 SCOPE OF THE STUDY

Urban middle class Malaysian citizens were chosen as the focal point of this study. This middle income group in the ASEAN is growing at unprecedented rates yet very little is known about the attitudes, behaviours and consumer preferences of these individuals. The middle class is generally the predominant and most influential class in newly industrialized countries and they should be watched for trends (Wahnschafft, pers. comm.).

This fast-rising middle class now constitutes the largest group in the Malaysian population and has the potential for dramatic growth. The rapid pace of industrialization and development is establishing the foundation for increased affluence of Malaysian citizens. Already over 50 percent of Malaysian citizens are urban residents and the majority are middle class. The absolute number of people within this cohort also will expand since Malaysia hopes that its population will increase from 18.6 million in 1992 to 70 million in 2060 (Department of Statistics, 1993).

For the purpose of this study, the middle class was defined as households having a combined income of $400 - $1120 U.S. per month. These income levels were

established in consultation with personnel at Frank Small and Associates who periodically conduct marketing research targeted at middle income Malaysian families. The statistics they provided were compared to mean incomes compiled by the Department of Statistics in order to attest to their accuracy.

The Kuala Lumpur metropolitan area was chosen as the site of this study as this metropolitan region and adjacent areas in the Klang Valley have been experiencing rapid industrialization, urbanization and increasing affluence among residents. The attitudes, aspirations and electricity consumption habits of the individuals living in this urban area are indicative of the middle class lifestyle that is emerging throughout urban centres in Malaysia. Citizens of the Kuala Lumpur metropolitan area have recently experienced the effects of strained electrical infrastructure and the environmental stress associated with increased consumption. This area is the largest urban region in Malaysia and as of 1991, encompassed several municipalities totalling approximately 3.4 million residents (Department of Statistics, 1993).

1.2 DATA COLLECTION

A number of data collection means were employed to ensure domestic sector electricity consumption habits, citizens' attitudes towards conservation and the opportunities this presents for DSM were studied in a comprehensive manner. An extensive literature review was conducted both before and during the field work portion of the research. In keeping with a participatory approach,[3] the views of a diversity of

[3] A participatory approach involves interaction with representatives from all major parties who will be affected by the decisions or policies that result from the research. This approach solicits and respects individual and local knowledge and strives to integrate it with the knowledge of experts in order to arrive at a workable solution.

individuals were solicited. By conducting interviews with experts, an attempt was made to interact with representatives from all key organizations in the fields of electricity and electricity-related environmental considerations.

Sustainability requires that responsibility for the impacts of decisions is shared and calls for greater public participation in policy decisions that affect the environment (Sani, 1993). To solicit the views of local residents on electricity consumption and DSM instruments, focus groups were conducted with Malaysian citizens. Although the views of children were not solicited directly, informal discussions took place with representatives from the Malaysian Nature Society and the Young Men's Christian Association, both of which are currently running environmental education programs and camps for children. Observation of Malaysian citizens also was employed as a means of data collection. Documentation of the researcher's initial impressions on the application of common DSM instruments in the Malaysian domestic sector provided an opportunity for feedback and refinement of ideas. Collectively, these means of data collection were used as the basis for designing DSM guidelines for the Malaysian domestic sector.

1.2.1 LITERATURE REVIEW

A literature review provided a background on the issues, a foundation for conducting further exploration and questioning and ideas for incorporating into research results. Numerous books, periodicals, newspapers, conference proceedings and studies were reviewed as an integral part of this research. A detailed listing appears under References.

Secondary data on electricity consumption, demographics and national economic accounts and projections were used to document the situation in Malaysia and to lay the foundation from which to expand. Books were used primarily for historical and theoretical information of a universal nature. Concepts such as the basis of DSM and the environmental impacts of electricity consumption were well documented in these sources. Periodicals, newspapers, conference proceedings and studies were a valuable data source as they provided up-to-date information on the status of electricity production and consumption, proposed energy developments and environmental concerns. Such information is imperative in addressing the dynamic situation in Malaysia as it provides the researcher with an understanding of the degree of change that has occurred to-date as well as input into changes that are likely to take place in the future.

1.2.2 EXPERT INTERVIEWS

Thirty-seven indepth interviews were conducted with regional energy and environment experts employed by government agencies, the private sector, research institutions and non-governmental organizations. The persons interviewed are listed in Appendix 1. The discussions focused primarily on identifying factors which will influence household electricity consumption and describing potential means for reducing consumption through energy efficiency measures. An Interview Guide (see Appendix 2) was employed as a means of obtaining desired information in a comparable fashion.

These meetings also were used to learn more about each organization, its roles and relationships to other parties in the energy and environment sectors. This information was used to develop an understanding of the interconnectedness of energy

sector organizations and how their relationships may impact the implementation and administration of a domestic sector DSM programme. The majority of those interviewed spoke openly on the subject and often elaborated on additional points of interest. If they did not feel comfortable with providing an answer on a particular question, this was openly communicated to the researcher and a referral to another individual with more expertise on the subject generally followed. This type of response helped to ensure the integrity of the information gathered.

1.2.3 FOCUS GROUPS

Focus groups can be a powerful tool for learning participants' awareness, attitudes, perceptions, opinions and preferences on virtually any topic. When properly carried out, focus groups can provide a greater understanding of behavioural factors than can be acquired through statistical quantitative research (Hooper, 1989).

Four focus groups were conducted from 7:00 p.m. to 9:00 p.m. on November 8 through 11, 1993. The scheduling of these groups preceded the national Energy Efficiency Week campaign that took place from November 16 to 22, 1993. The focus groups were purposely scheduled in this manner so that views were sought prior to exposure to the promotion of energy efficiency. A total of 18 women and 17 men participated in the focus groups. Participants were screened to ensure that the groups were sufficiently stratified and involved a variety of ages, middle class income levels, family structures and cultural and occupational backgrounds. A group profile, for each focus group, is detailed in Appendix 3.

Although the actual number of participants is relatively small in comparison to the total population, this is in keeping with a research approach which has been successfully employed by the Japanese. As Kenichi Ohmae states in his book The Borderless World:

> "Conventional marketing approaches won't solve the problem. You can get any results you want from the consumer averages. Personally, I would rather talk with three housewives for two hours each on their feelings about, say, washing machines than conduct a 1,000 person survey on the same topic. I get much better insight and perspective on what they are really looking for."

By conducting focus groups with a small number of Malaysian citizens, the same degree of insights and perspectives was sought.

A Focus Group Discussion Guide was designed to ensure that all research objectives were comprehensively addressed in order to provide sufficient data for assessing the relevance of common DSM instruments for their application in the Malaysian domestic sector and proposing an action plan for DSM implementation. This guide also was used as a means of educating the moderators on the subject matter. Three different moderators were employed since the focus groups were conducted in English (2 groups), Bahasa Malaya and Mandarin. Professional moderators were hired to assist with this function. Discussion flowed freely during the focus groups and much valuable information on consumption habits and attitudes towards conservation and DSM was obtained. The highlights of the issues discussed are included in Appendix 3.

A copy of the discussion guide employed is detailed in Appendix 4. Prior to its use, the Focus Group Discussion Guide was reviewed, for completeness and ease of understanding, by personnel from Tenaga Nasional Berhad (Tenaga) and the International Institute for Energy Conservation. Revisions were made to accommodate

their suggestions and enhance the usefulness of the guide as a data collection instrument. The Focus Group Discussion Guide also followed general ethical guidelines on interviewing subjects as set forth by the University of Calgary.

1.2.4 OBSERVATION

Visits to the homes of friends and colleagues provided the opportunity to view activities in Malaysian homes and to gather information informally about the lifestyles of the occupants. Also, living with a Malaysian family for a short period allowed the researcher to interact with the extended family, friends and neighbours of this family and learn more about the lifestyles, ideals and aspirations of these individuals and how this may impact the amount of electricity consumed within their home.

1.2.5 DATA ANALYSIS

Data collected during the expert interviews was reviewed and compared to the opinions expressed by the focus group participants in order to identify points which consistently reflected:

- an item or lifestyle change which would impact the amount of electricity consumed by Malaysian households
- the level of awareness and understanding of the concept of conservation and electricity related environmental issues and
- DSM instruments that would willingly be employed by Malaysian citizens to use electricity efficiently within their homes.

Statistical analysis of the data was not completed. Alternatively, Demand Side Management instruments that had been used successfully in other countries were assessed for the relevance of their application in Malaysia based on opinions commonly expressed

by regional energy and environmental experts and Malaysian citizens. Data gathered through observation and literature review also was used as input into determining what factors would contribute to increased domestic sector consumption and how DSM instruments could be employed to successfully minimize consumption and mitigate the environmental consequences associated with increased electricity consumption.

Expert opinions, coupled with an understanding of the organizational structure and functioning of the Malaysian energy sector, were used as the basis for recommending institutional responsibility and the timing of implementation of domestic sector DSM programmes.

1.2.6 FEEDBACK MECHANISMS

Prior to leaving the region, the researcher prepared a document entitled *A Critique of Demand Side Management Programmes and Their Appropriateness for the Malaysian Domestic Sector* and distributed it to interested parties in Malaysia and Thailand. Demand Side Management techniques that had been used successfully in other countries were used as the basis of the critique. The purpose of this report was threefold:

- to document immediate thoughts and impressions about the options available for conserving electricity in the Malaysian domestic sector
- to serve as a forum for exchanging ideas with interested parties and
- to solicit feedback from regional experts on the points presented.

A presentation of the research findings made at the Asian Institute of Technology provided another chance to communicate initial impressions of the situation and to solicit feedback. Together these opportunities provided much feedback on strengthening some

arguments as well as a critique on some issues. All comments received were assessed for their relevance and, where appropriate, were used to refine the original ideas.

1.3 LIMITATIONS OF THE STUDY

Conducting research always presents certain obstacles and challenges and gathering data in Malaysia was no exception. Basically four types of obstacles presented themselves. These were:

- no data available. On some occasions, information was requested from various sources, but could not be supplied because it was not compiled. In some instances, independent studies were obtained and reviewed as a means of obtaining a perspective on the information originally sought. For example, the utility company did not keep statistics on appliance ownership within households, but a study completed by the University of Malaya provided an understanding of household appliance ownership in middle class Malaysian households. For other issues, the perspectives of experts were sought in order to obtain insight into the subject.

- data was available but not provided to the researcher. Some recent studies were considered private and confidential and therefore were not available for review as part of this study. While the desire for confidentiality had to be respected, attempts were made to interview people who participated in such studies in order to obtain general knowledge about the situation.

- documented activities which had been planned for were not always implemented, resulting in the need to confirm documented sources. It could not be assumed that what was read was always reflective of what transpired. For example, the Fifth Malaysia Plan for 1986 to 1990 noted that an Energy Efficiency Centre was to be established. In 1993, this centre was still under consideration by the Ministry of Energy, Telecommunications and Posts. Interview subjects were a reliable means of verifying questionable documentation, and

- data obtained was not reflective of the current situation. This is attributed to the accelerated pace of change that is prevalent in Malaysia. This dynamic growth situation presents difficulties in obtaining up-to-date statistical information. Often, the situation had changed between the time that data was collected and the time the information was compiled and published. The difficulty experienced in obtaining current statistics was overcome to some degree by extrapolating on existing data based on information obtained regarding changes in the situation since the statistics were compiled.

This study was limited in its scope since it focused on middle class urban residents. Therefore, the views presented may not necessarily be reflective of the rural situation.

Despite these limitations, sufficient data was obtained to draw conclusions and recommend a plan of action. Chapter Two presents an overview of the energy and electricity consumption patterns existing in the Asia Pacific Region. The environmental implications of energy intensive growth and the role that DSM can play in minimizing consumption and mitigating the environmental impacts of consumption are presented in Chapter Three. Chapter Four assesses the relevance of common Demand Side Management instruments for their application in the Malaysian domestic sector and Chapter Five concludes with a proposed a plan of action for implementing Demand Side Management in the domestic sector.

2. INTRODUCTION

2.1 OVERVIEW: THE SIGNIFICANCE OF ENERGY

Throughout history, humans have used energy in various forms. Biological energy, derived from sunlight in the form of food, is vital to human existence. Human hands and horsepower provided muscle power for many generations. Until the 1950s, renewable resources such as wind, sun, falling water, firewood and biomass satisfied much of the world's energy requirements. The second half of the nineteenth century was marked by the penetration of fossil fuel energy in many industrializing nations of the world. Today, energy consuming technologies fuelled by these hydrocarbons have found their way into almost every facet of life in industrialized countries.

Industrialized countries are not alone in their demand for energy. The developing and newly industrialized countries of the world now face a period where they must adjust to their increasing energy demands. World energy demand continued to rise in 1991 but total demand was up by only one percent, well below the growth rates seen in the mid-1980s. Coming on the heels of a similarly low growth rate in 1990, it underlies the effects of recession in the industrialized countries and of political and economic restructuring in Eastern Europe (Asian Development Bank, 1993). In 1992, world energy consumption increased by a mere 0.2 percent, continuing the pattern of virtually nil growth since 1990. However, the flat global profile hides significant regional variations as high energy growth rates continued in the major Developing Member Countries of the Asian Development Bank.[4] In the developing countries of Latin

[4] The Developing Member Countries of the Asian Development Bank include: Bangladesh, China, Hong Kong, Fiji, India, Indonesia, Korea, Malaysia, Myanmar, Nepal, Pakistan, the Philippines, Sri Lanka, Taipei, Thailand and Vietnam.

America, Africa, the Middle East and Asia, the demand for energy rose by four to eight percent while the fastest growing Asian countries of Malaysia, Thailand and South Korea achieved double-digit growth rates from 1990 to 1992 (British Petroleum Company, 1993).

Developing countries of the world are in pursuit of a higher standard of living and energy is useful only in so far as it provides energy services in ways that improve the quality of life. This goal of an increased standard of living, coupled with increasing industrialization and high rates of population growth, has experts predicting a tripling of energy demand in developing countries between 1985 and 2025, with fossil fuels expected to be the major energy source. The share of energy consumption by developed countries is projected to drop from 81 percent in 1984 to 68 percent in 2000 (World Resources Institute, 1992). The developing countries' share will rise by an equivalent amount and the Asia Pacific Region is expected to continue to lead the way with sharp growth in energy consumption (Singh, 1993).

2.2 BACKGROUND ON ECONOMIC GROWTH AND ENERGY CONSUMPTION IN THE ASIA PACIFIC REGION

The 1980s ushered in what many analysts refer to as the "Pacific Century." The region is seen as the emerging centre of gravity for the world economy and, even if economic growth slows in the 1990s, there is wide acceptance of the idea that the region will continue to be one of the fastest growing in the world (Fesharaki and Sharma, 1991). The driving forces behind this rapid economic growth include significant expansion of industrial sectors, commercialization of agricultural sectors, high rates of population

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energy consumption is realized. A study of the Republic of Korea and the members of the Association of Southeast Asian Nations (ASEAN)[5] revealed a strong linear relationship between income and energy consumption (Lefevre, 1992). While the relationship between economic growth and energy consumption is not absolute, energy is a required input for economic activity and trade (Fesharaki and Sharma, 1991). The past decade of economic growth throughout the Asia Pacific Region has clearly set a precedent for a more energy consumptive society.

The Developing Member Countries of the Asian Development Bank achieved an annual growth rate in energy consumption of seven percent during the past decade (1980 to 1990) compared to a growth rate of only 1.2 to 1.3 percent per annum for the rest of the world. The Asia Pacific region as a whole accounted for 22 percent of world commercial energy demand in 1990, a growth rate of 3.5 percent over the past seventeen years (Asian Development Bank, 1992). The region's growth in demand for energy, especially oil, in the last two decades has been the highest in the world and this trend is expected to continue (Sharma and Tan, 1991). Energy demand in Asia is so dynamic that it is hard to obtain up-to-date statistics on consumption (Applyby, pers. comm.). Asian energy demand is doubling every twelve years at current growth rates compared to the world average of every twenty-eight years (Jayakrishnan, 1994).

In the coming decades, the region will require an unprecedented scale of investments in oil and gas exploration and development, downstream processing and

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5 The Association of Southeast Asian Nations (ASEAN) includes Brunei, Indonesia, Malaysia, the Philippines, Singapore, and Thailand. Brunei was excluded from the scope of the referenced study. No reason for this exclusion was noted although it is possible that it is attributed to the fact that Brunei is a relatively small developed country which has not experienced the same economic growth trends as the other countries which were included in the study.

distribution, power generation and energy infrastructure construction to support their growing demand (Singh, 1993). While some Asia Pacific countries such as Brunei, Indonesia and Malaysia are well endowed with indigenous energy resources, the increased rates of consumption of all forms of energy will result in the region's increased dependence on the Middle East for energy supply (Appleby, pers. comm.). Dependence on outside sources of oil will rise to unprecedented levels (Fesharaki and Sharma, 1991). Reliance on the Middle East for energy supply introduces the risk of supply disruption due to the political instability of the Middle East region.

2.2.1 GROWTH IN DEMAND FOR ELECTRICAL ENERGY IN THE ASIA PACIFIC REGION

Electricity consumption throughout the region has grown at a much higher rate than consumption of other energy sources (Lefevre, 1992). Governments realize that electricity is critical to accelerating economic and social development. Modern industrialized economies cannot develop without an increase in the availability of power (Katayama, 1992).

While there is a recognition that adequate electrical infrastructure is a prerequisite for maintaining economic growth, many infrastructure deficiencies exist. In many places, the region's phenomenal economic expansion threatens to run "out of gas" -- or rather electricity, which has become the essential fuel of the twentieth century (Katayama, 1992). Frequent blackouts and power shortages are a warning that Asia must produce more electricity or utilize current sources more efficiently in order to fuel its expanding economies. In the Philippines, brownouts are a daily occurrence (Monk and

Tinker, 1993). Industries in China's Guangdong province frequently experience factory shut-downs due to power shortages. In Jakarta, private generators in homes and offices have emerged as a new "status symbol" (Katayama, 1992). Small power plants for industrial estates are also common in Indonesia. Inadequate electric power infrastructure is the most obvious deficiency in many Asian countries (Rowley, 1993).

Energy planners, through their forecasts, have an important role to play in ensuring that rapid economic growth does not overburden power supplies. The success of energy planners at forecasting energy growth varies throughout the region. The Electricity Generating Authority of Thailand is recognized in electric power circles as a well managed, efficient utility that has thus far kept ahead of the unbelievably rapid growth in demand for electricity in Thailand (Lefevre, 1992). Tenaga Nasional Berhad also is regarded as a well managed organization despite recent power shortages (Codoni, pers. comm.). The failure to fully address structural changes in the economy, the presence of several new energy intensive industrial activities and making up for the shortfall of infrastructure development in previous periods are possible reasons for the existing power shortages.

Several new power plants, utilizing a diversity of fuel sources, have been constructed throughout Asia and many more are in the planning stages. The total installed generating capacity within the Developing Member Countries of the Asian Development Bank increased from about 70,395 Megawatts (MW) in 1973 to 284,640 MW in 1990. This expansion by 8.2 percent per annum in installed generating capacity in the region was the result of similar expansion in nearly all the countries with Indonesia

and Malaysia exhibiting high growth rates of 12 percent per annum and above (Asian Development Bank, 1992).

Despite these new sources of power, the immediate problem is still a lack of generating capacity (Katayama, 1992). The installed capacity in the Developing Member Countries of the Asian Development Bank is expected to increase to 536,336 MW by the year 2000, at a growth rate of six percent per annum (Asian Development Bank, 1993). The Asian Development Bank predicts that construction of an additional 300,000 MW, equivalent to roughly 500 large power plants, will be required during the 1990s.

2.2.2 ENERGY DEMAND IN THE ASSOCIATION OF SOUTHEAST ASIAN NATIONS

The countries of the Association of Southeast Asian Nations (ASEAN) are part of the economic transformation of the Asia Pacific Region. With the Philippines as the only notable exception, the countries of the ASEAN have been converted into global centres of large scale investment, development and trade and are viewed as integral players in Asia's economic expansion.

The energy consumption patterns of these countries are no different than those in the larger Asia Pacific Region. The demand for all forms of energy including oil, gas, coal and renewables such as hydropower, solar and geothermal energy is increasing. As the incomes of these countries rise, there is a shift towards greater use of electricity (Lefevre, 1992).

During the late 1980s, per capita electricity demand expanded rapidly in the region, growing at annual rates of more than 15 percent per year in Indonesia and 11

percent in Thailand. Investments in manufacturing facilities and rising incomes have resulted in Thailand's per capita sales of electricity increasing 35 fold, from 19 kilowatt-hours (kWh) in 1961 to 681 kWh in 1990. Even the recession plagued Philippines, which has been combating chronic brownouts and power shortages, saw electricity demand increase at more than four percent per year during the late 1980s (Monk and Tinker, 1993). Table 2-1 details the growth rates in electricity sales and Gross Domestic Product experienced in the ASEAN from 1980 to 1990. The degree of correlation between economic growth and electricity consumption varies amongst these countries. A number of factors influence this relationship including, but not limited to, the type of industrial activity that took place and its corresponding energy intensity, the efficiency of generating and transmitting electricity and the extent to which electricity supply became available after periods of limited electrical power.

Despite so much growth in demand for electricity in the 1980s it is noteworthy that the ASEAN should experience similar demand growth in the 1990s. There are several reasons why continued increases in demand are anticipated. Three-quarters of Indonesia's 180 million people still lack access to electricity. Thailand is still in the process of supplying power to over one-quarter of its 60 million people who are currently without electricity (Monk and Tinker, 1993). While rural residents consume comparatively less energy than their urban counterparts, rural electrification programmes coupled with significant increases in demand by increasingly affluent urban dwellers will ensure demand for electricity remains strong (Webster, pers. comm.). Growth in industrial requirements also assures increased electricity consumption throughout Indonesia and Thailand. With electricity available to 82 percent (1990) of its population,

TABLE 2-1

Growth Rate of Electricity Sales in the ASEAN
(1980 - 1990)

Country	Average Annual Growth in Electricity Sales (%)	Average Annual Growth in Gross Domestic Product (%)
Indonesia	15.51	5.51
Malaysia	9.13	5.93
Philippines	4.74	1.61
Singapore	8.81	7.07
Thailand	11.23	7.75

Source: Electric Utilities Data Book for the Asian and Pacific Region, Asian Development Bank, 1993.

Malaysia is seeking to expand service to a consumer base that is growing steadily in both volume of electricity consumed and absolute number of clients. In the Philippines, where power failures occur daily and where 40 percent of the population is still without access to electricity, the Ramos administration is emphasizing fast-tracked, gas-fired private power projects and geothermal development (Monk and Tinker, 1993).

Singapore is the only ASEAN country that expects a levelling of demand before the latter part of the decade (Monk and Tinker, 1993). Brunei, being a small country with a population of only 300,000, is a minor player in electricity consumption. However, because of its abundant reserves of oil and gas, it plays a major role as a petroleum producer.

The development of power supply has absorbed and will continue to absorb a major share of the public resources in the ASEAN. According to the Asian Development Bank, the countries of the ASEAN will need more than $100 billion U.S. to fund projects

in the electricity generation sector alone in the 1990s (Singh, 1993). In the Philippines, estimates in their medium-term development plan for 1993 to 1998 indicate that 41 percent of total government infrastructure spending will be for energy related projects (Monk and Tinker, 1993). While demand for capital to fund energy projects is expected to remain strong, the countries of the ASEAN also require substantial investment in transportation and communications infrastructure. From power lines to traffic lanes, from air freight capacity to water supply, the ASEAN countries are struggling to meet demand (Astbury, 1993). In turn this will affect the percentage of infrastructure dollars that each country allocates for the development of electrical infrastructure.

In the past, power production was the exclusive jurisdiction of either national utilities or individual manufacturers through captive generation (Monk and Tinker, 1993). This scenario is changing since, in order to meet increasing demand, several countries of the ASEAN have embraced private sector participation. The Philippines led this trend, opening electricity generation to private companies in 1987 (Monk & Tinker, 1993). Malaysia is currently trying to increase the efficiency of its operations through privatization and has awarded contracts to two private power developers led by Malay controlled firms (Tenaga Nasional Berhad, 1992). Indonesia is also moving forward with negotiations for construction of the $2 billion U.S. Paiton Phase I coal fired power project (Monk and Tinker, 1993). In order to assist in maintaining growth of their expanding economies, the governments in the region continue to place a high priority on the provision of electrical infrastructure.

2.3 ECONOMIC DEVELOPMENT AND INDUSTRIALIZATION IN MALAYSIA

Malaysia consists of two regions including Peninsular Malaysia and the states of Sabah and Sarawak in the north western coastal area of the island of Borneo (Figure 2-1). These two regions, which cover an area of approximately 329,758 square kilometres, are separated by 540 kilometres of the South China Sea. Peninsular Malaysia borders Thailand in the north and Singapore in the south, while Sarawak and Sabah border Indonesia's territory of Kalimantan (Derauh, 1992).

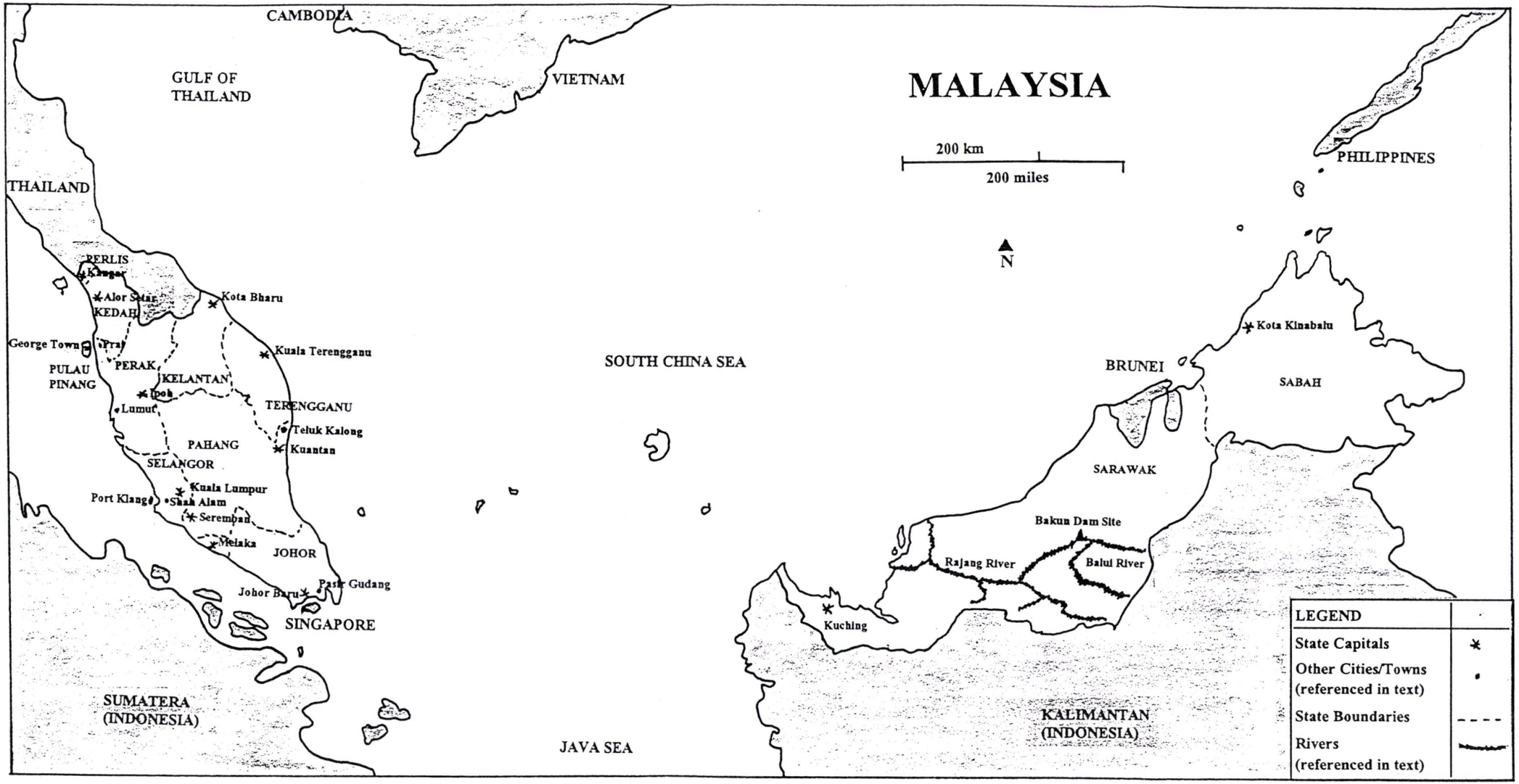
Malaysia was previously considered to be a quiet developing country with a wealth of agricultural products and natural resources. Agricultural products were the mainstream of the economy until the discovery of tin in 1850 transformed economic activity in the peninsula. Tin mining also changed the ethnic mix of the country as the British brought workers from Southern China to work in the mines. Later, rubber cultivation led to the arrival of hundreds of thousands of workers from southern India to staff the rubber estates. The Malays, who worked predominantly in the agricultural sector, had little contact with these new commercial activities that were developing. Each race was spatially and functionally separated from the others, although urban centres provided an opportunity for some intermingling (Ministry of Foreign Affairs, 1992).

Prior to Malaysian Independence in 1957, large resource-based activity was the foundation of the economy and industrial development was not encouraged. Based on colonial capitalism, this economic framework exploited natural resources, resulted in little value-adding economic activity within the country and led to the national economy becoming highly dependent on Western markets (Ministry of Foreign Affairs, 1992).

After independence, the government focused its attention on economic and social development. Water and electricity were extended to rural areas. Education and medical care were provided for the poor. During this period, the government pursued its chief objective, that of improving the lives of the people of this young nation. Despite relatively successful achievements, including an average growth in Gross Domestic Product of six percent per annum, Malaysia was shaken by racial conflict in 1969 (Ministry of Foreign Affairs, 1992). The violence, which resulted in several deaths, was symptomatic of wider social problems, mainly interracial disparities. The government's emphasis on economic growth had failed to solve some underlying social problems in the country.

In 1970, the government formulated its New Economic Policy, which would serve as the country's long-term development plan for the period 1970 to 1990. The overriding objectives of this plan were the eradication of poverty irrespective of race and the restructuring of society in order to eliminate the identification of race with economic functions (Ministry of Foreign Affairs, 1992). Unity among the races was seen as a prerequisite to a prosperous Malaysia and economic benefits were to be shared by all. During this period, Malaysia worked vigourously to attract investment, especially in the manufacturing sector. Lower commodity prices for rubber and tin emphasized the need to diversify. Rapid industrial growth guided by export-oriented policies became the formula for successful economic development. Through a series of successive five-year plans the government put its New Economic Policy into action. During the realm of this policy incomes increased, poverty was greatly reduced, the literacy rate increased, the

FIGURE 2-1


CAMBODIA
VIETNAM
GULF OF THAILAND
MALAYSIA
200 km
200 miles
N
PHILIPPINES
THAILAND
PERLIS
Kangar
Alor Setar
KEDAH
Kota Bharu
George Town
Prai
PULAU PINANG
PERAK
KELANTAN
Kuala Terengganu
SOUTH CHINA SEA
Ipoh
TERENGGANU
Lumut
Teluk Kalong
PAHANG
Kuantan
SELANGOR
Kuala Lumpur
Port Klang
Shah Alam
Seremban
Melaka
JOHOR
Pasir Gudang
Johor Baru
SINGAPORE
SUMATERA (INDONESIA)
JAVA SEA
Kota Kinabalu
BRUNEI
SABAH
SARAWAK
Bakun Dam Site
Rajang River
Balui River
Kuching
KALIMANTAN (INDONESIA)
LEGEND
State Capitals
Other Cities/Towns (referenced in text)
State Boundaries
Rivers (referenced in text)

death rate was reduced and life expectancy was prolonged (Derauh, 1992). Manufacturing increased from 13 percent of Gross Domestic Product in 1970 to 27 percent in 1990 (Ministry of Foreign Affairs, 1992).

In 1991, the National Development Policy was issued. Continuing from the success of the New Economic Policy, this plan focused on the eradication of hard-core poverty, further construction of infrastructure, increased entrepreneurship and diversification of the industrial base with emphasis on export-oriented, high-value-adding, high-technology industries (Ministry of Foreign Affairs, 1992).

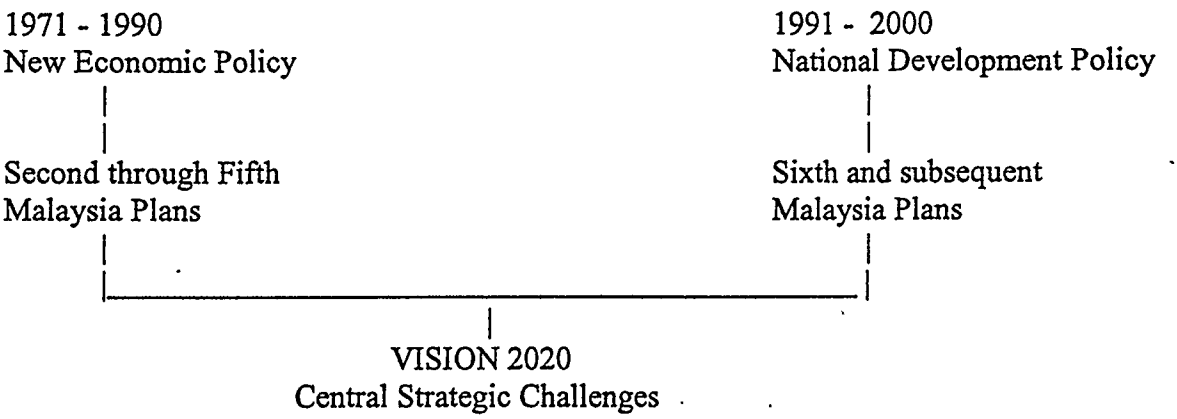
On February 21, 1991 Prime Minister Mahathir presented a speech entitled: "Malaysia: The Way Forward" to the Malaysian Business Council. This speech, commonly referred to as "Vision 2020", communicated the government's priorities for developing Malaysia into an industrialized or developed country. Development is not only pursued in an economic sense since social and cultural issues also are established as priorities. Nine central strategic challenges were set as targets to be overcome before Malaysians could consider their nation developed. Malaysia's development strategy and the nine strategic challenges of "Vision 2020" are shown in Figure 2-2.

Today, in addition to being the world's number one exporter of palm oil, rubber and tin, Malaysia is emerging as a major manufacturing nation (Asian Development Bank, 1993). It is the world's leading exporter of computer chips and the third largest manufacturer of semiconductor devices (Derauh, 1992). The government has set a target of doubling Gross Domestic Product every ten years between 1990 and 2020. This rapid growth requires an average annual growth rate of seven percent over this 30 year period. The projected growth rate was set high to motivate Malaysians into striving hard. Given

an annual growth rate of 6.3 percent from 1960 to 1989, Malaysian government authorities view the goal of seven percent as reasonable (Malaysian Business Council, 1991).

FIGURE 2-2

Malaysia's Development Strategy



1. United Malaysian Nation
2. Psychologically liberated, secure, developed Malaysian society
3. Mature democratic society
4. Fully moral and ethical society
5. Mature liberal and tolerant society
6. Scientific and progressive society
7. Caring society and caring culture
8. Economically just society
9. Prosperous society -- fully competitive, dynamic, robust, and resilient

Source: Malaysia: The Way Forward

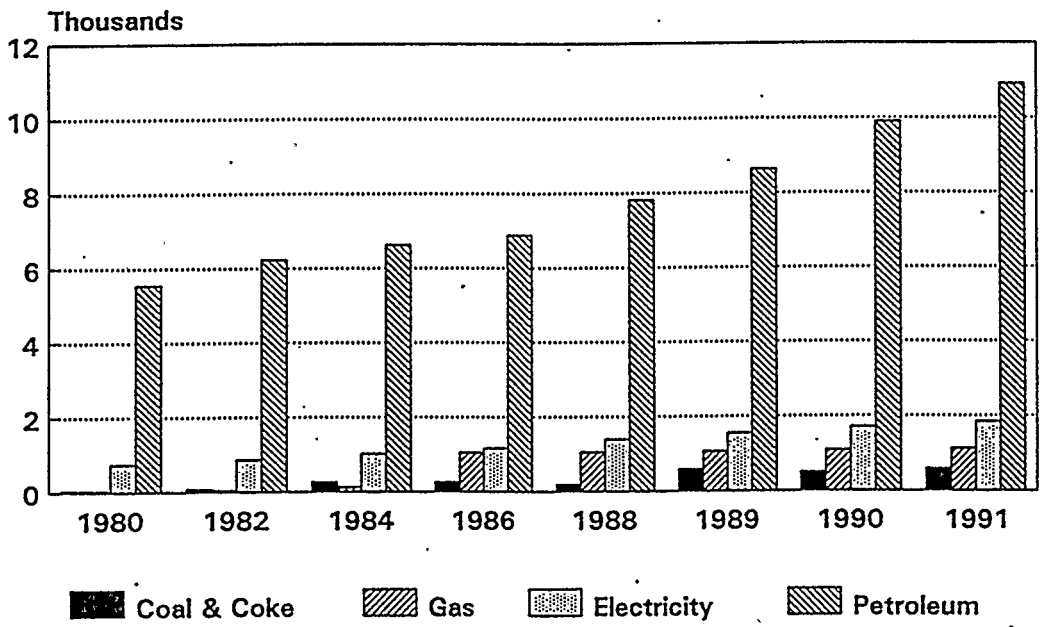
In the years ahead, Malaysia will have to learn to deal with globalization, increased competition, increasing protectionism and trading blocks and conservation of the environment. Domestic challenges that will require attention include potentially lower commodity prices, dependence on foreign investment and difficulties in gaining access to technology. However, with a firm vision in hand and much recent success to build upon, Malaysia appears prepared to face the challenges that lie ahead.

2.3.1 MALAYSIA'S GROWTH IN ENERGY DEMAND

Malaysia's rapid economic growth and industrialization brought about many changes in the energy sector, the most prevalent of which was the increased demand for energy. From 1980 to 1990, primary energy consumption grew by an average annual rate of seven percent per annum (Ministry of Energy, Telecommunication and Posts, 1991). This included increases in all forms of commercial energy. Figure 2-3 exhibits the growth of commercial energy by fuel type from 1980 to 1991.

FIGURE 2-3

Final Use of Commercial Energy by Type of Fuel
(thousand tonnes of oil equivalent)



Source: National Energy Balance Malaysia 1980 - 1991, Ministry of Energy, Telecommunications and Posts, Malaysia

The demand for primary energy is expected to remain strong at 9.5 percent per annum through 1995 (Asian Development Bank, 1993). In 2020, energy requirements could be three times current levels and possibly higher (Lee, 1994).

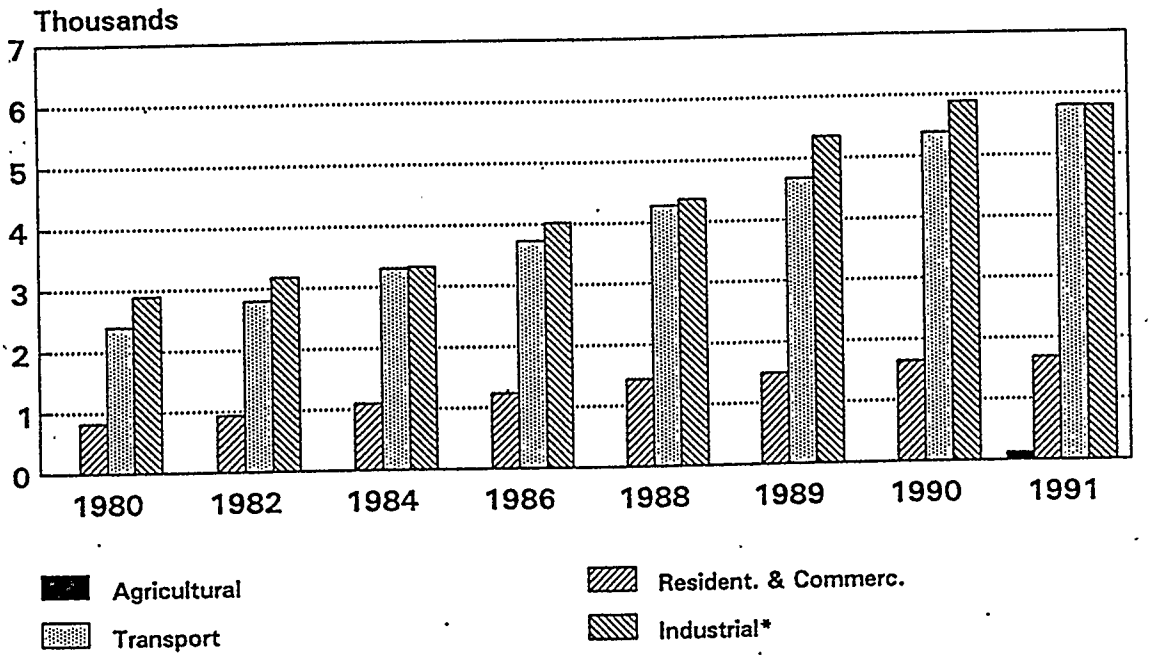
Many energy intensive industries were established from 1980 to 1991 and experts predict more of these will be established throughout the 1990s (Ministry of Energy, Telecommunications and Posts, 1991). From 1980 to 1991 high growth rates in energy consumption continued in all sectors of the economy. Figure 2-4 illustrates the increased energy consumption in all sectors of the Malaysian economy. Malaysia is fortunate to be well-endowed with generous and diverse energy resources. The principal non-renewable resources are oil (almost 48 million cubic meters) and coal (700 million tonnes). Malaysia is ranked sixteenth among the countries of the world in reserves of natural gas due to its vast reserves (1501 billion cubic meters) found off the coasts of eastern Peninsular Malaysia, Sarawak and Sabah (World Resources, 1992). The Peninsular Gas Utilisation Project, which is currently in its third phase of development, has been instrumental in distributing natural gas throughout Peninsular Malaysia. Efforts such as these have helped the government achieve the goal of its Four Fuel Diversification Policy. This policy promotes both less reliance on oil and optimizing the use of the nation's indigenous resources such as gas and hydropower. To date, this policy has been highly successful as evidenced by oil's share of primary energy declining from 87.8 percent in 1980 to 58.7 percent in 1990 (Asian Development Bank, 1993).

Renewable forms of energy have also played a minor role in assisting Malaysia in reducing its dependence on oil. Malaysia's renewable energy resources include hydropower, fuel wood, biomass and solar energy. Rainfall averaging 250 cm per

annum, coupled with favourable topographical features, gives Malaysia considerable hydropower potential, primarily in Sarawak (Ministry of Foreign Affairs, 1992). While oil and gas represent Malaysia's current strength in the field of energy, hydropower and coal are strategically important in ensuring a supply of energy for future economic growth (Asian Development Bank, 1992).

FIGURE 2-4

Final Energy Use by Sector
(thousand tonnes of oil equivalent)



Source: National Energy Balance Malaysia 1980 - 1991, Ministry of Energy, Telecommunications and Posts, Malaysia
(Data for 1981, 1983, 1985 and 1987 is not available.)

* Includes gas used as feedstock. Starting in 1991, Agricultural use was separated from Industrial use.

The administration and supply of energy in Malaysia is handled by several bodies. Figure 2-5 illustrates the key players. Oil and gas are produced by Petronas and multinationals who enter into production-sharing contracts with the state-owned oil company. Until very recently, electricity generation in Peninsular Malaysia was a monopoly held by government owned Tenaga Nasional Berhad. The year 1992 saw two changes in this regard. First, two independent power producers were granted licenses to produce electrical power for sale to Tenaga. Second, a public share offering for 30% of Tenaga was conducted on May 28, 1992.

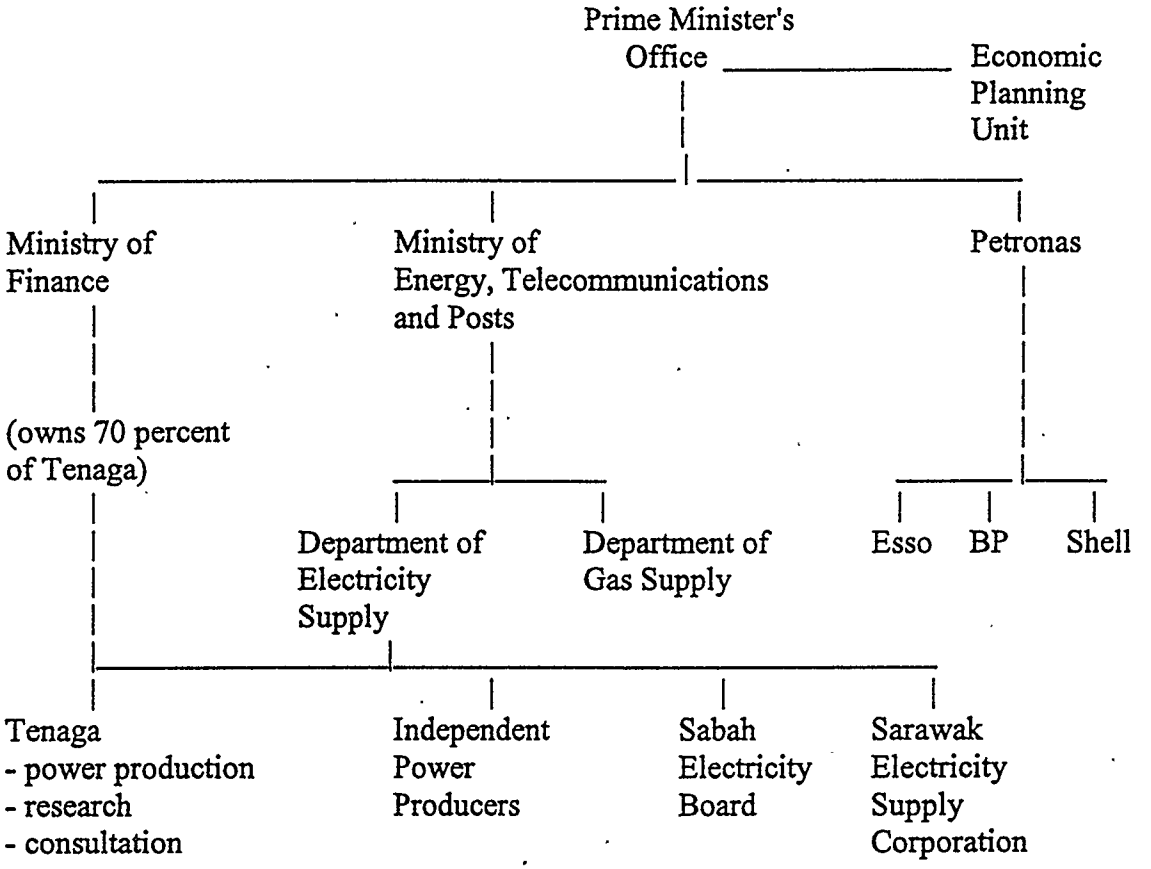
While the responsibility for oil, gas and electricity are handled independently by an appropriate organization, a ministry or a department, it is interesting to note that the Economic Planning Unit plays a co-ordinating role in energy management. Its responsibility is to ensure that there are adequate energy resources available for the economic development of the nation. This is indicative of the critical role that energy plays in development.

2.3.2 MALAYSIA'S GROWTH IN ELECTRICITY DEMAND

Electrical power first appeared in Malaysia in 1894 in a tin mine in Rawang, Selangor (Tenaga Nasional Berhad, 1992). Much has changed during the 100 year history of electricity in Malaysia. Today electricity supply in Malaysia is undertaken by three different utilities covering the three main regions of the country. Tenaga Nasional Berhad supplies power to Peninsular Malaysia, the Sabah Electricity Board supplies Sabah, and the Sarawak Electricity Supply Corporation has the responsibility for power

FIGURE 2-5

Energy Sector Organizational Structure



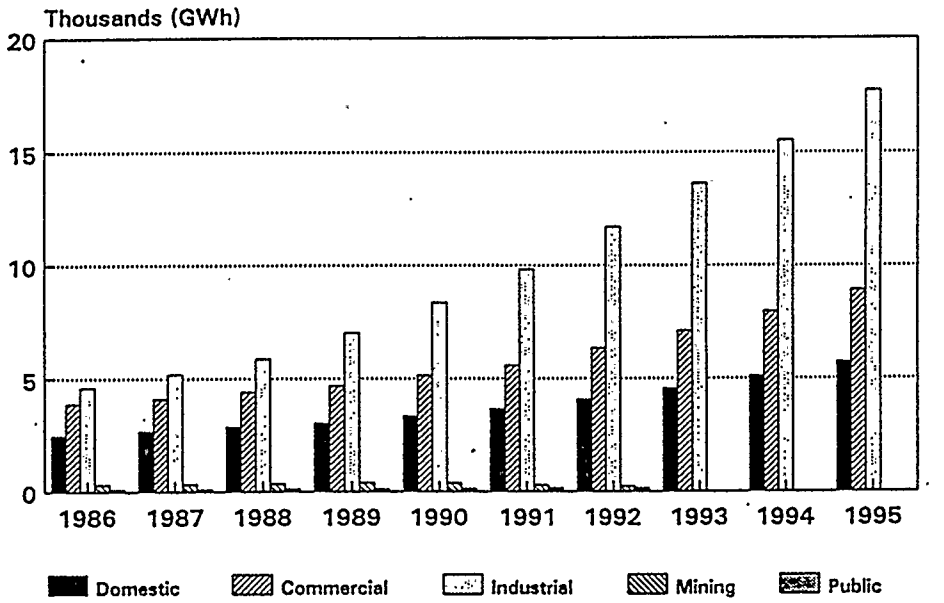
production, distribution and transmission within that state (Derauh, 1992). A Director General of Electricity Supply, who is appointed by the Minister of Energy, Telecommunications and Posts has the responsibility of overseeing the operations of these utility companies. Controlling the issuance of licenses and reviewing tariff structures are just two of the activities for which the Department of Electricity Supply is accountable (Department of Electricity Supply, 1992).

Power demand in Malaysia has been growing at an average of nine percent per year since 1980 (Asian Development Bank, 1993). Figure 2-6 illustrates the high rates of

growth experienced and projected. These high rates of growth are attributed to increased manufacturing, strong demand for commercial office space, strong demand for all categories of houses, increasing urbanization, demographic factors, technological changes and increases in electricity demand for end uses such as air conditioning and lighting (Tenaga Nasional Berhad, 1992).

FIGURE 2-6

Growth in Electricity Consumption, Malaysia



Source: Information Booklet, Tenaga Nasional Berhad, 1992

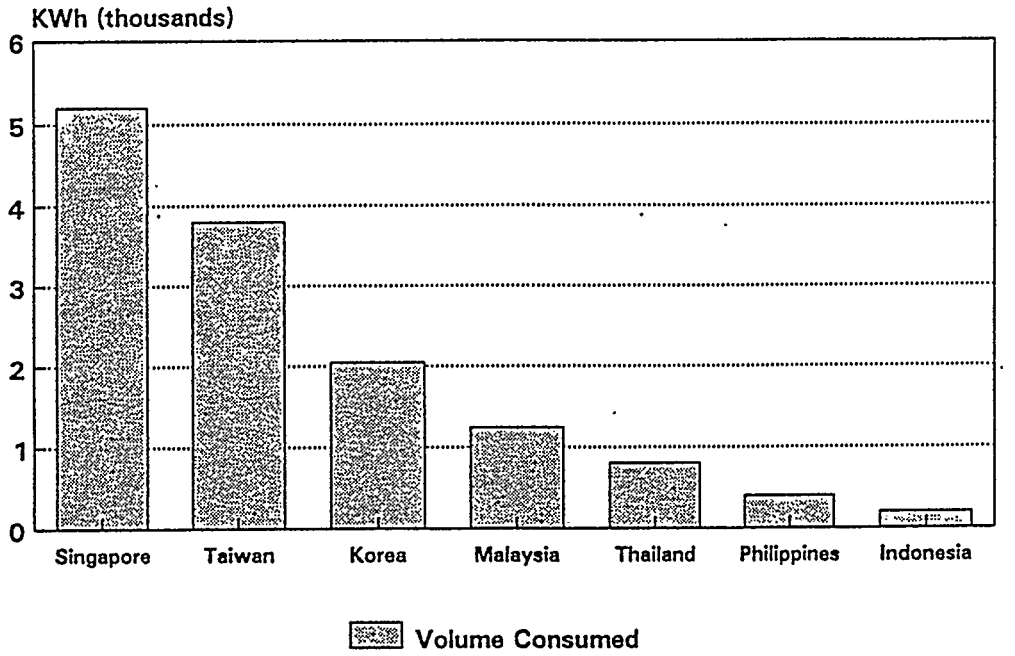
Malaysia is witnessing the increasing importance of electricity in modern living and a decline in the number of persons per dwelling. Technological advancement affecting the demand for electricity is expected to be high due to the penetration of

electricity in high temperature manufacturing, increased automation and the widespread use of robot-aided technology. Consumption by the agricultural and construction sectors will increase due to the anticipated increased use of electric motors and pumps (Tenaga Nasional Berhad, 1992). The government also is promoting the acquisition of electrical household conveniences so that citizens of Malaysia can attain a lifestyle similar to that experienced in developed countries (Mohanty, pers. comm.).

The combination of all of these factors has Tenaga's forecasters predicting that sales of electricity will increase at a rate of 12.4 percent per annum from 1990 through 1995 and then increase at a rate of 9.4 percent per annum from 1996 to 2000 as economic growth moderates (Tenaga Nasional Berhad, 1992). As illustrated in Figure 2-7, Malaysia's per capita electricity consumption is still low when compared with other developed and industrializing countries in the region. Malaysia's per capita consumption in the 1990s is comparable to per capita consumption in the United States in the 1950s (Chateau and Lapillonne, 1982). These comparisons suggest that much growth in consumption is still ahead. Anticipating increasing demand, Tenaga's total installed capacity is expected to be between 25,000 and 30,000 MW by the year 2020, up from 6,645 MW in 1992 (Monk and Tinker, 1993). Increasing demand also necessitates continuous expansion and reinforcement of the transmission and distribution systems. Currently these systems span the whole of Peninsular Malaysia from north to south, with a closed loop connecting the major load centre to the power stations. This is known as "The National Grid" and is illustrated in Figure 2-8. Transmission is connected with the Electricity Generating Authority of Thailand and the Public Utilities Board of Singapore.

FIGURE 2-7

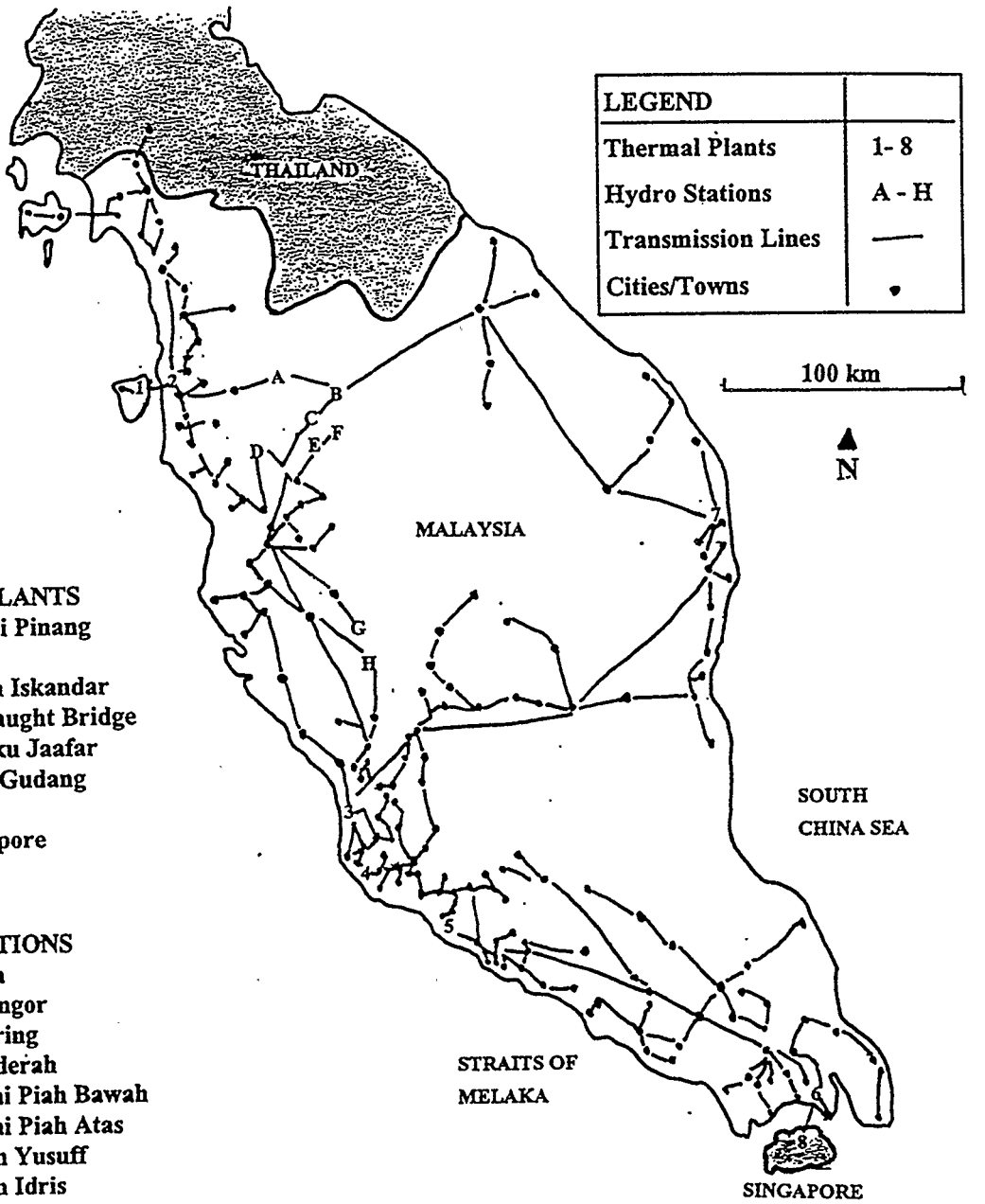
Comparative Statistics on Per Capita Electricity Consumption, 1992



Source: Information Booklet, Tenaga Nasional Berhad, 1992.

Expanded capacity will be required to meet increases in peak demand. As Figure 2-9 illustrates, Tenaga experiences three daily peaks of which the first peak drives Malaysia's infrastructure requirements. Loads begin to rise steadily from about 6:00 a.m. climbing quickly when Malaysians report for work around 8:00 a.m. Within three hours, the first peak of about 4,400 MW is reached at 11:00 a.m. Demand reduces somewhat during the noon hour but rises again to a second, somewhat lower peak around 3:00 p.m. The final peak, which averages around 4,000 MW, occurs around 9:00 p.m. as factories work during off-peak hours to ease peak load pressures (The Star, 1993). While increased domestic sector consumption, specifically air conditioning, contributes to the

FIGURE 2-8
TENAGA NASIONAL BERHAD – NATIONAL GRID



THERMAL PLANTS

1	Sungai Pinang
2	Prai
3	Sultan Iskandar
4	Connaught Bridge
5	Tuanku Jaafar
6	Pasir Gudang
7	Paka
8	Singapore

HYDRO STATIONS

A	Bersia
B	Temengor
C	Kenering
D	Chenderah
E	Sungai Piah Bawah
F	Sungai Piah Atas
G	Sultan Yusuff
H	Sultan Idris

Source: Information Booklet, Tenaga Nasional Berhad, 1992

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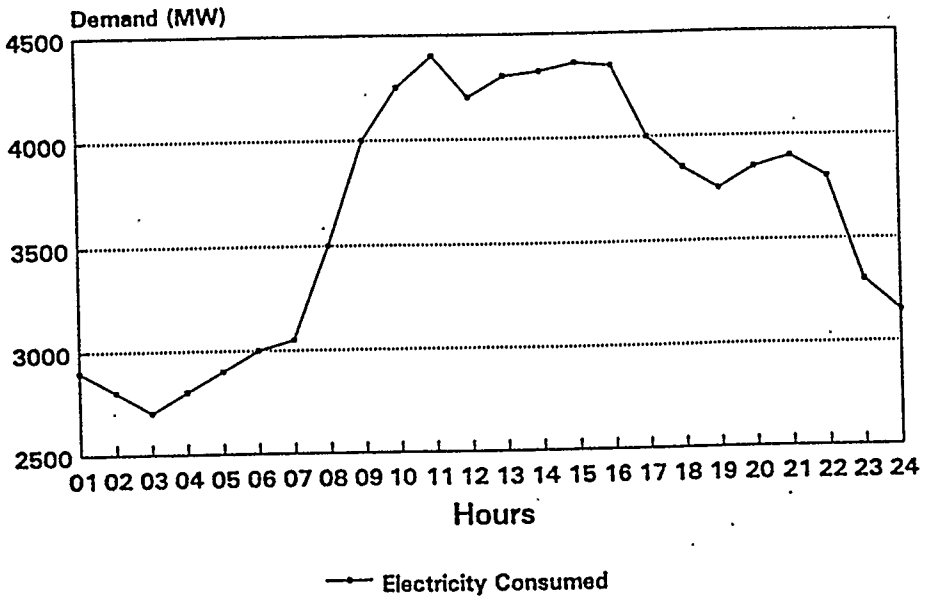
FIGURE 2-9

Electricity Demand Peaks
Peninsular Malaysia -- Normal Weekday



Source: The Star, Kuala Lumpur, March 23, 1993

third period of peak demand the main driving force behind each peak is industrial sector consumption (Mohanty, pers. comm).

A sophisticated forecasting system is employed to assist Tenaga with consumption projections in order to determine when additional infrastructure needs to be brought on-line. Modern forecasting methods are used to arrive at three official forecasts termed low, medium and high. The forecasting generally consists of:

- seasonally-adjusted-time-series analysis for the short-term forecast
- an econometric model for the medium-term forecast and
- an end-use approach to reflect structural and technical changes for the long-term forecast.

The use of several forecasting methods allows for different insights and interpretations of electricity demand to be analyzed and cross-checked for alternative growth scenarios. Tenaga began using this system of detailed forecasting in 1985 and, although the models used are now more complex, the basic questions are still the same. Will the growth in consumption continue? How do we ensure that there are sufficient human resources and infrastructure to support economic growth? (Cheong, pers. comm.).

Despite a sophisticated planning system, Malaysia has been forced to cope with limited electrical infrastructure. Malaysia is an example of growth outstripping power demand forecasts. Tenaga's expansion was based on a projected eight percent annual growth in electricity needs, which actually have risen by as much as 13 to 15 percent in some years (Katayama, 1992). Power failures in Malaysia have steadily increased since 1990. On September 29, 1992 a blackout affected nine of eleven states in Peninsular Malaysia and lasted for more than eight hours. In some parts of the country power was not restored for 24 hours (Rowley, 1993).

During this period, manufacturers in Malaysia lost an estimated $88 million U.S. and some are now delaying investments and expansion (Asiaweek, 1993). Although the cause of the blackout has never been confirmed it is believed to have been caused by a bolt of lightening that struck four power lines near Teluk Kalong on the east coast of Peninsular Malaysia. This caused an overload at the 1,000 MW Paka Power Station, causing it to "trip" and shut down. Other stations then fell like dominos as overloads swept through the grid linking them together.

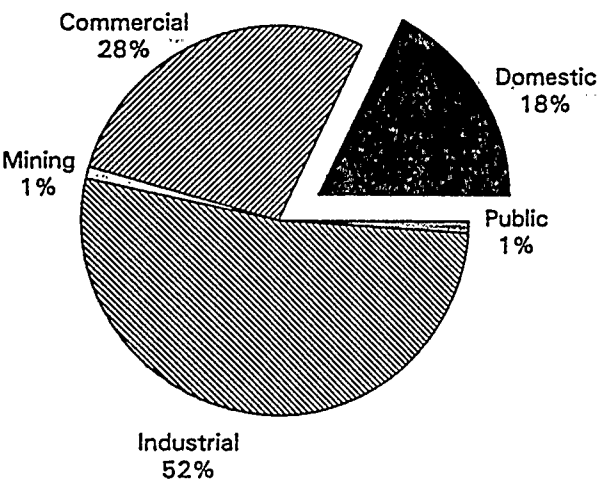
In order to ease the strain on the system, "load shedding" was introduced in 1993. Industrial customers were given financial incentives to adjust the timing of production resulting in reduced system load. However, power failures were still common. These incidents could put a dent in Malaysia's image as an attractive location for foreign manufacturers since adequate power is one of their principal requirements. Although the situation had improved considerably by the fourth quarter of 1993, there is still a need to place a high priority on providing a reliable supply of electricity in volumes sufficient to fulfill customer's requirements. To help bring additional generating capacity on-line quickly, contracts have been awarded to two independent power producers. Both Syarikat Yeoh Teong Lay (Syarikat) and Sikap Power Sendirian Berhad (Sikap) will sell power to Tenaga. Syarikat is building plants in Paka, Terengganu and Pasir Gudang, Johor, which will add 1,175 MW when they come on-line in 1995. Sikap is proposing to build and operate a 1,300 MW gas-fired power plant in Lumut, Perak (Monk and Tinker, 1993). While the introduction of independent power producers can help alleviate the current power crisis, there is a need to balance the inherent benefits of introducing competition against the importance of ensuring the security of electricity and the continuing financial viability of those licensed to produce power. The parties involved in supplying power to this rapidly expanding economy recognize that development cannot take place without infrastructural underpinnings. The current tightness of the system is expected to be a short-term matter as various steps are being taken to increase supply (Jayasankaran, 1994).

2.3.3 GROWTH IN ELECTRICITY DEMAND IN THE MALAYSIAN DOMESTIC SECTOR

A shift towards greater use of electricity in higher income countries has been noted (Asian Development Bank, 1992). This is definitely the case for Malaysia. The unprecedented economic growth rates of the Malaysian economy are setting the foundation for more individuals to raise their standard of living and a new class of consumers is emerging -- the middle class consumer. Although the domestic sector constitutes only 18 percent (see Figure 2-10) of the electricity sold and the percentage share is declining, total consumption in absolute numbers rose from 2,480 Gigawatt-hours (GWh) in 1986 to 4,083 in 1992 (Tenaga Nasional Berhad, 1992). Domestic sector consumption is predicted to continue to increase between ten to 15 percent per year through to the year 2000 (The Star, 1993).

FIGURE 2-10

Electricity Consumption by Sector
(Percent consumed in 1992)



Source: Information Booklet, Tenaga Nasional Berhad, 1992

The middle class now constitutes the largest group in the Malaysian population and has the potential for dramatic growth. Malaysia is attempting to increase its population to 70 million by 2060 from the current level of 18.6 million. The population growth rates is currently 2.5 percent per annum and, if this growth rate continues, the population is expected to reach 22.7 million by the year 2000 (Sani, 1993). While attempting to quadruple the population in seventy years may sound ambitious, one should note that with over one-quarter of the Malaysian population currently under age twenty, the high number of women of reproductive age provides a sound basis for believing that this level of growth may be achieved (Department of Statistics, 1993). Malaysia desires this high level of population growth in order to create the population base it feels is necessary for an internal market for its goods and services. However, such an increase in population will result in a strain on Malaysia's natural resources and environment and will contribute to international concerns regarding limited food supply and global population growth. As an alternative to quadrupling its population for market development purposes, Malaysia could encourage regional trade for its products and services.

Immigration, both legal and illegal, is another factor that will add to the number of people living in Malaysia. Many Indonesians and Philippinos are migrating to Malaysia to fill vacancies in the labour market. The formation of new families, attributed to both population increases and changes in family structure, also will result in increased consumption of electricity (Tenaga Nasional Berhad, 1992).

While the extended family structure is still common throughout Malaysia, the situation is changing rapidly. More and more children are leaving home and establishing

their own residences. In turn, they will acquire many domestic appliances. Many individuals are also leaving the rural areas and moving to cities that offer the promise of employment.

In 1970 only 26.8 percent of the population lived in urban centres. In 1992, over 50 percent of Malaysians were urban residents and the move towards urbanization is continuing (Derauh, 1992). Since an urban lifestyle is generally synonymous with more comforts and conveniences, urban residents use more electricity than their rural counterparts. Air conditioning, which makes life more comfortable and is increasing in popularity in urban centres, accounts for 30 to 55 percent of electricity costs among Malaysian families who have one air conditioner in their home. Lighting and refrigerators account for the next major portion of a household's electricity bill, each with a 20 percent proportionate share (The Star, 1993). While televisions, fans and irons consume smaller volumes of electricity they are common contributors to higher utility bills if used for extended periods of time (Table 2-2).

While the middle class represents the largest body of domestic consumers, increased consumption also will prevail in the other classes. In November 1993, the government introduced a programme to supply homes for low income families (Majid, 1993). This move will foster increased electricity consumption by those individuals who come to live in these dwellings. At the other end of the scale, upper class citizens are now utilizing additional air conditioners for their larger residences and installing complete kitchens (ovens, many small appliances, etc.) for meal preparation in their homes.

TABLE 2-2

Electricity Consumed by Malaysian Household Items

Item	Watts	Item	Watts
Iron	1000	4 foot fluorescent tubes	36 - 40
Rice cooker	600 - 1000	Light bulbs	40 - 100
Big refrigerator	150 - 300	Microwave oven	650 - 2000
Small refrigerator	60 - 100	20 inch television	60 - 70
One horsepower window air conditioner	700	Two horsepower window air conditioner	1500
Table fans	30 - 40	Stand fans	50 - 100
Ceiling fans	50 - 75	Computer	200- 300

Source: Tenaga Nasional Berhad, Printed in "The Star", March, 23, 1993.

Affluence is increasing throughout the population and rising with it is a greater desire to own and utilize electricity-consuming household goods. Personal goods consumption increased 14.3 percent in 1989 and 10.5 percent in 1990 (Webster, 1992). Consumption trends that North America experienced in the 1950s and 1960s will prevail in Malaysia in the 1990s (O'Brien, 1990). Electricity-consuming appliances such as lighting, fans, irons, entertainment equipment, larger refrigerators, water heaters and air conditioners top the shopping lists of many Malaysians. This type of dramatic increase in the acquisition and use of consumer goods will have a significant impact on electricity demand (Tenaga Nasional Berhad, 1992).

Electricity consumption at the household level is driven by many factors including consumer tastes or preferences, social norms, changing lifestyles, urbanization, technological advances, demographics, habits and affluence. All of these factors will play a role in the way in which electricity is consumed in Malaysian homes.

While individual prosperity and the comforts that accompany it appear desirable to Malaysians, pursuit of their "Vision 2020" will not be achieved without a cost. Electricity consumption will continue to have an impact on natural resources, the environment and human health.

3. THE IMPLICATIONS OF INCREASED ELECTRICITY CONSUMPTION AND AN OPTION FOR MITIGATION

3.1 ENVIRONMENTAL AND HEALTH IMPLICATIONS ASSOCIATED WITH ELECTRICITY CONSUMPTION

While the development of energy resources has contributed significantly to the expansion of the economy and the well-being of Malaysian citizens, energy utilization also has contributed to the degradation of the environment and to the declining health of some people. Malaysian cities, particularly Kuala Lumpur and the neighbouring Klang Valley, suffer from air pollution associated with energy-intensive growth. Sulphur dioxide and nitrogen dioxide concentrations are often above concentration levels deemed safe by the World Health Organization (World Resources Institute, 1992). Ambient lead concentrations, largely attributed to the use of leaded auto fuels, are high. This has the potential to impair neurophysiological development in children. Polycyclic aromatic hydrocarbons, which include confirmed carcinogens, are associated with the incomplete combustion of any fossil fuel (World Health Organization, 1992). Surface inversions associated with dry spells, light surface winds and the nature of the topography, have resulted in haze particulates being trapped in the Kuala Lumpur area. Complaints of increased asthma cases, impaired vision and a general feeling of depression are reported when these conditions exist (Sani, 1993). In 1990, there were 59 days in which suspended particulate matter in Kuala Lumpur exceeded the standard[6] set by the World Health Organization and the situation is likely to intensify as energy consumption increases (World Resources Institute, 1992).

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[6] Gravimetrically determined suspended particulate matter exceeds 230 micrograms per cubic metre as determined by the Global Environmental Monitoring System.

Although much of the deterioration in air quality is attributed to industrial processes and vehicular exhaust, power generation also contributes to the problem. However, to many people, the environmental implications associated with electricity consumption go unnoticed since electricity appears to be clean and efficient. This perception is attributed to the fact that emissions related to electricity use do not occur at the place of end-use, but rather occur at the place of electricity generation. Generation facilities are often located away from heavily populated areas so individuals do not witness or understand the impact their consumption has on the environment.

There are two aspects of electricity generation that have a significant bearing on the amount of pollutants released. The first relates to the amount of electricity used and the second to the types of fuel consumed during the generation of electricity (ESCAP, 1992). In Malaysia, electricity is generated using a mix of resources. Table 3-1 illustrates the sources of power generation. The changing composition of fuels reveals a movement away from oil and coal to natural gas, which is recognized as being

TABLE 3-1

Generation Mix by Fuel Type
(percent)

	1985	1992	*1995
Hydropower	24.6	12.79	14.50
Distillate	----	0.67	----
Oil	66.50	33.73	5.50
Coal	----	14.48	5.00
Natural Gas	8.90	38.33	75.00

* Predicted
Source: Information Booklet, Tenaga Nasional Berhad, 1992

more environmentally friendly and is available in abundance in Malaysia. Despite the switch to domestic natural gas, the impacts of electricity generation in Malaysia will still be significant. Malaysia's move to provide additional power to fuel its rapidly expanding economy, associated capital outlays and the increase in generating capacity will contribute to pressures on the environment. The environmental and health impacts associated with generating electricity are discussed on the following pages.

3.1.1 FOSSIL FUELS

Human consumption of fossil fuels including oil, gas and coal, and their resulting contributions to acid precipitation, ozone depletion and global warming is continually subjecting the world's ecosystems to stress.[7] Based on current estimates, by 1995, 85 percent of electrical power in Malaysia will be generated by various forms of fossil fuels (Tenaga Nasional Berhad, 1992). The use of fossil fuels creates a number of different primary environmental impacts which can be categorized as follows:

- chemical impacts resulting from the production and release of sulphur dioxide, nitrogen oxides, hydrocarbons, carbon dioxide, and particulate matter
- hydrological impacts relating to water use and pollution and
- mechanical impacts such as dust, noise, land clearance and visual amenity (Ramani et al, 1992).

The transport sector, which accounted for 41 percent of the final demand for fossil fuels in 1988, maintains the lead as the chief contributor to the environmental problems associated with the consumption of fossil fuels (Ramani et al, 1992). It is

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[7] Ecological stress is defined as any environmental influence that causes measurable ecological change. If the stress is short-term and subsequently alleviated, succession will take place. If the stress is long-term, ecological change will occur. The advent of severe stress causes mortality, reduction in species richness and variation in ecosystem functions such as productivity and nutrient cycling.

followed by the industrial sector where the absolute volume of fossil fuel consumed is increasing rapidly, attributable to high levels of foreign investment in manufacturing facilities and the emergence of the petrochemical industry. Electrical power generation, which is expected to account for 14 percent of Malaysian fossil fuel consumption by 1995, also contributes to environmental and health problems (Ramani et al, 1992).

Acid precipitation is one form of stress where several regions throughout the world have witnessed a measurable ecological change. The major contributors to acid precipitation are oxides of sulphur and oxides of nitrogen which are released into the atmosphere through industrial processes, motor vehicles and power generation (ESCAP, 1992). Acid precipitation is detrimental to life and life-support systems (Sani, 1993). Visible ecological impacts of acid precipitation include lifeless lakes and damaged forests and crops. Acid deposition also causes metals, some of them toxic, to leach out of the soil and accumulate in water, with subsequent entry into the food chain. Buildings, bridges and other infrastructure have been known to deteriorate due to the presence of acid precipitation.

Acid precipitation is steadily becoming a public concern in Malaysia, although the problems are not as severe as those experienced in Europe or North America. Studies by the Malaysian Meteorological Service show that acid precipitation is fast becoming a problem in Prai, Petaling Jaya and Shah Alam (Sani, 1993).

Fossil fuel consumption also raises concerns about ozone. Depletion of ozone in the stratosphere is of concern since the ozone layer acts as a natural filter absorbing most of the sun's damaging ultra violet rays. Many crops, such as rice and soya beans, which are common throughout Malaysia, are particularly sensitive to ultraviolet radiation and

are easily damaged (Freedman, 1989). In the oceans, aquatic life near the surface is at risk of having their natural habitats threatened by ozone depletion (Cushing and Walsh, 1976). Animals have been found to have vision problems attributed to ozone depletion (Geist, pers. comm.). A second concern, ground level ozone, is a major component of smog. Ground level ozone also is detrimental to agricultural crops. Ground level ozone damages the leaves of many plants. This leaf damage reduces photosynthesis, hence the plants' energy production, and often makes the plants more susceptible to insects and disease (Freedman, 1989). The repercussions of this are felt throughout the food chain as herbivores and, subsequently, carnivores have less food available to satisfy their requirements.

Human-made gases, produced as the result of hydrocarbon consumption, are changing the balance of gases in the atmosphere. This phenomenon is known as the greenhouse effect. Global warming and weather extremes are two symptoms of the greenhouse effect. Although there is debate as to the impact that greenhouse gases will have on the environment, it is predicted that global surface temperatures will rise and that there could be a substantial change in precipitation patterns. This would lead to rising sea levels, coastal flooding and more frequent and severe droughts in inland regions (ESCAP, 1992). The main threat that climate change is expected to pose in the medium-term is that it may exacerbate existing environmental problems in the Asia Pacific Region. Severe coastal erosion, extended hurricane belts, reduced agricultural yields and the loss of fresh water acquifers are just a few examples of disasters that are likely to occur if global warming intensifies (ESCAP, 1992). The resulting ecological disasters may become increasingly devastating due to the rising population in the region.

Disruption of ecosystems brought about by global warming could lead to human migrations on an unparalleled scale (World Health Organization, 1992).

Climate change also could bring about other important indirect consequences for health through increased or changing patterns in the spread of communicable diseases (World Health Organization, 1992). For example, a rise in temperature and rainfall in a particular region would likely extend the areas where malaria vectors survive.

Although the issues of acid precipitation, ozone and the greenhouse effect frequent the headlines, production and transportation accidents such as oil leaks or spills also have the potential for the widespread destruction of habitats. There are also work place accidents (and occasionally fatalities) associated with the production of fossil fuels. The construction of fossil fuel energy infrastructure including gas plants and pipelines has adverse effects on the environment as well.

Natural gas emits approximately 40 percent less carbon dioxide per unit of heat generated than does coal or oil (International Energy Agency, 1991). For this reason and others it is gaining popularity as a "clean fuel." In Malaysia, there is a move towards converting power plants that previously used oil or coal to natural gas. In 1992, Tenaga converted units at the Tuanku Jaafar Power Station, the Sultan Iskandar Power Station and the Connaught Bridge Power Station to gas firing (Tenaga Nasional Berhad, 1992). Rehabilitation and conversion projects are in progress or are scheduled for various other power stations. In the years ahead, the major demand for gas in Malaysia will be for electricity generation (Government of Malaysia, 1991). However, Malaysia's supply of natural gas is not without limits. Estimates of supply range from 99 years, based on current consumption levels, to as low as 40 years supply when increased consumption is

factored in (Hamid, pers. comm.). In the long term coal and hydro are expected to become the fuels for power generation (Asian Development Bank, 1992).

The foregoing discussion highlights some of the environmental stress that humans are imposing on ecosystems throughout the world through the consumption of fossil fuel energy sources. The problems are not unique to the power sector nor are they unique to Malaysia. However, until the 1980s the contribution of the countries of the Asia Pacific Region to global carbon emissions were only about one-seventh of those from North America. By 1985, the emissions from the two regions had become almost equal. If a "business as usual" scenario is followed, carbon emissions from the developing countries of the Asia Pacific Region will, by the year 2010, be roughly three times the current rate (ESCAP, 1992). This will result in an intensification of the problems associated with the production and consumption of oil, coal and gas.

3.1.2 NUCLEAR ENERGY

Nuclear energy is presently not a source of power in Malaysia since opposition to it comes from Prime Minister Mahathir Mohamad. He believes Malaysia's natural gas supplies are sufficient to meet the country's energy needs for approximately one hundred years. Others maintain that the natural gas supply may be exhausted within a few decades if the current surge in consumption continues. This may induce pressure for nuclear power (Tsuroka, 1993).

Nuclear power plants generally produce less environmental pollution than many other fuels (World Health Organization, 1992). Under normal operations nuclear power can reduce emissions but the perceived risks of nuclear accidents, the anxiety about the

risk to health of present and future generations, the imputed dangers associated with the storage of nuclear wastes, its high capital cost, the dependence on outside fuels and the fear of proliferation of nuclear arms has prevented it from making in-roads in many countries (ESCAP, 1992).

The health hazards specific to nuclear power are those due to exposure to ionizing radiation. Radiation has known impacts such as skin burns, damage to bone marrow and sterility, which occur only after acute exposure to radiation. Radiation also has chronic effects such as cancer, which are believed to occur as a result of exposure to a wide range of doses (World Health Organization, 1992). Exposure can be minimized by building in safety features in the design phase. These include barriers to prevent the release of radiation and a diversity of safety systems to avoid common causes of system failure (Hafele, 1990).

Because of the many issues surrounding the implementation of nuclear power, much debate is expected to prevail, in Malaysia and around the world, on this topic. There are clearly environmental and human health risks that should be considered when assessing whether or not nuclear power is a viable option for electricity generation in Malaysia.

3.1.3 HYDROPOWER

In Malaysia hydropower is a substantial energy resource that represents an important long-term development alternative and diversification option for electricity generation to meet the growing power demand. In the state of Sarawak alone, hydropower potential is estimated at 20,000 MW (Ministry of Energy,

Telecommunications and Posts, 1986). While large scale hydroelectric power development promises economies of scale, its development requires a long gestation period and faces the critical issues of timing, finance and environmental impact (Government of Malaysia, 1991). The use of hydropower may reduce greenhouse gas emissions and acid precipitation but the price is high in terms of loss of land, destruction of habitat and often the relocation of indigenous people (World Health Organization, 1992).

Flooded areas result in the destruction of vegetation and many animals are driven from their territories. The accumulation of a huge new water body behind a dam may cause physical stress on the earth's crust and induce seismic activity. As experience in Europe and Asia has shown, such forces may result in the collapse of dams and subsequent flooding of downstream areas. The retention of river water by large dams has two down-river effects. It deprives down-stream water of nutrients essential for aquaculture and agriculture and it seriously affects the replenishment rate of down-stream acquifers. In areas where people depend on wells for their daily supply of drinking water, the lowering of groundwater tables has the potential to cause water shortages (World Health Organization, 1992). The cost and environmental impacts of providing transmission and distribution systems is another area of concern (DeCicco et al, 1992). This is of particular significance for Malaysia where the main hydropower potential exists in Sarawak on the island of Borneo yet the main consumers of power are located in Peninsular Malaysia.

Indigenous people who are uprooted due to dam construction often suffer because their traditional lifestyle is impaired. Their homeland is destroyed and they can no

longer obtain food, water and shelter by employing the traditional methods of their ancestors (World Health Organization, 1992). Often, little is offered as practical compensation for their loss.

The actual process of generating hydropower does not produce wastes or by-products harmful to human health. However, the accumulation of a large, almost stationary body of water sets in motion a train of events in tropical areas that may enhance the spread of infections and diseases including malaria. Fortunately, many of the negative effects on health can be prevented or mitigated by adopting appropriate engineering and environmental management practices in the construction and operation of dams (World Health Organization, 1992).

Despite the drawbacks associated with hydroelectric power, several hydroelectric projects are under consideration in Malaysia. A new $695 million U.S. hydroelectric project in Jeli near the Thai Kelantan border is expected to be completed in 1995 (Tsuruoka, 1993). Another hydroelectric project under consideration is known as the Bakun Hydroelectric Project (Bakun). It is located on the Balui River in the Upper Rajang River Basin in the state of Sarawak. The impoundment of the Bakun Dam will create a man-made lake with 695 square kilometres in surface area. This is larger than the island of Singapore which is only 620 square kilometres. A total of fifteen communities with a population of approximately 4,300 inhabitants would be directly affected by the construction of the project, including the Kenyah, Kayn, Lahunan, Ukit and Penan native tribes. Power generated by the Bakun Dam would be transferred to Peninsular Malaysia via submarine cable (Ministry of Energy, Telecommunications and Posts, 1986).

The proposal to construct the Bakun Dam is surrounded by much controversy. The proponents assert that the project can be financed successfully and that it will benefit the national economy. A preliminary investigation into the environmental and sociological implications of the Bakun Hydroelectric Project was undertaken as an integral part of the feasibility study. The results of the study indicated ways of mitigating many of the negative social and environmental impacts. Sarawak will benefit as the result of diversification as this dam will lessen the state's dependence on the forestry industry. Many jobs will be created during the construction phase and revenue will accrue to the state owned utility once the dam is operational. Opponents of Bakun question the need for the project in light of contracts awarded to independent power producers to produce 5,000 MW of power using natural gas (Consumers Association of Penang, 1993).

Bakun is expected to initially produce 2,400 MW of power and full scale development along the Rajang River could yield as high as 16,000 MW (Ministry of Energy, Telecommunications and Posts, 1986). The economic viability, environmental destruction and social implications are under fire from those opposing the development. When the study was initially completed in 1985, the cost was estimated at $3.126 billion U.S. and would result in an economic rate of return of 12.2 percent. The revised cost as of December 1993 is stated at $12.24 billion U.S., which leaves people questioning the economics of the project (Consumers Association of Penang, 1993). Opposition groups insist that a full scale environmental impact assessment be completed and made available to the public before work on the dam commences.

The decision as to whether or not Bakun will proceed varies daily. Some sources indicate that a revised project, with less environmental destruction, will be constructed. The Department of Environment state that it has not received an environmental impact assessment for the project and therefore it cannot proceed (Ghani, pers. comm.). Others are concerned that an environmental impact assessment will be a mere formality with little public accountability. From this example, one can see that many conflicts surrounding hydropower development in Malaysia are anticipated.

3.1.4 RENEWABLE ENERGY SOURCES

In addition to hydropower, a number of renewable energy technologies have the potential to operate in Malaysia. Its location in the tropics provides favourable conditions for the use of solar power. Although the high level of cloud cover and the advent of monsoons limits the possibility for solar generation in some parts of the country, several projects using solar photovoltaic cells for lighting, small power sources and pumping have been implemented in remote or small island communities (Hamzam, pers. comm.). Solar panels are increasingly being used for domestic water heating in urban areas. However, the full potential of non-conventional sources of energy remains virtually untapped in Malaysia (Government of Malaysia, 1991).

Malaysia also has great interest in renewable energy sources involving agricultural wastes. Pilot projects are focused on the twin objectives of disposing of agricultural wastes with minimum environmental degradation and harnessing their energy content for commercial or economic benefit. Over two hundred palm oil mills in Malaysia are energy self-sufficient through the utilization of palm oil fibre and shells as

boiler fuel (Ministry of Foreign Affairs, 1992). This cogeneration technology produces steam and generates electricity.

Wind, solar, water, fuel crops and geothermal energy sources are viewed as environmentally sustainable energy technologies that provide energy in various parts of the world. These renewable resources may have the least damaging environmental implications. However, some would argue that windmills cause noise pollution while others are concerned about the high amounts of fossil fuels lost in the process of constructing solar and wind energy equipment as compared to their eventual energy yield (ESCAP, 1992). The generation of wind power has been known to be detrimental to birds that cross over clusters of windmills. Substantial ecosystem destruction results from the implementation of large scale solar collection systems since life beneath the photovoltaic cells is disturbed (Davidson, 1977). There also is considerable debate as to exactly how much land would be required to convert to a solar or wind society. Despite some negative impacts associated with renewable energy technologies, they are viewed as the most environmentally benign sources of energy (ESCAP, 1992). The Malaysian government, despite the lack of a formal policy addressing renewable energy, is informally encouraging more research into renewable energy technologies (Roy, pers. comm.). For these reasons, one would expect to see improvements in technology and reduced costs in order to make them a viable energy alternative in the future.

3.1.5 .TRANSMISSION AND DISTRIBUTION

The transmission and distribution of electrical power is beginning to be questioned for its associated environmental and health impacts. The environmental

concern with transmission and distribution lines is that, although the nature of their impact is small, environmental impacts often occur by increments, each of which may seem small enough to ignore (Thompson, pers. comm.). Laying a power line may venture into land that previously had been undisturbed and such development may set a precedent for more development in the area. The cumulative impacts of a series of small changes can be devastating (DeCicco et al, 1992).

Since 1979, a concern has arisen regarding the possible health effects of electromagnetic fields (DeCicco et al, 1992). It has been suggested that exposure to electromagnetic fields may increase the risk of some cancers, such as leukemia, lymphoma and nervous system tumours. The evidence for the existence of increased cancer risk is based on epidemiological studies on occupational workers and the general public but the conclusions are weak and unsubstantiated (World Health Organization, 1992). More research is underway on the possible health effects of electromagnetic fields. Until such studies provide conclusive evidence regarding the impacts of electromagnetic fields the prudent avoidance of electromagnetic fields is recommended (DeCicco et al, 1992).

3.2 ENERGY CONSERVATION AND DEMAND SIDE MANAGEMENT

There is a common tendency to blame energy producers for the environmental destruction associated with their products. But what must be remembered is that the origin of the environmental, health and social impacts of electricity supply is consumer demand (Ramani et al, 1992). There is a need to recognize that no power sources are totally benign. These reasons suggest roles for Demand Side Management (DSM) and

conservation to minimize consumption levels and mitigate the environmental impacts associated with electricity consumption.

Environmental concerns over energy developments in the Asia Pacific Region have been increasing over the years. However, the environmental concerns have generally been sidelined due to a preoccupation with economic growth, for which energy supply expansion has been essential (Ramani et al, 1992). Recognizing that the region's high rates of growth in electricity consumption cannot be met by conservation and DSM alone, there is still room for them to make a significant contribution (Tai, 1994). The situation presented in recent literature[8] by Mr. Dominic Tai, the Public Affairs Manager for China Light and Power, applies to many countries in the region. He believes that long-term planning is key to successful electricity supply management and that while DSM efforts will undoubtedly reduce future demand, the dynamic growth rates experienced will dictate the need for expanded generating capacity to ensure a high-quality reliable supply is maintained.

Demand Side Management is the systematic effort to manage the timing and amount of electricity demand by customers and to increase the overall efficiency of electricity use by customers (International Institute for Energy Conservation, 1991). DSM departs from the traditional treatment of customers as mere meters to be billed and payments to be collected. It aims to influence what happens beyond the meter. By advising and showing customers how to use electricity efficiently, power utilities hope to improve service to customers and to become responsible corporate citizens in this "green age" (Ramani, pers. comm.). DSM strives to reduce peak demand (which drives

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[8] Recent literature includes letters to the editor in The Far Eastern Economic Review, January 20, 1994.

infrastructure requirements) and endeavours to balance base loads. Energy efficiency does not mean enforced savings through the curtailment of consumption levels. Rather, it represents a view of energy as a service and has the aim of delivering required energy services to the consumers in the most cost-effective manner or producing similar or greater output with reduced energy input. DSM instruments, if successfully implemented, serve to reduce the overall rate of growth in electricity consumption without impairing the lifestyles desired by citizens or the development goals of the nation. In turn, electricity growth rates do not exceed economic growth rates, but alternatively have potential to be lower than Gross Domestic Product.

DSM and consumption reduction through cost-effective energy efficiency and conservation are key elements in an environmentally sound strategy for the provision of electricity services (Ramani et al, 1992). Improved energy efficiency offers the kind of compromise that economic development and environmental conservation need in order to co-exist. DSM helps to achieve environmental sustainability which has been given greater importance in development planning as evidenced by policy statements in the Sixth Malaysia Plan. This plan emphasizes prevention through conservation rather than curative measures after destruction has occurred (Government of Malaysia, 1991).

Whether or not the environmental rationale proves effective in bringing about changes to electricity development paths in the future, countries in the Asia-Pacific Region will still have to contend with depleting capital resources for conventional energy development (Ramani et al, 1992). Conservation is probably Asia's least expensive way to alleviate its electricity shortages (Katayama, 1992). For example, in Thailand, the cost of providing an additional 2,000 MW of power is $4 billion U.S.. The cost of DSM that

will produce a savings of 2,000 MW through improved efficiency is $1.6 billion U.S.. This will result in an efficiency savings of $2.4 billion U.S. over a 10 year period (International Institute for Energy Conservation, 1991). The savings associated with DSM have potential for further increase if the resulting environmental damages could be monitized in the financial analysis. When less funds are required for energy infrastructure, more funds are free for development elsewhere in the economy. DSM is increasingly attractive to the region's fiscally conservative governments and should enhance the ability of governments and utilities to anticipate and address demand (Monk and Tinker, 1993).

DSM also offers several other benefits. Through reduced consumption of electricity, corporations and individuals save on their utility bills. One Japanese study claims that developing countries can reduce energy needs by as much as 17 to 20 percent by adopting small energy-saving steps. Based on Japan's actual experience, the savings are much higher. Between 1973 and 1987, Japan reduced the amount of energy needed to produce $1 million U.S. worth of Gross Domestic Product by 33 percent (Ministry of Energy, Telecommunications, 1993). This type of savings results in reduced production costs and more competitive products. This should be of interest to Malaysia which, with virtually full employment, risks rising labour costs and will want to keep other costs low to retain its competitive position.

For individuals, the dollar value of the savings per household are substantially less but still worthwhile. For example, a single-storey house without air-conditioning, but with the lights used daily for six hours, the television for four, the video cassette recorder for three, fans for three, and the iron and kettle used frequently, a monthly

electricity bill of $20 U.S. could be expected. A two storey house with two air-conditioners and normal consumption from other electrical appliances would be paying approximately $52 U.S. per month. Assuming a 20 percent savings attributed to DSM, the first household would save $48 U.S. annually and the second home would save roughly $125 U.S. per year (The Star, March 1993). Promoting savings may also help Tenaga improve its corporate image which was tarnished due to the power shortages experienced in 1992 and 1993.

Foreign exchange savings is another benefit of DSM. Approximately 70 percent of the investment in power plant construction is foreign based. Expenditures on DSM measures are increasingly made locally, implying less capital outflow and less foreign debt (ESCAP, 1992). Energy efficiency would also help to strengthen Malaysia's balance of payments position through reduced energy imports or larger volumes of energy available for exports.

Energy conservation also can have social benefits. Through conservation measures, more energy is available for all corporations and citizens. This may be of particular appeal to Malaysians who have been plagued with power failure and load shedding throughout 1993. Incorporated into overall planning strategies, efficiency improvements help the country to better anticipate, address and possibly avoid problems that frequently accompany development (Department of Electricity Supply, 1993).

Although there are numerous benefits associated with DSM, it is not without some risk. Market risk arises because customer acceptance of the DSM instrument is not guaranteed (Baker and Battle, 1992). Also, because DSM cannot guarantee a set amount of supply, as can the addition of new infrastructure, another element of risk is exposed.

This type of risk, known as measurement risk, occurs when the utility is unable to accurately measure the full impacts of DSM. While it is difficult to determine the exact amount of electricity supply that can be made available through the implementation of DSM it would not be unreasonable to expect a 20 percent contribution in Malaysia. This estimate is based on the effectiveness of existing technologies (Lovins, 1990), but it should be recognized that the exact amount of savings is contingent on many variables. The efficiency of technologies, participation rates and educational efforts promoting DSM will all impact the actual level of savings achieved.

Despite the presence of some risk, pressure will almost certainly mount for a greater emphasis on DSM because it serves multiple objectives and proves appealing and saleable on both economic and environmental grounds. It has been recognized that energy policy can, and indeed should, involve both supply side and demand side measures (Ramani et al, 1992).

3.2.1 DEMAND SIDE MANAGEMENT ACTIVITIES IN THE ASEAN

A recognition of the benefits of DSM has gained momentum in the countries of the ASEAN and programmes are in various stages of implementation throughout the region. The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is supporting DSM initiatives by scheduling eight educational and promotional events over the next three years (Wahnschafft, pers. comm.).

Thailand was recently established as an Asian "model country" for DSM by the International Institute for Energy Conservation. Programmes for all sectors are currently being implemented. The first two years of the plan (1992 and 1993) consisted of

planning and pilot projects to evaluate different energy-saving technologies and programme strategies. Full-scale implementation of the DSM programs will be carried out from 1994 to 1996 and thereafter. Studies conducted by Thai government agencies and outside experts estimate a total of at least 2,000 MW of power generation could be avoided over the next ten years through DSM actions (International Institute for Energy Conservation, 1991).

Singapore was a forerunner in this area when it established an Energy Conservation Department in 1981 (Rashid, 1992). They also have set up an Energy Conservation Centre to conduct research and distribute information. Today, efforts for conservation are promoted through a formal Green Plan which addresses a variety of environmental issues (Wah, pers. comm). Singapore's early efforts may be attributed to the fact that Singapore has no energy related natural resources so has to import all means of producing anything but solar energy.

The Philippines has released a national energy plan for 1992 to 2000 which includes a 17 percent contribution by DSM by the year 2005 (Cherniak et al, 1993). This is in despite of the fact that an energy conservation law failed to pass into legislation in 1991. The International Institute for Energy Conservation is actively assisting the Philippines in formulating their DSM plans (Rumsey, pers. comm.).

In Indonesia, the government has formulated a general policy on energy which has as its three main elements intensification, diversification and conservation. An energy conservation programme which started in 1979 has not produced tangible results. However, a 1991 Presidential decree was issued to enforce conservation within the Ministries. In July 1992, a National Energy Conservation Campaign was launched to

mark the beginning of a vigourous national effort in energy conservation (Arismunandar, 1992).

3.2.2 DEMAND SIDE MANAGEMENT ACTIVITIES IN MALAYSIA

Malaysia has not been as active in DSM as some of the ASEAN countries as Malaysia's efforts have been primarily supply side oriented. A Four Fuel Diversification Policy[9] was pursued which has led to more diversified energy supply mixes but not necessarily to less consumptive energy systems. Malaysia is now positioning itself to catch up to or exceed the energy efficiency achievements of its neighbours (Jaafar, pers. comm.).

The Ministry of Energy, Telecommunications and Posts coordinates Malaysia's Energy Efficiency Programme. The main activities under the direction of this programme include:

- an Energy Conservation Study which commenced in October 1993 and is funded by the Asian Development Bank. It is scheduled to take one year to conduct audits on selected industries, recommend policy responses for improved energy conservation in the industrial sector, and train counterpart staff

- Energy Efficiency Week which is an awareness campaign that has been run annually since 1990. In 1993, the focus was on involving households in energy conservation and public displays were established

- an Energy Efficiency Award which is given out yearly to industry and building owners who have made a concerted effort to institute energy efficiency measures. The 1993 building award focused on innovative energy efficient concepts for hotels, and

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[9] The Four Fuel Diversification Policy has emphasized the use of coal, hydropower, natural gas and oil as the primary sources of energy. Alternative sources such as agricultural wastes and solar power were considered secondary options under this policy.

- energy audits for buildings and small and medium sized industries. The government has allocated $134,000 U.S. under the development budget of the Ministry to carry out audits for 45 firms during the term of the Sixth Malaysia Plan (1991 - 1995) (Department of Electricity Supply, 1993).

The Ministry of Energy, Telecommunications and Posts is presently investigating the possibility of establishing an Energy Research and Efficiency Centre. In order to back their support of DSM and conservation, the government also is considering legislation on the rational use of energy. While the government is leading these initiatives, other organizations are simultaneously pursing energy efficiency. The Federation of Malaysian Manufacturers has an Energy and Utilities Committee that promotes the responsible use of energy within its membership. The Institut Teknologi MARA is conducting research into alternative energy and the Standards and Industrial Research Institute of Malaysia recently established an Energy Technology Group to conduct research in this area. The Environmental Protection Society of Malaysia is encouraging the government to consider the energy savings that could be achieved through wide scale implementation of DSM prior to proceeding with Bakun.

Although not all personnel are convinced of the merits of energy conservation, advocates within Tenaga view DSM as the least-cost energy resource when both environmental costs and welfare needs are taken into account (Ministry of Energy, Telecommunications and Posts, 1993). Tenaga has initiated a programme called "Smart Savers" to promote energy efficiency throughout its distribution area. Other activities undertaken by Tenaga include setting up their own buildings as model buildings to demonstrate energy efficient lighting technologies, pilot marketing of fluorescent lamps, promoting roof top turbine ventilators as an energy efficient state-of-the-art technology and a cooperative project with the California Energy Commission under a grant provided

by the United States Trade Development Agency. Tenaga Nasional Research and Consultancy, the group responsible for promoting energy efficiency, has the goal of building public confidence and creating a market for energy efficient products and services affordable by all individuals and businesses.

Many organizations in Malaysia have clearly recognized that DSM can help the country pursue sustainable development. Money is saved, the linked problems of acid precipitation and air pollution are attacked and industrial competitiveness is improved through conservation measures (Hall and Hanson, 1992). To date, the main emphasis has been on implementing conservation in the industrial sector but the importance of implementing DSM in all sectors is gaining momentum.

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4. DEMAND SIDE MANAGEMENT OPTIONS FOR THE MALAYSIAN DOMESTIC SECTOR

4.1 INTRODUCTION

Throughout the world, a number of Demand Side Management programmes exist and it is reasonable to state that no two programmes are identical. Each programme must be designed to fit the customs and culture of the people who ultimately will see the programmes through to fruition and produce the desired results. They also must be tailored to a country's physical and economic environment. Therefore, a DSM programme that has been very successful in North America or Europe cannot simply be transplanted to a tropical country with a booming economy, such as Malaysia, and be expected to bear the same results. Alternatively, attention must be given to the unique cultural, political, environmental, technological and economic conditions that exist within Malaysia. Both the "hardware" issues such as product development and the "software issues" namely people's attitudes and behaviours, must be addressed before arriving at appropriate policies (Mustapha, pers. comm.).

Recent literature[10] has characterized Malaysians as people who uphold traditional Asian values including respect for authority, consensus in decision making, strong family values and supremacy of the community over the individual. Such values should be respected in designing a workable DSM programme. Also, when implementing DSM it should be viewed from the perspective of how it will help Malaysians achieve their goals (Rumsey, pers. comm.).

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10 Recent literature includes *The Asian Way* and *Wise Men of the New Asia* published in Asiaweek on March 2, 1994, *Who Needs Democracy?* published in Newsweek on November 22, 1993, and *Nobody Elects the Press* published in The Far Eastern Economic Review on April 7, 1994.

Asians have been articulating a future that combines the modern and the traditional since the 1930s. The selective adoption of Western values and ideas is stressed by Asia's new thinkers (Asiaweek, 1994). This establishes a basis for implementing DSM instruments in Malaysia while still respecting societal values.

4.2 OVERVIEW OF THE RESEARCH FINDINGS

The focus groups revealed that the majority of people do not understand the concepts of energy conservation or energy efficiency. The notion of Demand Side Management was foreign to almost all participants. Most people associated energy conservation and efficiency with the curtailment of use. The association of conservation with curtailment initially caused some hostility towards the concept of DSM. People felt that they had worked hard to acquire the electricity-consuming appliances they own and they felt that, if they were willing to pay the electricity bill, they should be able to use them.

Misconception about the notion of energy conservation and DSM may stem from a number of causes. First, individuals may not have had any previous exposure to the concepts and, therefore, education on the subject is desirable. Second, in previous years, the emphasis of energy efficiency campaigns had been on saving electricity. In Bahasa Malaya, the goals of such programmes were stated as "jimantkan tenaga" which translates as "save energy." The emphasis is now on "gunakan electrik dengan cekap" which is "the promotion of the efficient or wise use of electricity."

When the concept of energy efficiency was explained to focus group participants as a means of doing the same tasks while consuming less electricity or altering the timing of their use in order to reduce the demand on infrastructure, people unanimously agreed that, while they did not want to curtail their consumption, they were willing to act responsibly in their use of it. The younger people (focus group number two) were more receptive to the concept of DSM and exhibited more of an appreciation for the environmental benefits of reduced consumption. This may be reflective of higher levels of education and/or a greater awareness of environmental issues. Overall, participants expressed a willingness to cooperate with DSM efforts if it was in the economic interest of the country and if social equity was promoted. Environmental considerations were consistently raised later in the discussion and often had to be prompted by the moderator.

The level of understanding of the concept of DSM by the interview subjects was considerably higher although some misconceptions about conservation occurred. The interview subjects recognized that energy, the economy and the environment are interrelated. Ensuring adequate supplies of energy frequently was noted as the major concern whereas DSM was not considered to be as critical for economic development. Alternatively, DSM was viewed as desirable for the benefit of society as a whole and was seen as a potential untapped source of energy supply for Malaysia. None of the experts disputed the relevance and benefits of DSM, but some were stronger advocates of it than were others.

4.3 A CRITIQUE OF DEMAND SIDE MANAGEMENT TECHNIQUES TO ASSESS THEIR RELEVANCE FOR APPLICATION IN MALAYSIA

On the pages that follow, common DSM practices are assessed for their feasibility for introduction in the Malaysian domestic sector. The views presented are those of the researcher based on an analysis of the opinions expressed by regional experts and focus group participants. The opinions of experts or focus group participants are stated throughout the critique to substantiate the views presented, to acknowledge the originator of an idea or to quote the source of information.

Many options are discussed to illustrate the variety of instruments available for pursuing DSM. The implementation of some of the instruments may be difficult and others are not recommended for implementation at this time. The number of options illustrates what is possible if there is the political will to see them through (Mohanty, pers. comm.).

4.3.1 EDUCATION AND AWARENESS

Increasing education and awareness levels about energy conservation and the benefits of implementing DSM programmes is essential. Domestic sector markets need mass education, publicity and seminars with the basic goal of convincing the consumers to participate (Saha, pers. comm.).

One academic and former Malaysian government official believed that people have not yet seen the need for conservation so this message must be the first conveyed (Codoni, pers. comm.). He suggested that people should be shown the economic, social and environmental benefits of DSM for themselves and for the nation as a whole.

Appealing to the personal and national savings associated with the wise use of electricity will serve as one means of motivating individuals to conserve. Another means would be to appeal to the social value of equity which is a major component of Malaysia's "Vision 2020." DSM efforts will help to ensure there is a stable supply of electricity at all times for use by everyone. This may be relevant to Malaysians who recently experienced power failures and the introduction of load shedding. Educational efforts should ensure that people are aware that conservation is not necessarily synonymous with curtailment.

People also need to be shown how they can use energy more responsibly. At the present time, there are very few energy efficient products available on the Malaysian market so the active promotion of these, although valuable, will yield minimal results. Therefore, the initial focus should be on establishing energy efficient habits such as turning off the lights and other electrical equipment when leaving a room, having the air conditioner set at a moderate level, attempting to reduce consumption during peak periods, etc. As more energy efficient products are introduced in the marketplace, their introduction should be accompanied with education on the benefits of these appliances. Education in this area will have to address concepts such as payback periods and life-cycle costing so that people can see the long-term benefits of their initial investment in energy efficient technologies. Tenaga's "Smart Savers" programme could be expanded to address these issues.

There are numerous media available for communicating the merits of DSM. In order to reach the widest audience, a number of media should be employed. Several focus group participants suggested that television advertisements would be the most effective means of increasing awareness about the need for energy conservation.

Commercials could be used to demonstrate simple means of conservation. More detailed information on how to bring about electricity savings could be placed in easily accessible locations such as Tenaga's offices and other locations where customers pay their utility bills.

Focus group participants also noted that statements of advice or brochures on the means of using energy efficiently, inserted with their bills, would serve as reminders for the need to use energy responsibly. They felt that this form of reminder should only be distributed intermittently because, if conducted frequently, it would lose its effectiveness. Tenaga is currently designing a new computerized billing system. As this system is still in the early design phase, consideration should be given to introducing a system of including a simple reminder message or graph on the front on the bills.

Working with children to ensure that energy efficiency becomes a way of life for them is another educational opportunity. Many of the experts and focus group participants suggested that efforts made to educate children would have a multiplier effect on their parents. They also recommended that the education of children start at a young age, preferably pre-teen, in order to have the greatest impact. Energy efficiency could be taught at schools and also in informal clubs and organizations where badges and other forms of recognition could be awarded upon demonstrating a knowledge of the concepts. Some organizations, such as the Malaysian Nature Society and the Young Men's Christian Association already are active in the promotion of environmental education for children. The assistance of these groups could be sought. In order to bring about these programmes for children, both formal educators and private clubs

would have to be provided with information so that they can see the relevance of teaching these concepts to children.

Malaysian household members also stated that they should not be the only ones who are asked to participate in DSM activities. People thought that the government and Tenaga should lead by example. Tenaga is in a good position to do this as they are actively retrofitting some of their buildings so that they can be models of how energy efficient products can be used in commercial buildings. Both the Ministry of Energy, Telecommunications, and Posts and Tenaga are also active with energy audits in the industrial sector. The efforts undertaken in other sectors should be communicated to members of the general public to serve both as examples of what can be done and to provide leadership and motivation for more individuals and organizations to become involved. As Sham Sani states in his book Environment and Development in Malaysia:

> "The bottom line is, no conservation programme, however good its design, can be completely successful without public support, which can only come from well-informed citizens who are aware and fully committed. This must include all sections of the community from administrators, politicians and the private sector right down to the ordinary man in the street and school children."

A lack of awareness and uncertainty are potential barriers to improving energy conservation. In order to overcome this obstacle and because it is not socially acceptable for Tenaga to profit because Malaysian people are uninformed (Jaafar, pers. comm.), awareness and education programmes will be critical to the successful implementation of DSM in the domestic sector. It also is important that policy-makers are aware of all the instruments and technologies available for pursing DSM as well as its related economic, social and environmental benefits so the issue can be addressed comprehensively.

Conclusion

There is clearly a need to promote an awareness of electricity conservation and its economic, social and environmental benefits to the public. Initially the focus of education and awareness programmes should be on encouraging the development of energy saving habits. As more energy efficient products are introduced into Malaysian markets the emphasis of educational programmes should switch to emphasizing the benefits associated with ownership of these items. Television commercials and notifications with utility bills are the preferred options for promoting education and awareness pertaining to DSM.

4.3.2 ADVISORY SERVICES AND HOUSEHOLD AUDITS

Since the concepts of energy efficiency and the wise use of electricity are new to many Malaysians, focus group members expressed an interest in being advised as to how to act responsibly. Several people expressed an interest in having more knowledge on the subject of energy efficient appliances and a few individuals desired information on how to retrofit their homes. In many countries, toll free numbers where workers distribute the required information are established as an advisory service. Such an approach is not recommended for Malaysia because face to face communication is culturally predominant. However, advice could be provided in conjunction with the implementation of education and awareness programmes.

People were not receptive to the idea of household audits since they perceived efficiency auditors as sales people whom they did not want in their homes. Therefore, household efficiency audits should not be introduced in the initial stages of implementing

a DSM programme in the domestic sector. However, as people's awareness and desire to conserve energy increases, households audits could be re-assessed for possible introduction.

4.3.3 ENERGY EFFICIENT PRODUCTS

The introduction and promotion of energy efficient appliances is an area with tremendous potential for lowering electricity consumption in Malaysian households. Estimates on how much electricity can be saved range from 30 to 75 percent but this is contingent on how fast efficiency can be improved and at what cost (Fickett, 1990). At present, technological progress in household appliances has the potential to reduce demand levels by a minimum of 20 percent. Lower estimates than this are based on older technologies (Lovins, 1990).

The majority of focus group participants were receptive to the idea of acquiring energy efficient appliances since this would provide a means of enjoying the appliances they desire while consuming less electricity. One individual stated "If they were available, they would be a big hit." A small group of participants were skeptical about using energy efficient products because they thought these would not function as well as the appliances they currently own. In Malaysia, there are currently very few energy efficient appliances available in the marketplace. Energy efficient lighting is available and some energy efficient air conditioners and refrigerators are starting to appear.

Several multinational appliance manufacturers including Sanyo, Hitachi, Toshiba, Matsushita, Sharp, Carrier and Singer, currently manufacture household appliances and air conditioning equipment in Malaysia. The presence of large American, Australian,

British and Japanese corporations increases the likelihood that many manufacturers have access to energy efficient technologies. Some are already manufacturing energy efficient appliances in the ASEAN for export markets which include Australia, Canada, Japan and the United States. It is uncertain why more energy efficient appliances are not available for Malaysian markets. One factor that enters the picture is that sometimes the factories that build energy efficient appliances are located in Export Production Zones (EPZs).[11] In Thailand's case, some energy efficient products, originally produced in Thailand appear as imported goods. The finished goods are exported and then re-imported with the associated high protectionist duty (Rumsey, pers. comm.). Trade policies would require revision to prevent these situations from recurring. Although this type of occurrence has not been confirmed in Malaysia, the likelihood that it is occurring is quite high because several of the firms which produce household products are located in the EPZs.

Another potential reason why energy efficient products are not common on Malaysian markets is that manufacturers gear their production to the local preference and not necessarily to the latest technology (Codoni, pers. comm.). Until there is a demand for energy efficient goods, manufacturers are likely to continue producing goods for which there is a stable market.

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11 Export Production Zones (EPZs) are common throughout the ASEAN. The majority of goods produced in the EPZs are specifically designated for export markets. Often the EPZs are located in Economic Growth Triangles which involve the partnering of three countries to capitalize on a diversity of resources to maximize market penetration. Malaysia is involved in two Economic Growth Triangles -- a northern triangle with Indonesia and Thailand and a southern triangle with Indonesia and Singapore.

a) Product Standards

In order to ensure that at least a minimum level of energy efficiency is obtained, it is desirable to introduce efficiency standards. However, if standards are going to work, industry has to have some say. Industry should also be encouraged to constantly beat the standards, not just produce at a level imposed on them by the government (Tyler, pers. comm.). By seeking the involvement of manufacturers, this will serve to establish standards which are technologically feasible, economically efficient and practical.

The introduction of standards cannot be applied universally to all household products. Standards can be applied much more quickly to products which are produced solely by multinationals with access to energy efficient technologies. For products where both domestic and foreign producers exist, there is a need to consider the additional lead time that will be required by domestic producers to acquire the latest technology. This is essential so that foreign producers do not benefit at the expense of domestic firms who do not have easy access to energy efficient technologies.

Product design competitions would be an appropriate means of ensuring that the minimum standards are continually exceeded and revised upwards. Design competitions are already common in Malaysia and could easily be adapted for the purpose of upgrading standards. Through such competitions, more energy efficient and state of the art technologies will be introduced. Malaysians have a spirit of competitiveness and this should be appealed to as it will prove to be beneficial for ensuring that technologies are continually upgraded.

Standards harmonized throughout a block of nations, perhaps for the ASEAN, should be considered so that manufacturers develop and market efficient devices (Ramani

et al, 1992). This would permit larger scale production and economies of scale which, in turn, would serve to offset some of the cost of producing these goods. The countries of the ASEAN are in the process of lowering trade barriers and an Asian Free Trade Agreement has been proposed (Tsuroka, 1993). These trade initiatives set the stage for facilitating the manufacture and distribution of energy efficient household products as an attractive business opportunity.

b) Product Testing

The introduction of standards should be accompanied by product testing to ensure the efficiency, safety and quality of the products before they enter the market. A perception of inferior quality and a lack of confidence in the benefits of energy efficient appliances are two potential barriers to the widespread introduction of energy efficient products. Therefore, if energy efficient products are not adequately scrutinized before they are marketed and they later turn out to be inferior in terms of their operation, efforts to promote them will fail. The case of electronic ballasts[12] in Bangkok presents an example. In 1989 there were a series of buildings retrofitted with electronic ballasts in Bangkok. In almost every case, the ballasts failed prematurely and in one case a fire was caused. To this day, Thai lighting designers, architects, engineers and building owners are suspicious, if not hostile, toward electronic ballasts (Rumsey, pers. comm.). Adequate product testing prior to the marketing of each energy efficient appliance will help to alleviate this problem. Communication that the products have been tested and meet established performance standards should help overcome the skepticism expressed

[12] Ballasts are a component of fluorescent lamps which serve to provide the starting voltage and stabilize and reduce the current in a circuit.

by some people. Product endorsement by a respected authority such as Tenaga, would also promote confidence in energy efficient products and enhance their distribution.

c) Product Labelling

With the introduction of energy efficient appliances, there is a need to provide a means for such appliances to be easily identifiable. This can be achieved through product labelling. Malaysian citizens were receptive to the idea of product labelling but emphasized a desire for the labelling to be in "layman's" terms so that it was understandable by all. If the labels were not easily understandable then people admitted they would not read them.

As suggested by some focus group participants, one means of displaying the energy efficiency of the product would be to have a graph illustrating the consumption level, expressed in Malaysian Ringits (MR)[13], without the incorporation of energy efficient technologies and with reduced consumption. Another system under consideration by Tenaga is a "five star"[14] rating system similar to that used internationally by hotels. Both of these methods present a simple means of communicating the efficiency of a device and have been employed successfully in other parts of the world.

d) Rebates

Rebates are often seen as a means for enhancing the distribution of energy efficient products. They are given to entice people to buy responsibly and to help offset the incremental costs normally associated with energy efficient goods.

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13 Malaysian Ringits (MR) are the currency of Malaysia. At the time of printing this document $1 U.S. equalled $2.5 MR.

14 In a "five star" system each individual star would equate to a set level of electricity savings -- that is, the higher the number of stars the greater the energy efficiency of the appliance.

Introducing rebates in Malaysia is not desirable because these are not a part of the existing culture. Another problem with customer rebates is that the process is administratively burdensome which would increase the cost of a DSM programme. These increased costs also reduce the overall competitiveness of the organizations that administer them. People would be more receptive to an immediate discount or rebate at the time of purchase since this is in keeping with the way transactions currently take place. In Malaysia, it is common practice to request a discount when making a purchase. The problem with discounts is that they are so commonplace that any discount that is given will not likely be interpreted as a discount specifically for the promotion of an energy efficient appliance. A further argument against the introduction of rebates or discounts is that the Malaysian government does not want to foster a dependent society and customer rebates are perceived to represent a handout (Jaafar, pers. comm.).

A more appropriate means of supporting the introduction of energy efficient products would be to provide manufacturers with cash incentives to develop more efficient goods. In the October 1993 budget, the government set aside funds for technology research and development since there is a recognition that research and development must come up with products that sell (Astbury, 1993). Since lack of access to financing is often a barrier to the introduction of energy efficiency, this budgetary allocation may provide some of the funds necessary for developing appropriate energy efficient technologies. These grants could help to cover the research and development costs associated with designing energy efficient goods that are tailored for Asian markets. By offsetting a portion of the higher costs of energy efficient products, another potential barrier to improvements in energy efficiency, that of price or affordability, is addressed.

The removal of import tariffs is another means of reducing the cost of energy efficient products.

When administering rebates to the producers, caution should be exercised. There is a need to monitor the results so that producers demonstrate that they have developed products that provide the desired energy savings. Research and development rebates should also be given to a number of manufacturers so that competition is maintained and the market place ends up with energy efficient products produced by a number of companies. Thus, the consumer is free to choose among suppliers.

e) Product Development Emphasis

A question that arises is which domestic sector appliances will yield the greatest return if they are designed with energy efficiency as an objective. To arrive at an answer, there is a need to consider which appliances individuals aspire to own and which items have already reached the saturation level in Malaysian homes.

Although Tenaga does not maintain statistics on household appliance ownership, a 1992 University of Malaya study on energy demand in the domestic sector revealed that items such as lighting, televisions, rice cookers, fans, irons and refrigerators had nearly reached the saturation level in middle-income Malaysian homes. The fact that these items are common in Malaysian households was confirmed during the focus groups (See Appendix 3). The widespread ownership of these items will affect the penetration rate of energy efficient products as replacing working, but inefficient appliances, is seen as wasteful. Therefore, a time lag between the introduction of energy efficient appliances and the breakdown and replacement of existing appliances is likely to occur.

On the other hand, due to the demographic profile of Malaysia and changing family structures, many new households are being formed. This will result in a continued strong demand for these products because they represent what many people currently consider to be essential household appliances.

As affluence increases, the desire for air conditioners and water heaters is increasing. This point was highlighted by focus group participants and many of the experts interviewed. As both of these items are large energy consumers, emphasis should be placed on producing these items with high efficiency standards. Consideration should also be given to installing timers on these items so that air conditioners and water heaters can be used when desired, but do not operate when the home is vacant or when there is no demand for hot water.

When questioned about what types of items will have the greatest impact on household electricity consumption levels in the future focus group participants and interview subjects frequently noted the following items:

- air conditioning units
- larger refrigerators
- water heaters
- washing machines
- computers and
- entertainment equipment including televisions and stereos.

Based on this information, it is advisable to concentrate product development efforts on air conditioning, water heaters, refrigerators and washing machines. Smaller products

including energy efficient irons, fans, televisions and rice cookers should also be a priority for development as demand for these items is expected to remain strong.

Promotion of Energy Efficient Products

Although some energy efficient lighting already exists on the Malaysian market, the widespread introduction of energy efficient products will have to be accompanied by the promotion of these items. Essentially, the market for these goods will have to be created. Any product can be made more efficient if there is the market for it (Rumsey, pers. comm.). Retailers will have to become knowledgeable about the operation and costs of these products so that they can convince the public of the merits of owning energy efficient appliances.

Focus group participants expressed a willingness to purchase energy efficient goods but stated that they would not go out of their way to acquire them. This suggests that such goods would have to be sold through numerous retail outlets to maximize market penetration.

From observation, it is apparent that Malaysians are status conscious. Some focus group members confirmed this by suggesting that the phenomenon of acquiring items because friends, neighbours and peers have them is prevalent in Malaysia. However, this should not imply that energy efficiency features will sell only on top of the line models. Energy efficient models should be available at all product levels so they are attractive to a variety of income groups.

When promoting the acquisition of energy efficient goods, marketing options include encouraging social responsibility, identifying the operating savings associated with owning the appliance, appealing to the "high tech" quality of the product and noting

the prestige associated with ownership of the product. Although an initial appeal to the "trend-setters" may be appropriate, marketers should be careful to ensure that their promotions appeal to a wide audience to maximize market penetration. Associating both status and social responsibility with the ownership of energy efficient products would enhance their distribution.

Conclusion

The widespread switch to more efficient appliances would result in benefits in terms of avoided generating capacity as well as lower levels of emissions (Shrestha, 1990). Although the market will have to be developed, Malaysian citizens expressed a willingness to consume electricity responsibly providing energy efficient appliances allow them to use the products they desire without wasting valued resources. As design competitions already have been held to promote the development of energy efficient rice cookers and fans, production of these items should be pursued. The feasibility of the timely introduction of efficiency standards should be investigated. Because of the presence of several multinational manufacturers in Malaysia, the impact which standards will have on domestic producers must be given consideration prior to their introduction and enforcement. When marketed, energy efficient products should be easily identifiable though labelling and should be promoted in accordance with the values and aspirations of Malaysian citizens, namely the product's "high tech" nature, the personal savings associated with ownership, social responsibility and prestige.

4.3.4 HOUSING DESIGN, CONSTRUCTION AND LANDSCAPING

Housing design, construction and landscaping which foster the efficient use of energy represents another area of opportunity for Malaysia. Considerable domestic sector construction is taking place and even more is anticipated as Malaysia's economy remains strong. Early attention to energy conservation in the design and construction of housing could be a prime source of energy savings in the future (James, 1991).

Many experts suggest that energy efficient housing design and landscaping are viable means of promoting energy efficiency. The focus group participants were also receptive to this idea. People felt that it was much more economical and worthwhile to incorporate the ideas "up front" in housing design and construction than to try and retrofit.

Housing Design and Construction

Several options exist for fostering energy efficient housing design and construction in Malaysia. Insulation is a cost-effective measure that promotes energy efficiency by reducing the amount of heat absorbed through exterior surfaces. Insulation could become a standard feature in new homes. The potential efficiency increase due to insulation is estimated at between 30 to 50 percent (Powell, 1993). New building material developments may also be appropriate. These include low-density structural concrete, vacuum insulations and reflective window glass.

In addition to utilizing the latest construction technologies, homes also can be designed to allow for increased natural air circulation. This serves as a means of natural or free cooling and has the potential to reduce dependence on fans and air conditioners. Houses also can be grouped to create air channels for breezes. Trees and air currents can

work well together when given the proper layout and design yet this concept has not been widely applied in Malaysia (Razoli, pers. comm.).

While technological developments and new designs have the potential to yield tremendous energy savings in the construction of Malaysian homes, traditional ideas also have potential uses today. Some ideas cannot be replicated due to a lack of materials and changed lifestyles but the underlying philosophy need not be lost (Reddy, pers. comm.). Traditional ideas such as the minimal use of glass in the direction of the sun, the use of awnings for sun avoidance and the careful placement of active living areas within a home are still appropriate for the 1990s and beyond. In new homes, ceilings are often placed too low, resulting in reduced ventilation and little opportunity for using ceiling fans (Singh, pers. comm). Roofs with vented attics provide another option for providing ventilation and promoting a cooler home. Air pipes, located beneath the surface, can be employed as a means of cool air intake.

Given the diversity of housing forms in Malaysia, attention should be directed to establishing the means of promoting energy efficiency for a variety of dwelling styles. For example, condominiums or apartments are more likely to employ concepts similar to those used in commercial developments rather than methods that promote efficiency for terraced housing or single family dwellings. Regardless of the type of dwelling, attention should also be given to ensuring that the concept of "healthy homes" is promoted through the choice of construction materials and by ensuring adequate air exchange and circulation.

Installing energy efficient appliances at the time the house is constructed is another option for fostering conservation. People are more inclined to make the extra

initial investment when purchasing a home because the extra cost is small in comparison to the total value of the house (Ramani, pers. comm.).

Landscaping

One of the simplest, oldest and yet most effective strategies for reducing a home's heat gain is to diffuse sunlight by planting shrubbery and painting the house a reflective colour (Bevington and Rosenfeld, 1990). Grass and shrubbery should be planted in the area immediately surrounding homes. Strategically placed trees can provide shading and natural cooling. Landscaping and vegetation have a cooling effect whereas surrounding a home with concrete absorbs and later radiates heat.

In Los Angeles, California, downtown temperatures are three degrees Celsius higher than they were in 1940 and are increasing by 0.5 degrees Celsius every ten years because of the spread of asphalt across the city. Not only is asphalt dark and a heat absorber, it replaces trees and reduces cooling by evapotranspiration. Passive strategies such as planting shade trees and whitening buildings and asphalt can reverse the "heat island effect" which costs the citizens of Los Angeles, California an extra $100,000 U.S. for cooling and adds 1,000 tons of carbon dioxide to the atmosphere every hour (Bevington and Rosenfeld, 1990).

A recent study on the effects of the Klang Valley connurbation on temperatures indicated that commercial centres were several degrees warmer than the surrounding countryside and that maximum temperatures coincide with built-up areas (Sani, 1993). The creation of heat islands in Kuala Lumpur and neighbouring cities in the Klang Valley can be offset partially through careful city planning and by increasing the amount of vegetation present.

Means of Encouraging Energy Efficient Housing and Landscaping

One of the barriers to fostering improved energy efficient design and construction is that, while lower operating costs will prevail, there is a perception that the capital costs of construction will increase substantially. Because it is the tenant and not the developer who would benefit from lower operating costs, developers have little incentive to design energy efficient homes. If energy efficiency is not considered in the design and construction of a home, it is the owner, tenant or future owner of the building who inherits the cost of inefficiency. This situation emphasizes the need to consider both capital and operating costs in order to assess the benefits of energy efficient housing. Some Malaysian architects argue that energy efficient homes are not necessarily more expensive when capital and operating costs are assessed collectively.

One of the biggest emerging consumers of electricity in many homes is air conditioning units. Much of the need for air conditioning could be reduced through housing design that provides air escapes for hot air and large volumes of air exchange for ventilation (Lim, pers. comm.). The choice of construction materials also can be altered to foster natural cooling. For example, wooden homes will be cooler than homes constructed of concrete. While these techniques and materials may increase the initial cost of a home, a portion of the cost can be recovered through installation of fewer or smaller capacity air conditioners and the corresponding costs of operating them. Buildings last 50 to 100 years. Over the life of a building, energy-related improvements make tremendous economic sense (Bevington and Rosenfeld, 1990).

The question that remains is how to bring designs which promote energy conservation into existence. While building codes could be established for insulation

standards, other means of promoting energy efficiency in building design and construction are not as easily legislated (Lefebvre, pers. comm). This is attributed to the fact that multiple objectives are pursued, meaning that both natural cooling and air conditioning are employed in many homes (Lim, pers. comm.). This presents the challenge of designing homes which provide adequate ventilation to allow breezes for natural cooling, yet can be sealed sufficiently to avoid cooling loss should the occupants choose to use air conditioning.

Design competitions, as part of the annual Energy Efficiency Awards programmes, would help initiate action in this area. These competitions would result in the presentation of examples of energy efficient houses and landscaping techniques to the public. New and innovative ideas would result. More people need to experience, enjoy and spread the word about naturally cooled homes (Lim, pers. comm.).

Another alternative for initiating action would be to give tax incentives or rebates to developers to design more energy efficient homes. Such incentives also would offset higher capital costs if they are proven to result. Home energy rating and labelling programmes which certify that a house meets a specified level of energy efficiency, or that it contains specific energy saving features, is another way of influencing builder attitudes in favour of energy efficient housing. Lower mortgage rates for energy efficient homes also have been employed successfully in some countries to encourage people to invest wisely in their homes (Baker and Battle, 1992).

Conclusion

Designing, constructing and landscaping new housing developments to promote the wise use of energy is a viable option for Malaysia (Lim, pers. comm.). While the

existing housing stock would not be impacted by such efforts, the options for dealing with existing homes are detailed in the following section. Malaysians were receptive to incorporating energy efficient designs, materials, landscaping and appliances into new homes yet there is a need to provide citizens with examples of how this can be achieved. Design competitions, coupled with incentives to developers, home owners or both, provide the means for introducing energy efficient housing in Malaysia.

4.3.5 RETROFITTING

The focus group members and interview subjects were more receptive to the idea of designing energy efficient new homes than they were to the idea of retrofitting existing homes. Retrofitting ideas such as changing to energy efficient lighting, installing insulation and sealing air conditioned apartments to prevent cooling loss were perceived as being expensive, time consuming and messy.

If retrofitting were to be encouraged, people stated that they would require additional education about how to retrofit their homes. Retrofitting ideas for all types of homes (terraced houses, condominiums, single detached homes, etc.) would have to be described and displayed where the information would be easily accessible. Retrofit programmes which provide the recipient with technical assistance when installing energy efficient equipment is another approach that has proven to be successful in other countries.

Because retrofitting is expensive, incentives may be required to encourage people to retrofit their homes. Since roughly 50 percent of the Malaysian population is of Malay origin and are Muslims, this presents an opportunity to adhere to the practices of the

Islamic banking system in extending loans for retrofitting. Under the Islamic banking system, no interest is charged on money loaned but both the borrower and the lender share in the savings. Tenaga could administer a retrofitting programme through loaning funds interest free and adjusting the customer's monthly bill to reflect the portion of the electricity savings that accrues from the retrofit. Government backing may be required to provide the initial capital. Even though such a loan strategy adheres to the principles of Islam and would appeal to a large segment of the population, promotion of the loans should be made on a non-denominational basis so as to not reflect any ethnic bias.

Conclusion

Retrofitting existing homes to promote energy efficiency generally was not well received by the experts interviewed or by the focus group attendants. If pursued, incentives and education on the techniques for retrofitting would be required. Malaysians were much more receptive to incorporating energy efficiency in new homes so emphasis should first be placed in that area.

4.3.6 TARIFF STRUCTURE ADJUSTMENTS

Experts and citizens who participated in the focus groups indicated that significant price increases would encourage them to conserve electricity. However, caution must be exercised in altering the pricing structure for several reasons. While Malays seem to accept costs as given and rarely dispute them (Codoni, pers. comm.), 50 percent of the population is comprised of Chinese and Tamils who are not as accepting of price and may question the need for a rate increase. Several focus group participants, of a variety of ethnic origins, stated that a price increase would be unfair. The political

party that permits a price increase is likely to be viewed unfavourably at the polls during the next election. Second, care must be taken when associating tariff structure adjustments with DSM. Any issue that is coupled with tariff adjustments will probably "go down with it" (Rumsey, pers. comm.). Therefore, because tariff adjustments have the potential to be unpopular, they should not be introduced simultaneously with the introduction of other DSM instruments.

Third is the fact that a "significant" increase would be required to motivate individuals to conserve electricity. People noted that, unless the price changed substantially, it would not motivate them to conserve (although actual action taken may prove differently). However, such a substantial increase in the domestic sector electricity tariff would not be publicly acceptable at this time since Tenaga recorded a pre-tax profit of $739 million U.S., a 17.9 percent return on investment, for its financial year ending January 31, 1993. In recognition of their excess profits and as a means to compensate the millions of consumers who had to bear the discomfort caused by frequent blackouts and load-shedding last year and early this year, Tenaga recently announced a customer refund (Parkaran, 1993). Customers were given a five percent discount in their electricity bills for a period of six months. In addition to the discount, Tenaga did not levy the usual five percent government service tax.

A utilities tariff should be set at the long run marginal cost. This is the long-term total cost of producing one additional unit of output. The long run marginal cost incorporates the cost of future developments and permits the utility to recreate their own network (Codoni, pers. comm.).

Alternative Tariff Structures

Within a framework that employs the concept of long run marginal cost, there are still several options for domestic sector tariffs structures, some of which may be more effective at promoting conservation than the current structure. The present domestic sector tariff structure is as follows:

For the first 100 kWh per month:	$0.080 U.S./kWh (MR 20 sen)
For the next 900 kWh per month:	$0.092 U.S./kWh (MR 23 sen)
For each additional kWh per month:	$0.104 U.S./kWh (MR 26 sen)

The majority of focus group participants indicated that this price structure did not motivate them to conserve.

One option under investigation by the Department of Electricity Supply is the establishment of a tariff structure where the first level would be based on a predetermined number of units considered essential for a minimum level of convenience and comfort within a household. The price per unit of electricity consumed at this level would be modest so that all households could afford to use essential appliances such as those required for cooking and fans for cooling. The price established for the next level would be considerably higher reflecting an additional charge for the use of non-essential, convenience or space conditioning appliances. This type of tariff structure has been labelled "lifeline rates" by the Asian Development Bank. Many utilities in the Asia Pacific region now have lifeline rates for domestic consumers (Asian Development Bank, 1993).

This proposal supports the notion of equality in that all households would be provided a minimum level of service at a reasonable rate. It is compatible with the country's development goals, of which one objective is to ensure that all citizens can

afford life's basic comforts. The intent of the premium pricing would be to promote the responsible use of electricity.

The main problem facing such a proposal is how to determine the number of units that would be considered essential for a minimum level of convenience and comfort. Such a level is contingent on the size and style of the dwelling and the number of occupants. Also, in a rapidly industrializing country like Malaysia, people's perceptions of what is a necessity and what is a luxury are changing. For example, electric rice cookers which at one time were considered luxury items, have now reached the saturation level in Malaysian homes. They are considered "essential" since they are used daily in most homes. Air conditioning is another potentially contentious item as some would argue that it is an essential item if Malaysians are to enjoy comforts equivalent to those of developed countries. Others may not consider them necessary for a comfortable lifestyle.

A further complication is that comprehensive statistics are not available for the average consumption per household. These are needed in order to assess how much electricity most households are consuming. A survey conducted by the University of Malaya in two middle class neighbourhoods in the Klang Valley revealed that all households were consuming less than 400 kilowatt-hours per month and 36 percent of Subang Jaya residents (an upper middle class neighbourhood) consumed less than 100 kilowatt-hours per month. In Bandar Baru Bangi (considered a lower middle class neighbourhood) the study showed that 76.5 percent of households were consuming less than 100 kilowatt-hours per month (Agus, 1993). It is interesting to note that this level of electricity consumption is considerably lower than that of western tropical cities.

Recognizing that the establishment of the basic level of consumption would be subjective, careful study and citizen involvement is needed to determine the "lifeline level" that has the potential for making this a viable alternative pricing structure.

Another pricing option that exists involves the introduction of an electricity consumption tax. Although the majority of citizens may be unaware of this fact, policy-makers would agree that the current tariffs do not reflect the full costs associated with the production and consumption of electricity. Many social and environmental costs are not reflected in the rates established. Following the example proposed by the Department of Electricity Supply, a tax could be charged on consumption beyond a basic needs level which would serve to promote the responsible use of electricity. Revenue generated from the tax could be diverted for further study on energy efficiency, alternative energy technologies and electricity and energy related social and environmental issues. A similar approach is currently being used in Thailand.

A third pricing option involves charging the highest incremental price for all units consumed rather than employing a tiered structure (Mohanty, pers. comm.). For example, assume there is one price for the first 100 kilowatt-hours per month and an additional price for the next 900 kilowatt-hours per month. Under this system, if a household exceeds 100 kilowatt-hours per month they would pay, for example, $0.092 U.S. (23 sen) for all kilowatt-hours consumed rather than the lower rate of, for example, $0.08 U.S. (20 sen) on the first 100 kilowatt-hours. This structure provides greater incentive to lower consumption although the existing price structure may have to be altered to have the desired effect.

Additional study on these approaches would be required prior to their implementation. In fairness to Malaysian citizens, any type of change to the tariff structure should be announced to the public well in advance of its actual implementation date. If a price adjustment is necessary to support DSM initiatives, it should lag well behind the introduction of energy efficient household appliances and housing designs so that people are given amply opportunity to act responsibly on their own accord before a new and potentially more costly tariff is charged. Giving people options before adjusting the price will also increase the political acceptability. Without these steps, there will be the potential for backlash against all DSM efforts.

The establishment of tariff structures is not a simple process. The fact that one sector may subsidize other sectors serves to complicate the issue. However, this also has the potential to permit the adjustment of tariff structures without altering the overall revenue base of the utility company. Consideration of the impacts of tariff structure adjustments on both electricity producers and consumers must be carefully reviewed before alterations to the existing structure take place.

Conclusion

People acknowledged that the present tariff structure does not encourage them to use electricity wisely. However, a number of different pricing options exist that may serve to encourage Malaysians to conserve electricity. Prior to their introduction these options would require careful study for their impact on consumption and the financial viability of the utility. Any changes to the tariff structure should be introduced only after citizens have been educated on the benefits of using energy wisely and after the methods and means of using energy efficiently are available.

4.3.7 TIME OF DAY PRICING

The opinions of focus group participants on time of day pricing were mixed. Some stated that they would be willing to alter the timing of some of their activities whereas others suggested that this type of DSM instrument was more appropriate for industry than for small domestic consumers.

A study of domestic sector electricity users completed by the University of Malaya Faculty of Economics and Administration in 1992 indicated the following:

- the number of respondents who were willing to change the timing of electricity use, without any financial incentive, appears to be low. That is, only about a third (35 percent) of them are willing to change the timing
- the concept of a tariff discount system for a change in timing of electricity use was viewed favourably by the residential consumers, and
- since the majority of the residential consumers think that their electricity bill is high, the introduction of a tariff discount system should be a great incentive for the consumers to save on their electricity bill by changing the timing of electricity use.

Although this study recommended introducing tariff discounts for off-peak consumption, the costs of installing and continually metering the timing of consumption in households is prohibitive (Othman, pers. comm.).

Time of day pricing is used primarily in the industrial and commercial sectors where incentives are given to large volume consumers to shift their electricity consumption to off-peak hours so as to minimize the loads placed on infrastructure. It is not common in the domestic sector because the cost of metering makes it economically unfeasible. A time of day meter[15] costs approximately $400 U.S. versus $20 U.S. for a regular meter (Othman, pers. comm.). Another factor limiting the introduction of time of

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15 Time of day meters record the amount of electricity consumed each hour of the day, every day of the year, so that peak and off peak pricing can be applied accordingly. Alternatively, the meters currently used record only the total volume consumed to which one rate is applied.

day pricing is the fact that Malaysia is experiencing a labour shortage. This results in insufficient numbers of trained personnel available to read and calibrate a vast number of meters on a regular basis. Additional staff also would be required to handle the increased complexity of the billing system, initially resulting in higher costs until such a process were automated and calculated electronically.

However, since one third of the households sampled and some focus group participants expressed a willingness to change the timing of their use of certain appliances, this provides an opportunity for some effort to be expended in this area. Campaigning for households to voluntarily reduce consumption during peak periods could be conducted in conjunction with education and awareness programmes. Thirty-five percent of the population has already expressed a willingness to participate, and with increased promotion of the benefits of reducing consumption peaks, many more customers also may adjust their timing. Appealing to societal values may prove to be beneficial in this situation.

Conclusion

The introduction of time of day pricing is not a viable option for the Malaysian domestic sector at this time. The major deterrents are the high cost of specialized meters and a shortage of trained personnel to read the meters and manually calculate billings with different price levels. Alternatively, public appeals for citizens to voluntarily reduce consumption during peak periods could be conducted as part of education and awareness campaigns.

4.4 EXTERNAL INFLUENCES WITH POTENTIAL TO AFFECT THE CONSUMPTION OF ELECTRICITY AND THE RELATIVE IMPORTANCE OF DEMAND SIDE MANAGEMENT

With a firm development strategy for economic success embedded in "Vision 2020", supported by growth rates which are more than twice as high as the world economy, Malaysia is poised for continuing prosperity. Malaysia's expanding population base, rising levels of individual affluence and increasing urbanization and industrialization will all be factors contributing to a strong demand for electrical energy in the years to come. However, there are other factors that have the potential to reduce electricity consumption levels and the priority assigned to DSM practices. Energy planners will need to address these factors for their effect on electricity demand to ensure that electrical infrastructure is not built unnecessarily, causing environmental damage and a strain on limited capital resources.

4.4.1 NATURAL GAS

The use of natural gas is relatively new in the ASEAN. As governments and industry become familiar with established and new uses of gas and as they prepare to make heavy start-up investments in infrastructure and distribution, the consumption of gas is sure to rise by "leaps and bounds" (Fesharaki, 1992). Malaysia already has started laying the foundation for the expanded use of natural gas through the development of the Peninsular Gas Utilization Project. Gas Malaysia Sendirian Berhad (Gas Malaysia) was incorporated in May 1992 and has a programme in place to ensure that gas distribution pipelines and services are available throughout Malaysian communities as soon as possible. As of September 1993, Gas Malaysia had converted twelve large industrial

consumers to natural gas. Plans are in place to convert additional users in the industrial areas of Pasir Gundang, Seremban, the Bukit Raja Industrial Estate and the Shah Alam industrial area.

Gas Malaysia has a twenty year plan to distribute natural gas throughout all sectors. The commercial and residential sector will be planned gradually in order to capture this market effectively. The lack of public awareness about the uses and benefits of natural gas is a factor to be considered (Kawakubo, 1993). Gas Malaysia plans to target 300 residential houses as a show case to attract the public's attention. Initially, they intend to convert ten homes in Shah Alam. Although the costs of conversion would be paid in full by Gas Malaysia, volunteers for this project have been hard to find as people are concerned about the flammable and explosive properties of natural gas (Leong, pers. comm.).

Two of the focus groups briefly discussed the use of natural gas in their homes and much skepticism towards using natural gas was expressed. This is despite the fact that liquefied natural gas is commonly used in Malaysian homes for cooking. The successful commercialization of absorption-type air conditioners has made natural gas a viable fuel for space cooling (Hamid, pers. comm.). Water heaters, which are gaining in popularity amongst Malaysians, also are suited to the use of natural gas. The Kuala Lumpur City Centre project, which will be home to the national oil company Petronas, will be the first commercial structure to be fuelled with natural gas.

Malaysia has natural gas reserves of 1501 billion cubic meters (World Resources, 1992). Based on the current consumption rate and coupled with a predicted 9.5 percent per annum increase in the use of natural gas, the reserves are sufficient for greater than

40 years (Kawakubo, 1993). The Sixth Malaysian Plan (1991 to 1995) has provided the impetus for Malaysia's entry into the gas era (Government of Malaysia, 1991). Although it may be some time before the impacts of natural gas are felt, the impact that natural gas may have on electricity supply and demand should be given serious consideration by energy planners at Tenaga. Extensive use of natural gas within the domestic sector has the potential to reduce individual levels of electricity consumption and the relative importance of DSM practices.

4.4.2 SOLAR POWER

Renewable energy technologies, particularly solar power, have the potential to reduce the amount of electricity that is currently supplied by Tenaga. Solar power presently is used by Telekom Malaysia to provide power in remote locations. It also is used exclusively on the island of Pulau Aur to provide electrical power to fifty homes. This test project has resulted in the refinement of solar technologies based on the findings of this housing project.

Despite a high degree of cloud cover, particularly during the monsoon seasons, solar power has potential in Malaysia. At present the cost of photovoltaic cells for solar generated electricity is roughly five times more expensive than electricity generated by conventional means. Fortunately, technological progress in this area has been more rapid than anticipated (Hamzam, pers. comm.). Mass production and economies of scale would help to reduce cost, but there first has to be a demand for these products.

Passive solar technologies[16] are appropriate for heating water, which is an area of increased demand. The technology is simple, proven, environmentally benign and

readily available. Storage of the heated water is simply an insulated tank so it presents minimal concern.

However, a concern with other solar technologies is the difficulty in storing excess electrical power for times of minimal or no sunlight. While there is still a need to improve battery storage, technological improvements are reducing this constraint. In some countries systems are structured so that excess electricity is sold back to the grid. While solar power's impact on electricity demand and the need for DSM is not expected to have the same potential magnitude of natural gas, it is very worthwhile to consider when planning to meet the nation's energy requirements.

4.4.3 THE BAKUN HYDROELECTRIC PROJECT

The proposed Bakun Hydroelectric Project, if constructed, would provide Malaysia with an additional 2,400 MW of power by 2005. When fully operational in 2015, Bakun has the potential to produce a total of 16,000 MW of power. This project, in addition to several other power projects which are in the planning stage, has raised concern among investors that, in the long run Tenaga will have excess capacity and, therefore, they should not be actively promoting DSM. Others, predominantly environmental activists, advocate that the extensive expansion of power sources should not take place until the full extent of energy available through conservation efforts has been taken into consideration. The costs and benefits of pursuing solar power versus the

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16 Passive solar technologies incorporate solar collection into the infrastructure of the device. There is no special hardware to move heat from the point of collection to the point of utilization.

costs and benefits of hydro power requires consideration. Both financial outlays and the environmental and social costs should be considered in such an analysis.

While the debate on the merits and necessity for Bakun continues, the relevance of pursuing DSM is under question. All the opportunities associated with conservation measures should be assessed. DSM can help resolve Malaysia's supply problems in the short-term, help to maintain its competitive position through lower production costs in the medium-term and provide long-term business opportunities.

Thailand's power demand is also growing rapidly and authorities are under pressure from powerful environmental groups not to dam any more of Thailand's rivers. This has resulted in Thailand seeking alternative power supplies including importing power from Laos. Alternatively, Malaysia's excess capacity could be sold to Thailand since Tenaga's grid is already connected to the Electricity Generating Authority of Thailand. Malaysia also could develop an energy efficiency industry whose markets and expertise are likely to be sought by other developing countries.

There are relatively few examples of DSM in the context of developing countries (Bhattarai and Shrestha, 1993). This presents an opportunity for Malaysia to establish itself as an innovator and market its products and expertise. DSM is also Tenaga's least cost source of power which should be attractive to investors.

Tenaga's investors, Malaysian citizens and their environment can benefit in many ways through the implementation of domestic sector DSM. The experts and focus group members who participated in this study have an understanding of the need for and benefits of pursing the rational use of electricity. Chapter Five incorporates their

suggestions for viable conservation options into an action plan for implementing DSM in the domestic sector.

5. ACTION PLAN PROPOSAL

5.1 PROGRAMME IMPLEMENTATION

Chapter Four illustrates the instruments available for pursuing DSM in Malaysia's domestic sector. Although these instruments have been employed successfully in a number of countries throughout the world, the implementation of DSM in the Malaysian domestic sector will be challenging for three reasons. Firstly, Malaysian citizens' understanding of the concepts of energy conservation and DSM is low and few options currently are available in Malaysia for fostering conservation and efficiency. Secondly, people have interpreted the government's promotion of consumption to mean achieving the same level of comfort as developed countries through continued consumption of all goods and services. Thirdly, Malaysia, as a newly industrialized country, is faced with many challenges associated with rapid development and continued economic growth. This, coupled with the fact that there are limited human resources with expertise in the area of energy efficiency and conservation, places constraints on how, when and to what extent concepts such as DSM can be introduced.

Recognizing these pressures and challenges, it is desirable to phase in the implementation of domestic sector DSM. A four phase programme is proposed as follows:

- policy and preparation
- promotion
- practice and
- refinement.

Policy and Preparation

As a starting point and to secure government support, DSM should be established within the framework of government objectives and policy. This preempts the need for an Energy Conservation Policy to be implemented.

An Energy Conservation Policy needs to communicate that DSM is compatible with the country's development goals on social, economic and environmental grounds. A review of the Sixth Malaysia Plan confirms this. Although many examples of compatibility exist throughout the Plan, one specific example states that:

> "the conservation of the environment is the responsibility of all, namely, the Government, industries and the public. Reliance on the Government and its machinery alone is insufficient to guarantee environmentally sound and sustainable development."

This supports the involvement of all citizens in environmental initiatives, of which DSM is clearly one.

While policy makers in Malaysia are aware of the interconnectedness of energy consumption and the quality of the environment, domestic sector DSM initially should be pursued on economic and social grounds because the public's comprehension of these issues is greater. The subsequent promotion of DSM on environmental grounds presents an opportunity to educate people about energy-related environmental issues which is also within the context of the Sixth Malaysia Plan.

The introduction of an Energy Conservation Policy that promotes the rational use of energy would lay the foundation for the introduction of a national DSM plan. The implementation of such a policy is under review by the Malaysian government. The timely introduction of a Energy Conservation Policy would enhance cross-sectoral implementation of DSM.

If people are aware that their government and particularly Prime Minister Mahatir supports such an initiative, then they will at least attempt to comply. The fact that focus group participants suggested that the Prime Minister address energy conservation in a speech is indicative of their respect for authority and their willingness to participate in government sponsored initiatives. The effectiveness of the promotion of policy rests with the government's Four Fuel Diversification Strategy. This policy has been very successful in reducing reliance on oil through policy promotion of diversification to other forms of energy.

Since policies, by their existence alone, do not have any implementation value, they must be followed with action. Therefore, during this phase there is a need to prepare for the promotion and practice of electricity conservation.

Work should commence with manufacturers to bring energy efficient products to market in Malaysia. The upcoming introduction of energy efficiency standards should be communicated during this phase. The early announcement of the introduction of standards is necessary to allow manufacturers to retool their plants for the production of energy efficient goods or, for those firms already manufacturing energy efficient goods for foreign markets, to reassess their production strategies. The exact timing of the introduction of efficiency standards will vary depending on the product and the nature of manufacturers producing the item. For example, if the product is manufactured solely by large multinationals with access to energy efficient technologies, standards can be introduced much quicker than on items such as ceiling fans where energy efficient design is in its infancy. Incentives in the form of research grants could be extended to manufacturers during this phase to encourage the design of energy efficient goods for

Malaysian markets. Design competitions that encourage manufacturers to continually strive for excellence in the development of energy efficient products would be appropriate during this phase.

During this phase, work also should commence with developers to promote the design and construction of more energy efficient housing. Housing design competitions would provide a means of fostering efficiency by developers and provide demonstration projects for the public. The timely introduction of incentive programmes for energy efficient housing could motivate developers to participate in these initial design competitions.

Since human resource development is also critical to the successful implementation of domestic sector DSM, there is a need to ensure that people are provided with the skills and knowledge necessary to put the plans into action. People who are presently being trained through industrial sector efficiency programmes could receive additional training to further expand their skills and their ability to train others.

Action on some of the activities suggested has already been initiated but these efforts can be expanded to lay the foundation for subsequent phases.

Promotion

Introducing an Energy Conservation Policy provides an opportunity to introduce domestic sector awareness and education programmes. The events of Energy Efficiency Week, which was hosted by the Ministry of Energy, Telecommunications and Posts and Tenaga in November 1993, are exemplary of the kinds of activities that can be undertaken. During this week, public displays demonstrating energy saving household devices and lighting were set up, information on energy efficient habits and practices was

distributed and people were provided with the opportunity to ask questions of informed personnel. While a formal display and promotion need not be permanently established, these types of activities are examples of initiatives which could be expanded.

The primary intent of the promotion phase is to educate citizens about the concepts of energy conservation and energy efficiency and introduce them to the means of pursuing the objectives of the Energy Conservation Policy. Through education and awareness programmes, it is hoped that people will recognize the benefits of DSM so they become motivated to participate. Education is empowering and is preferred to having DSM simply imposed on citizens without explanation or understanding.

Initially, promotion efforts will have to focus on establishing energy efficient habits such as turning off lighting in vacant rooms, shutting off unused equipment and setting the air conditioner at a reasonable level. People should be informed about the limits of current infrastructure, planned expansion proposals and the costs associated with electrical infrastructure development. The focus at this stage is to alter people's attitudes and habits through education and awareness. An understanding of basic conservation elements, coupled with a knowledge of the benefits of reducing electricity consumption peaks, lays the groundwork for campaigns which strive to move people's use of domestic appliances away from peak periods. Campaigns of this nature promote "avoiding the electricity rush hour." Campaigns focused on the domestic sector will have only a modest impact on reducing demand peaks since the peaks are primarily driven by industrial consumption. However, knowledge acquired and habits developed at home are transferable to the work place.

As additional options become available, such as energy efficient products and building designs, the focus of education and awareness programmes should shift to address the benefits of these instruments. Education on life-cycle costing and cost-benefit analysis would be appropriate at this time. Promotion efforts at this stage should assist in creating the market for energy efficient goods and housing.

During this phase, the DSM initiatives undertaken in other sectors should be communicated to the public to ensure that they are aware that everyone is participating in the best interest of their nation.

Practice

The practice phase involves the actual implementation of the means of fostering the rational use of energy. Although there are many options for bringing about electricity conservation and efficiency in the domestic sector, emphasis should be placed on the introduction and widespread use of energy efficient appliances, housing design, construction and landscaping. The reason behind emphasizing these areas is as follows.

Basically, there are two broad types of scenarios to which DSM can be applied. These are static environments and dynamic environments. North America could be described as a static environment, that is, one in which very little growth is occurring. In this type of scenario, retrofitting and household audits, both of which deal with the existing environment, are appropriate.

In contrast Malaysia is quite different. High rates of economic growth and individual consumption lie ahead so the scenario would be categorized as dynamic. In such a dynamic environment, greater energy savings will be achieved through focusing on the numerous appliances and homes that people are planning to buy in the near future.

This is not to say that other options such as advisory services, household audits and retrofitting, would not yield a return. However, given a limited "window of opportunity" in terms of timing and scarce fiscal and human resources, an emphasis on energy efficient products and housing would yield maximum benefits.

Assuming that earlier efforts to bring energy efficient products to market were successful, this phase should see the widespread introduction and promotion of these items. Retailers will have to be provided with more in-depth knowledge on energy efficient products in order to assist customers with assessing their options and making responsible choices.

Energy efficient housing developments also should emerge as part of this phase. Incentive programmes for the public would now be provided.

Refinement

Subsequent to the introduction of DSM instruments, evaluations should be completed in order to assess the effectiveness of the programmes. The means of measuring the results should be considered as each phase is implemented. Initial goals should be established so that actual performance can be measured against established objectives. Where necessary, revisions should be made to overcome shortfalls or to reinforce those components of programmes which have proven to be very successful. Evaluation is key to ensuring that DSM programmes provide the resources expected of them and do so in ways that are cost effective. Evaluations can also help to legitimize the status of DSM as an energy resource equivalent in output and reliability to power plants (Hirst and Reed, 1992).

Adjustments to the tariff structure may be required to support DSM initiatives. This is one issue which will have to be carefully monitored and implemented with caution if it proves to be necessary. As previously noted, price increases should be administered separately from the promotion of DSM and only after people have been given sufficient lead time to alter their consumption habits..

As education on energy conservation increases and people begin to implement conservation practices, their needs will change. This emphasizes the need for monitoring and refining DSM instruments in the domestic sector. The appropriateness of introducing household audits and retrofitting programmes should be reassessed as conservation efforts progress. Design competitions, for upgrading product efficiency standards, also would be a critical component of this phase.

5.2 TIMING OF IMPLEMENTATION

The four phases described should not be viewed as mutually exclusive or of set length. They will be somewhat overlapping and also should interact with DSM initiatives planned for other sectors.

The timing of the implementation of DSM in the domestic sector must be done strategically to ensure the resources required for success (trained personnel, energy efficient appliances and housing) are available. The policy and preparation phase is one area where work can begin immediately.

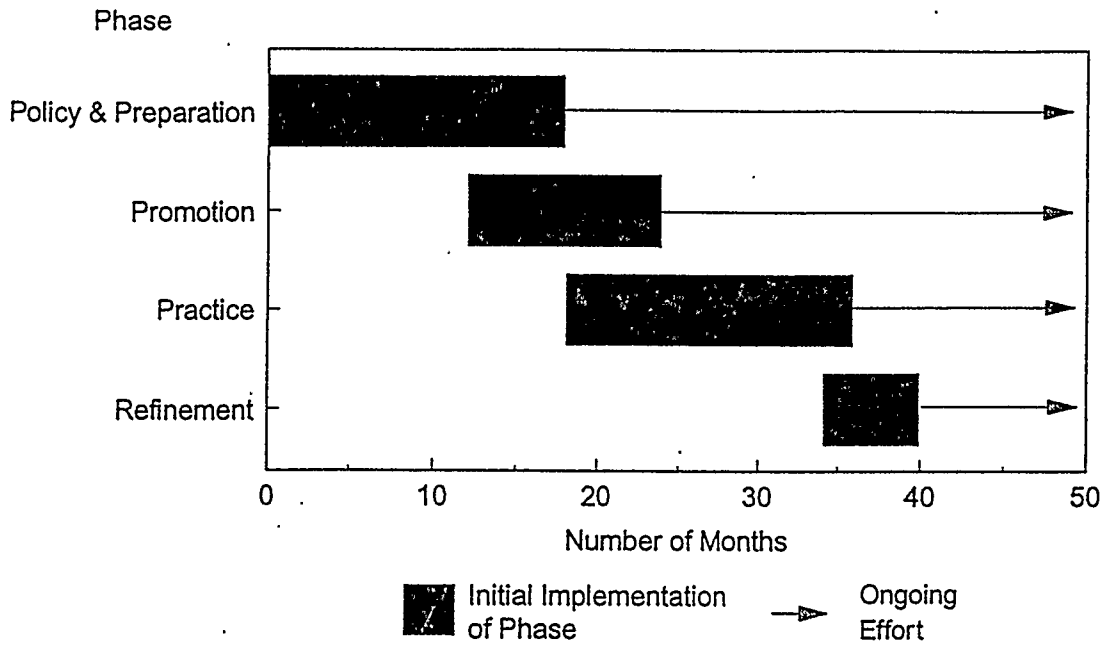
While educating the general public on energy efficiency is clearly desirable, the commencement of this action must be timed appropriately so that people are first educated on the concept and are given some basic means of bringing it about. Then,

without too long a lag, energy efficient products and homes should be introduced. The market should not be created until the goods are available. Malaysian authorities anticipate that it will be approximately two years before energy efficient products and housing begin to penetrate Malaysian markets (Jaafar, pers. comm.) Once DSM is introduced there is a need to keep the momentum going. This will involve coordination among the various sectors, manufacturers and developers, in order to leverage their activities and expertise.

Figure 5-1 suggests a time frame for the introduction of the four phased domestic sector DSM programme and illustrates the overlapping nature of the various phases. Employing a timetable similar to the one suggested in Figure 5-1 would see DSM implemented in the domestic sector within four years from the date that a definite commitment to promoting conservation within this sector commences. Although specific dates have not been indicated on the implementation schedule, it is important to note that Malaysia currently has a "window of opportunity" in which to pursue conservation initiatives. As each new home is built and each new product is acquired, the "window" becomes smaller. Therefore, it is beneficial to commence activity in this sector as soon as possible to capture the greatest return. The Energy Conservation Study, which focuses on the industrial sector, is scheduled to be completed in October 1994. This programme will produce people with the skills and knowledge necessary to actively pursue DSM in other sectors.

FIGURE 5-1

Domestic Sector Proposed Implementation Schedule



In promoting and practicing domestic sector DSM priorities will have to be established because it is not feasible to implement a programme throughout the entire country at one time. Since Kuala Lumpur is the national capital and the largest metropolitan region in Malaysia, it is advisable to first introduce domestic sector DSM in this city. Kuala Lumpur with its decoratively lit government offices and colourful neon lights is known as the "Garden City of Lights", so the successful implementation of DSM throughout this city would establish it as an example for the rest of the country. Over time, the programmes could be expanded to other major centres including cities such as George Town and Johor Baru. In the longer term, domestic sector DSM instruments could be assessed for the feasibility of their application in the rural areas of Peninsular Malaysia as well as in Sarawak and Sabah.

5.3 INSTITUTIONAL RESPONSIBILITY

The Ministry of Energy, Telecommunications and Posts is ultimately responsible for policy implementation as part of its general responsibility for energy policy. Once a policy is documented and approved, this Ministry also must establish the means of promoting it. This does not imply that the government must do all the work to encourage conservation and DSM. Rather, they should assume the roles of pro-active promoter of policy and coordinator of energy efficiency efforts. For DSM to succeed, the government must build the institutional framework, encourage an increase in DSM activity through moral suasion and have enforcement capabilities to ensure initiatives are pursued by all parties.

While legislation ultimately may be necessary to ensure adherence to energy conservation programmes, it could be argued that regulation should not be considered until people have been properly educated and all the savings possible through information and education are achieved (Samdami and Armstrong, 1988). In Malaysia, it also could be argued that adherence to legislation is not part of the culture since much existing legislation is not complied with and only minimal attempts are made to enforce it. Legislation has merit for prompt application in some cases, such as in dealing with large multinationals who have access to energy efficient technologies. In other situations it is not applicable for the arguments stated above. For these reasons, legislation should not be the first step in promoting conservation nor should it be universally applied. The effectiveness of legislation in supporting each component of a DSM programme must be considered on a case by case basis. Table 5-1 comments on the appropriateness of

TABLE 5-1

Appropriateness of Legislating DSM Instruments

DSM Instrument	Appropriateness of Legislation
Education and Awareness	Legislation is not appropriate. Pursue in conjunction with policy implementation.
Advisory Services and Household Audits	Not recommended to be pursued in the initial phases of DSM. Therefore, legislation is not appropriate at this time.
Product Efficiency Standards	Phase in legislated minimum standards and upgrade the standards periodically.
Product Efficiency Testing	Legislate testing standards and the governing inspection body.
Product Efficiency Labelling	Make labelling compulsory through legislation.
Housing Insulation Standards	Phase in legislated minimum standards and upgrade the standards periodically.
Housing Design and Landscaping	Introduce through design competitions. Legislation is not appropriate in the initial phases of DSM.
Retrofitting	Not recommended to be pursued in the initial phases of DSM. Therefore, legislation is not appropriate at this time.
Tariff Structure Adjustments	Approval of tariffs is already a legislated responsibility of the Department of Electricity Supply.
Time of Day Pricing	Legislation is not appropriate. Pursue in conjunction with Education and Awareness.

legislation for each of the DSM instruments discussed in Chapter 4. Full scale implementation of energy efficiency legislation should be implemented only once people have been educated on the concepts and have had the opportunity to freely comply. This time lag provides the government with the time necessary to establish the means for

measuring and enforcing compliance and for focusing on critical areas first. Initially, the government's efforts are best directed at implementing an Energy Conservation Policy.

Tenaga Nasional Berhad, Petronas, the Institute Teknologi MARA, the Standards and Industrial Research Institute of Malaysia, the Federation of Malaysian Manufacturers, individual architects and others, have all undertaken efficiency efforts of their own accord. The Department of Electricity Supply also sees the promotion of energy efficiency as one of their objectives. These activities and perceptions of responsibility emphasize the need to streamline these efforts into an effective DSM programme. All activities do not have to be run by the same organization but there is a need to coordinate their activities. In Thailand and the Philippines, there are committees that meet monthly to coordinate activities. The committees are made up of members of concerned agencies (Rumsey, pers. comm.). If a similar committee were established in Malaysia, it could act as a coordinator of activities and as a distributor of information. Participation by trade associations, industrial organizations, environmental groups and customers is beneficial to pursuing the broad objectives of DSM. A collaborative approach is desirable so that all interest groups understand the positions and constraints of the other, while working towards enhancing energy efficiency and the environment in a consistent, cost effective and concrete manner (Baker and Battle, 1992). In addition to the parties that have undertaken their own energy efficiency initiatives, committee representation could be sought from the Department of the Environment, independent power producers, electrical associations, builder associations, financial institutions, environmental non-government organizations and the general public. Individual activity could be pursued as described in the following examples.

Tenaga is a candidate to promote DSM and to work with manufacturers and developers to bring to market energy efficient products and housing designs. While the loss of revenue from DSM represents a cost from a utility perspective, such a problem need not arise if careful infrastructure planning is maintained and if international markets are found for electricity generated in excess of Malaysia's demand. Should a situation of excess capacity prevail, profit adjustments may have to be worked out with Tenaga. Under this scenario, determining a means for Tenaga to share in the savings associated with DSM would be necessary for the programmes success. A strong commitment to DSM on the part of the utility ownership, management, and employees is a critical factor in achieving success (Baker and Battle, 1992).

Regulation by the Department of Electricity Supply would ensure adherence to the government's energy efficiency objectives. This department could assume the role of ensuring that all participants in DSM initiatives are working individually, as well as collectively, to promote the rational use of electricity. Establishing programmes to further develop and promote renewable technologies, such as solar, would be another area of responsibility for the Department of Electricity Supply.

The Standards and Industrial Research Institute of Malaysia would be an appropriate body to test efficiency standards. This institute currently tests products for compliance to various standards with an emphasis on safety. Although energy efficiency testing is not currently part of their mandate, they recently established an Energy Technology Group that is looking to play an active role in promoting conservation and efficiency (Ang, pers. comm.).

Universities such as the Institute Teknologi MARA could continue to conduct research on alternative energy technologies. Organizations such as the Federation of Malaysian Manufacturers could promote energy conservation in production techniques, and could encourage their members to design and produce more efficient goods.

5.4 CONCLUDING COMMENTS

There are many advantages associated with domestic sector DSM and Malaysia is in a good position to implement them and reap the rewards. DSM has the potential to save financial resources for development in other sectors of the economy, to ensure electrical energy is available for all -- citizens and investors alike, and DSM will serve to reduce the environmental impacts associated with electricity consumption. Several programmes exist throughout the world which clearly illustrate the benefits associated with DSM. Unfortunately, there are also risks since DSM cannot guarantee the set amount of supply that the construction of additional infrastructure can. With careful planning, implementation and monitoring of DSM programmes, this risk can be minimized and the benefits associated with energy conservation can be achieved.

With electricity demand expected to remain strong and continue growing well into the next century, the electricity savings recognized through DSM instruments will not be able to accommodate all of the increased demand (Tai, 1994). Regardless, there is still room for Demand Side Management to make a significant contribution to electricity supply, continued economic development and improved environmental quality. Also, since supply side approaches alone do not guarantee that electricity will be provided in

the most cost effective manner and with the least environmental impact, they should be complemented with demand side approaches.

Work will be required to spread awareness of the need for energy conservation and efficiency. Efforts to bring energy efficient products and housing to Malaysian markets will have to be expanded. While there are challenges and barriers to be overcome, Malaysia has a proven track record at tackling challenges. Malaysia's firm commitment to DSM would help Malaysia foster a position not only as a current leader in economic development but also as a promoter of sustainable development. Given Malaysian citizens' hard work and dedication to achieving the country's development goals, with proper direction and motivation, Demand Side Management has the potential to become another Malaysian success story.

APPENDIX 1 - INTERVIEW SUBJECTS

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* Denotes a full interview was not conducted. Informal communication only.

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APPENDIX 2 - INTERVIEW GUIDE

1. Household electricity consumption is growing in Malaysia. What do you believe are the main driving forces behind the increased levels of consumption?

- solicit input on:
a. goods acquisition vs. other factors. ie. the formation of new households, absolute population growth, etc..
b. if goods are identified, then which goods -- ie. irons, washers, air conditioners, convenience appliances, etc..

2. When it comes to providing electricity to a growing market what do you feel are some of the major issues associated with increased consumption? ie. adequacy of supply, power outages, environmental concerns regarding proposed hydro development, environmental concerns regarding oil or coal generation.

3. Demand Side Management / Energy Management is a means of reducing overall energy consumption through efficiency measures and reducing peak consumption levels. Do you feel if appropriate Demand Side Management policies/programs were implemented that they would have an impact on domestic sector electricity consumption levels?

4. What types of Demand Side Management techniques do you feel would be appropriate for implementation when trying to manage electricity consumption of the domestic sector in Malaysia?

- education, awareness and information distribution
- teaching energy efficiency in schools
- pilot programs
- publicity programs/campaigns
- advisory services
- stiffer tariff structure -- ie. pay the top price on all units consumed
- time of day pricing
- manufacturing standards for appliances, bulbs, etc.
- manufacturing rebates
- product labelling
- customer rebates
- household audits
- regulations

5. Who do you feel should have the responsibility for implementing such policies/programs?

6. What do you feel are the risks/obstacles of implementing Demand Side Management in the domestic sector in Malaysia?

7. What do you feel would be the benefits of implementing Demand Side Management in the domestic sector in Malaysia?

8. Additional comments:

a) In Malaysia the national energy plan electricity projections currently parallel economic growth. Demand Side Management techniques have the potential to reduce demand. Do you feel energy demand can be reduced to a level lower than economic growth if Demand Side Management programs are implemented?

b) Thoughts on how Malaysia's "Vision 2020" will impact electricity consumption levels.

APPENDIX 3 - FOCUS GROUP COMMENT SUMMARY

FOCUS GROUP NUMBER ONE

Group Profile:

- nine females aged 30 to 40 years
- 40 percent Chinese, 40 percent Malay, 20 percent Indian
- Household income of $800 to $1120 U.S. per month
- Occupations included: housewife, secretary, printing assistant, community adviser, quality control inspector and purchasing assistant.
- Household size: ranged from three to 13. All participants were married with at least one child.
- discussion moderated in English

Objective 1 - Appliance Ownership in Malaysian Households

- Appliances owned include: air conditioner, blender, electric kettle, iron, microwave oven, oven, refrigerator, rice cookers, television, toaster and washing machine

Discussion time: 15 minutes

Objective 2 - Factors Contributing to Increased Consumption

- Increased appliance ownership.
  Desired products included: air conditioners (in more than one room if one was already owned), computers, entertainment equipment, larger refrigerators and water heaters.
  Interesting points raised include:
  - "most of the appliances we own are brand new"
  - "the air con is a newly installed unit"
  - "electricity consumption will rise as people are adding more appliances rather than replacing them"
  - "appliances are wanted for convenience"
  - "it will cost more but it's more convenient. Saves time. We finish our work faster."

- Family size and structure.
  Points of interest include:
  - "in a large family often everyone cooks their own dinner which consumes a lot of energy"
  - "if bigger family, more consumption, because more people using the fan, some houses got a few TVs and hi-fi."
  - "the population is increasing and many young people want their own homes"

- Habits.
  Interesting points raised include:
  - "individual ironing, ie. one or two pieces at a time, results in more electricity being used"
  - "people do not use electricity wisely. They need a consciousness."
  - "consumption varies with how many people and for how long they occupy the home. In my family many of the members are away during the day."
  - "discipline is important"
  - "I'm not conscious about using electricity, but I don't waste. I won't stop from using something because it consumes electricity, but it's more of discipline."

Discussion time: 30 minutes

General comments: Participants were knowledgeable in this area and discussion flowed freely.

Objective 3 - Current Awareness of Conservation and Demand Side Management

- Initial definitions of conservation included:
  - "to save -- don't waste, reduce, being disciplined with use, not wasting, using carefully, planned use, buy less electrical items, good habits, using less electrical products"

- Benefits of conservation were perceived as:
  - "eliminating the shortage, helping the nation to save electricity, distribute it (electricity) equally, reducing unemployment -- as people cannot work when there is no electricity, reducing electricity costs, savings on electricity bill, making the nation more conscious of what they have -- brings the nation together and appreciating what you have"

  One perceived negative side-effect was noted as follows:
  - "It's (conservation) a benefit for personal reasons, but not for the country on the whole. New electric things will come out and people will use it to save time. If we were to use less (ie. not buying these products), they would not be able to sell."

Discussion time: 35 minutes

General comments: Discussion on this area was slow to start, but momentum gathered once the participants starting raising a few ideas. Economic and social issues were seen as the benefits of electricity conservation. The notion of conservation was limited to "saving electricity." No environmental benefits were raised. The moderator questioned the group on the environmental benefits of conservation and silence followed. The participants did not believe that using

electricity was bad for the environment as there was no connection as to how electricity was produced. Once a brief explanation of the environmental implications of electricity use was explained, the participants saw conservation as a means to reduce consumption of the country's natural resources.

Objective 4 - Assessment of the types of Demand Side Management and Conservation Practices Households Would Subscribe to

Highlights of participants comments are noted below in the respective category.

- Awareness Programs.
  Education and awareness programs were seen to be desirable. The following were suggested means of accomplishing this objective:
  - "have catchy advertisements. Make it interesting."
  - "sell conservation as if you are selling a product"
  - "television ads will reach the largest audience. Every house has a TV."
  - "introduce the subject to the children and let them voice their opinion and then come up with the solutions"
  - "schools cover children. For adults, I think mostly advertisements."
  - "competition. Who gives the best slogan (promoting energy efficiency) gets a prize."
  - "print words on the bill. If you see the words, you're more alert."
    - "eg. compare individual bills with averages"
  - "an information centre would be good, but we don't want people coming to our homes as they will be sales people"
  - "the campaign lifted up our consciousness. If you have the discipline, it's enough. But sometimes we get careless. It's good to remind us."

- Energy Efficient Products.
  The only energy efficient product that people were aware of was lighting. While very few energy efficient products are currently available, people were receptive to the idea of using them and offered the following comments:
  - "the new generation needs more sophisticated things"
  - "these products should be easily accessible to the public -- even in supermarkets"
  - "they (efficient products) need to be reasonably priced"
  - "sell as a promotion. Even a poor family would want that because it consumes less electricity. If they can't afford to buy it and only the rich can buy it, the rich will spend less than the poor."
  - "the product must be advertised"
  - "shops need to have knowledge of the products they are selling"
  - "markings are needed to identify efficient products. I would like a sticker system of identification."

- Price/Tariff Adjustments.
  Response on price increases to promote conservation were mixed. Some were in favour of a higher price while others opposed the idea. The following points were raised:
  - "raising the price would be unfair to the poor"
  - "the price should be set to make you conscious of use so that you use electricity responsibly"
  - "it shouldn't be so high it's not affordable and it shouldn't be so low it's taken for granted. It should be a reasonable price for all."
  - "time of day pricing is unfair to small consumers -- why should households have to change their timing and suffer at the benefit of corporations and industry?"

- Housing Design and Construction.
  Much discussion took place on this topic. Three of the women were currently in the process of building new homes and were very receptive to the idea of more efficient design and operation. The following comments are noteworthy:
  - "it's good for the new house"
  - "energy efficient bulbs should be used"
  - "desire more windows for lighting and ventilation"
  - "placing of the light so that we don't have to use so many bulbs"
  - "awnings, blinds, curtains"
  - "grow more plants. Have trees outside. Growing grass outside. It's cooler."
  - "I will include these things (efficiency ideas) in my new home as this is easier and less messy than putting them in my current home."
  - "interior colours should be "cool" shades"
  - "position of the house. Where it's facing."

Discussion time: 75 minutes

General Comments: Participants had many suggestions on how they would be willing to participate in programs to reduce their consumption of electricity. They openly admitted that they were not willing to do without electricity, as it was something they very much desired, but that they were willing to be "disciplined" in their use of it.

Concluding Comments: Although the focus group was only scheduled to last two hours, discussion continued for in excess of the allotted time. People were interested in the topic and openly shared their views. All of the women participated in the discussion and the moderator did an excellent job of ensuring that all participants had an opportunity to speak on each topic if they choose to. With an increased knowledge of the means of conserving electricity, participants expressed a greater willingness to alter their actions as it was in their best interests as well as the interest of the nation.

FOCUS GROUP NUMBER TWO

Group Profile:

- eight males aged 20 to 30 years
- 40 percent Chinese, 40 percent Malay and 20 percent Indian
- Household income $800 to $1120 U.S. per month
- Occupations included: bank clerks, a computer programmer, sales personnel, armed forces and graphic designer.
- Household size: ranged from one to 12. All participants were single. With the exception of one individual, all participants lived with their families with family sizes ranging from six to twelve.
- discussion moderated in English

Objective 1 - Appliance Ownership in Malaysian Households

- Appliances owned include: air conditioner, blender, computer, electric kettle, fan, iron, lighting, microwave oven, refrigerator, rice cooker, television, typewriter, video player and water heater

- Discussion also took place on which items consume the most electricity. The following points were noted:
  - "the iron -- everybody does the ironing and we have eight people in our house"
  - "the kettle -- because the heating element consumes a lot of energy compared with the others"
  - "the fridge -- well, it's big with two doors"
  - "the rice cooker -- it's a big rice cooker, the huge one, like they use in the restaurant because there are eight members in the family and I have two nieces"
  - "the fan -- every time when I'm home, I always switch on the fan"

Discussion time: 25 minutes

Objective 2 - Factors Contributing to Increased Consumption

- Increased appliance ownership.
  Desired products included: audio visual, bigger TV, personal computer, refrigerator, typewriter and washing machine
  Interesting points raised include:
  - "people in our country, they can afford more things than they used to. They tend to buy more things than is needed in the house."
  - "people need them (electrical appliances) to simplify daily work"
  - "I am getting married. Maybe, starting next year, I would start to look for everything."

- Family size and structure.
  Points of interest include
  - "big family do tend to use more electricity"
  - "I think all my electrical appliances need to be changed because by family is going to grow bigger (as extended family within the home grows)."

- Habits.
  Interesting points raised include:
  - "they are trying to make their life as easy as possible so when we do that, that is when we use up too much electricity"
  - "frequency of use of the appliances is one of the major factors which causes consumption to increase"
  - "maybe you can be careless, your girlfriend is on the line, and you were ironing clothes and you talk about half an hour and forget about the iron"

- Changing lifestyles and aspirations.
  Points of interest included:
  - "I think there's one more major factors. Last time, I don't have a fan in my house, I don't have a TV and even using charcoal iron to iron my clothes. That time, I don't use any electricity. So what I think is, we're trying to keep up with the time, that's why we are using use so much energy."
  - "I think it depends on how modernized is the family. If it's a medium family like mine, then we don't use a lot of appliances and maybe for the high level income owners, maybe they will use so many electrical appliances."
  - "upgrading your appliances and your neighbour see you got an upgraded PC and they get one to challenge you or whatever"
  - "last time people don't use a heater but now a days, they like to use a heater for their baths"

- Weather.
  Comments pertaining to weather include:
  - "if it's a hot day we switch on the fan all day, but if it's a rainy day we switch off the fan"

- Increasing urbanization.
  Interesting points include:
  - "nowadays people are very conscious, they want to have their own room, so everybody wants to buy a house, especially in K.L."
  - "a lot of people from K.L. and from outside are buying houses also"
  - "people who lives outside of K.L. -- they're moving in"

Discussion time: 40 minutes

General Comments: This group had many ideas on why electricity consumption is growing and why it will continue to increase. One individual also noted that solar energy, to heat water, was one way in which electricity use could be minimized.

Objective 3 - Current Awareness of Conservation and Demand Side Management

- Initial definitions of conservation included:
  - "cut cost, use less, try to reduce the frequent use of energy, switch off the TV and fan, not buying electrical appliances which are not necessary, remembering to switch off all the electricity, employing economies of scale -- for example I do my ironing for one week, buying product using less voltage"

- Benefits of conservation were perceived as:
  - "people are looking for more ways for them to save electricity"
  - "the bill is lower and things will last longer"
  - "we can save a lot of electricity. We might even sell electricity to neighbouring countries."
  - "less air pollution. Because the power generated by our dams are not enough usually the government use oil as fuel for the generators or coal to generate. The more electricity is saved, you use less oil or coal so it's better for our environment. That's in the case if we use fuel, but if we use hydro electric, I don't think that will effect the environment."
  - "spend less money on power generation."
  - "it can motivate the product manufacturers to invent products which use less electricity"
  - "economy grows. If our infrastructure is good, it contributes to economy growth because the stability is good. This means more investment, more employment."

Discussion time: 35 minutes

General Comments: The individuals in this group generally associated conservation with the curtailment of use, rather than efficient use of electricity. They were quick to identify a variety of benefits that would result through promotion and implementation of electricity conservation.

Objective 4 - Assessment of the types of Demand Side Management and Conservation Practices Households Would Subscribe to

Highlights of participants comments are noted below in the respective category.

- Awareness Programs.
  These individuals thought that promoting efficiency and educating people was a good idea. The following points were raised:
  - "people are looking for more ways for them to save electricity"
  - "many people are conscious about this (energy efficiency), but they don't seem to be doing anything"
  - "I think so far the best media is TV"
  - "show ways to achieve benefits"

- Energy Efficient Products.
  The participants were aware of energy efficient bulbs and were receptive towards seeing more of these types of products on the market. The following comments are noteworthy:
  - "they (people) will try to find ways or devices which perform at the same level but only consumes less electricity"
  - "the way to compromise is to buy products that are electricity saving"
  - "there is advanced technology, like a timer to switch things off automatically"
  - "some people think the more power the better the product -- they need to know this is not true"

- Housing Design and Construction.
  - "use intelligent buildings or smart houses. They use less energy, caused by the architecture of the building."
  - "well insulated buildings work to prevent the loss of air-conditioning"
  - "housing projects should have greens and all that. If you have more trees, the area around the house gets cooler so you don't use so much fans and all that."
  - "houses should have lots of windows"

- Solar Systems.
  - "set up a solar system on top of the house, then you don't have to use too much electricity"

Discussion time: 40 minutes

General Comments: The participants had some unique ideas as to how they would be willing to conserve electricity in their homes.

Concluding Comments: This group had a good comprehension of the subject matter and would freely debate the issues if they did not agree with the view presented. A couple of the participants appeared to have had some previous exposure, possibly through education, to the concepts presented and they willingly explained the issues to the remaining group members. These young men were receptive to new ideas and appeared to be having fun discussing the issues. A few members remained after the meeting ended to discuss a few additional ideas, indicating an interest in the subject.

FOCUS GROUP NUMBER THREE

Group Profile:

- nine males aged 40 years and above
- 100 percent Malay
- Household income of $400 to $600 U.S. per month
- Occupations included: government clerk, shop keeper, warehousman and factory workers.
- Household size: ranged from four to ten. All participants, except one, were married.
- discussion moderated in Bahasa Malaya

Objective 1 - Appliance Ownership in Malaysian Households

- Appliances owned include: electric kettle, fan, hair dryer, iron, refrigerator, rice cooker, television, video and washing machine

- When asked if they owned air conditioning the following responses were given:
  - "no, high cost"
  - "no need"
  - "cannot afford now"
  - "if I can afford I want to have five air conditioners"

Discussion time: 10 minutes

Objective 2 - Factors Contributing to Increased Consumption

- Increased appliance ownership.
  Desired products included: additional TV, air conditioning, bigger refrigerator, washing machine and video
  Interesting points raised include:
  - will acquire "whatever is new and what makes our life simpler and easier"
  - "executives or rich people will want air conditioners"
  - "sometimes its not what we want but the kids ask for it. When they see their friends house has this, they are bound to feel something. So if can afford, then I'll buy for them."

- Habits.
  - "we're not wasteful cause we're from the kampong (village). We were taught that way."
  - "now a days people want an easier life"

- Increasing standard of living and home ownership.
  - "If last time they're renting a house and now getting their own house then they tend to buy more things. As a result the bill goes up too."
  - "shift from squatters to new houses will be followed by buying more electrical appliances"
  - "as the result of an increasing standard of living more people are buying their own house"
  - "TVs and fridge -- all those are necessities at homes now. The majority owns one now."

Discussion Time: 30 minutes

Objective 3 - Current Awareness of Conservation and Demand Side Management

- Initial definition of conservation included:
  - "use less, watch less TV, cut down the usage, switch on the light only when needed, iron all items at one time"

- Benefits of conservation were perceived as:
  - "bill will go down"
  - "though the electric bill is the income for government, but if we use too much, they won't have enough supply. As a result they have to build other generators. Indirectly we'll incur the cost too. So, if we save, they'll have more balance and that balance could be used for other projects."
  - "if the government builds less dams they won't use up so much space. Because to build a dam, it will use up 40 to 50 acres of land and will involve the river too."

  One perceived negative side-effect was noted as follows:
  - "If we use less, they (Tenaga) will make a loss. It's their business."
  - "I think they'll be happier if the bill is higher -- they earn more"
  - "logically speaking, they (Tenaga) should encourage us to use more, but now they're asking us to save?"
  - "only under the critical period will government launch those campaigns"
  - "Tenaga is a private one -- they won't ask us to save"

- Two individuals questioned why they should conserve as follows:
  - "we are the one paying the bill, so who cares as long as we can pay the bill?"

Discussion time: 40 minutes

General Comments: Like in the other groups, suggestions for bringing about reduced consumption related to reducing use. Participants were very quick to identify the economic benefits of conservation. However, when questioned on the environmental benefits silence initially prevailed, but later several valid comments were noted. Some individuals expressed resistance towards the idea of conservation because they felt that if they could afford it, then the government should not be telling them not to use it.

Objective 4 - Assessment of the types of Demand Side Management and Conservation Practices Households Would Subscribe to

Highlights of participants comments are noted below in the respective category.

- Awareness Programs.
  Awareness and education, primarily of children, were seen as being beneficial. The following were suggested as ways of getting the conservation message to the people:
  - "tell everybody"
  - "use TV"
  - "have a brochure to give out, leaflets"
  - "campaigns in schools. The kids can teach the parents to do so, like they'll teach me not to smoke."
  - "teach the children when they are young. Adults like us are too used to it (electricity use)."

- Energy Efficient Products.
  The men expressed some skepticism about energy efficient products and noted that in order for them to buy them the quality of the product would have to be guaranteed. The following comments were offered:
  - "not aware of any products that don't use so much electricity"
  - "can use a more economical refrigerator because it is practical"
  - products are a "good idea, but the price has to be reasonable and the quality of the product must be equivalent too"
  - "I'll doubt about the quality or effectiveness of the product if it has the same heat, but consumes less electricity"
  - "if there is one kind of new iron, but it is still as good as others, then maybe we will consider"

- Price/Tariff Adjustments.
  The men did not like the idea of an increased tariff and agreed that it would not necessarily make them reduce their consumption of electricity.
  - "maybe we'll use less -- cut down the usage"
  - "maybe people will end up using their own generator"
  - "if they're rich, the people can use solar. It's quite popular now, but its expensive -- about RM $600."

- Government communication.
  People felt that the government had to lead the conservation initiative and then they would follow. Points of interest are as follows:
  - "they (Tenaga and the people) will do it only when the government asks them to"
  - "the government will definitely have to order them (factories like Toshiba, Sanyo, etc.) to do so (ie. produce energy efficient goods)"
  - "Tenaga should lead by example, not just expect us to do everything"

- Audits and advisory services.
  The participants were receptive to the idea of a place where they could seek advise, but did not want efficiency auditors entering their homes. The following comments were offered:
  - "there is no need for experts to go to the house and teach you"
  - "teach us, leave it to us, we ourselves will play our part"

- Building design and landscaping.
  People thought efficient housing designs were a good idea, but they were concerned that it would be too costly.
  - "can, good idea"
  - "they can build, but if it's expensive we can't afford"
  - "if the government wants to build this kind of house in a new project then okay, but not to fix into our house now. It is a lot of work to do this to our house."

Discussion time: 60 minutes

General Comments: A number of unique ideas were raised by this group both as means of approaching the implementation of demand side management and in articulating their concerns about the concept.

Concluding Comments: This group presented the greatest resistance to the idea of energy conservation and demand side management practices. Basically they were skeptical about the governments or Tenaga's intent and also about the quality of efficient products. They felt that the promotion of energy efficiency and responsible habits should be addressed with children and younger people so that it becomes a way of life with them. Despite their resistance to conservation they were willing to offer some valid suggestions as to how it might be pursued.

FOCUS GROUP NUMBER FOUR

Group Profile:

- nine females aged 35 years and over
- 100 percent Chinese
- Household income of $400 to $600 U.S. per month
- Six of the women worked outside the home and three members were housewifes
- Household size: ranged from two to seven
- discussion moderated in Mandarin

Objective 1 - Appliance Ownership in Malaysian Households

- Appliances owned include: electric kettle, fan, iron, lights -- fluorescent and bulbs, radio, rice cooker, slow cooker, television, washing machine (some) and water heater (some)

- When asked if they owned air conditioning the following responses were given:
  - all said "no"
  - "I've never thought about it"
  - "not everyone will use it, only those rich ones"

Discussion time: 10 minutes

Objective 2 - Factors Contributing to Increased Consumption

- Increased appliance ownership.
  Desired products include: air conditioner, automatic kettle, better rice cooker, big refrigerator, dishwasher, karoake, microwave, spot lights, video games and washing machine
  Interesting points raised include:
  - microwave -- "its suitable for us, especially people like us. Lazy housewifes, just put everything inside and that's it. Also, very convenient."
  - "of course I'll have (automatic kettle) if I can afford, but this is not necessary, just a luxury because it's expensive"
  - "usually we won't change appliances if it can still be used"
  - "as long as it can still be used I won't change TV"
  - "I'll leave the hi-fi for my son to buy. I'm not interested."
  - "I'll get a dishwasher if I strike lottery"
  - "air conditioning of course, that's when we're rich"

- Family size and structure.
  Noteworthy points include:
  - "forming a new family, like getting married will mean more consumption"
  - "there are less kids now (per family), but then most of them will shift out from the family -- indirectly they consume more. They got to buy their own electrical appliances."
  - "younger people want a world of their own. The desire to be independent is there."

- Changing lifestyles and aspirations.
  Points raised include:
  - "when you're rich, you tend to buy everything which is not necessary -- they want a better life"
  - "this is not just a result of city development, even rural people also very rich nowadays"
  - "the higher education, the more they (young people) will earn, then the more they want to enjoy. The more they know the more they want."
  - "but I'm already used to heater, can't bathe with cold water"
  - "everybody takes life easy now. They prefer to enjoy their life and live more comfortably."

- Housing.
  The following points were noted:
  - "more high-rises means more lifts and that consumes more energy"

Discussion time: 30 minutes

General Comments: This group emphasized that most of the items that they aspire to own were desired to help them have an easier life. They were also aware of how changing lifestyles and family relationships would impact electricity consumption.

Objective 3 - Current Awareness of Conservation and Demand Side Management

- Initially when asked if they had heard about energy conservation all participants said no and one asked: "asking us to use less electricity?". The moderator then explained that conservation is about using less electricity and finding methods to increase the effectiveness of its use and the following ideas were suggested.
  - "watch less video, don't switch off and on the light that frequent, remember to switch off when not using, don't cook the rice too early and keep it warm because it consumes a lot of electricity, bathe earlier so that no need to use the heater, use less light, use less iron, do house chores during day time -- no need to switch on the light"

- Benefits of conservation were perceived as:
  - "decreasing the bill"
  - "it is better that we control (electricity consumption) than control by them (the government or Tenaga)"

Discussion time: 35 minutes

General comments: The concept of energy efficiency was completely foreign to this group. Even when it was explained to them there was still some confusion although the explanation did arouse some discussion about efficient lighting, which the participants felt was general knowledge. Very few benefits were identified. The moderator had to prompt discussion on the majority of the benefits, particularly on the environmental and national economic benefits. On these topics the participants generally agreed with what the moderator had suggested, but did not elaborate on the issue.

Objective 4 - Assessment of the types of Demand Side Management and Conservation Practices Households Would Subscribe to

Highlights of participants comments are noted below in the respective category.

- Awareness Programs:
  The ladies were supportive of awareness programs and suggested the following:
  - "use TV, everybody watches TV nowadays"
  - "newspapers. They already told us to save electricity, but only when there was no electricity."
  - "a speech given by Prime Minister would encourage wise use"
  - "advertise how to go about it and provide the reasons why"
  - teach students "like recycling, even primary students know more than us. They'll come back and teach us. Parents will be happy also."
  - "the government should impose some rules and teach you"

- Energy Efficient Products:
  The participants were aware of energy efficient bulbs, but were not aware of other efficient products. They offered the following comments on this subject:
  - "if they are available they will be a good idea. Of course, I'll give it a try."
  - "were so used to that kind of life (one that consumes electricity) that it is difficult to change. Unless they come up with new products which is better, then we'll buy."
  - "just make sure it's really good and not too expensive also"
  - "since most of us buy at electrical shops, probably they can introduce and recommend these products to us"
  - "these products should be labelled, maybe with pictures, so we know which ones to buy"

- Price/Tariff Adjustment:
  People were not supportive of price increases to promote conservation. Their comments were as follows:
  - "no, definitely not"
  - "we will not really save electricity, because we still have to use all those things to do our work."
  - "but if they want to do that, slowly I think everybody will be used to it."
  - "if you want us to save, design new products is the best way"
  - "it's difficult to adjust the schedule, its difficult to do everything in the day-time. Changing the pricing will not change habits."

- Audits and Advisory Service:
  People expressed mixed opinions on this subject as follows:
  - "good idea (audits), but worry also, somehow they are still strangers coming into your home"
  - "no need to come to our house, through public media will do"
  - "its better for them to demonstrate and we can compare. Especially people like us, not well-educated, might not understand what's written there -- so demo."

- Housing Design and Construction:
  Many felt that housing design and landscaping were a good idea, but that they would have to respect Chinese culture and beliefs if they were to be accepted by the community. The following comments were noteworthy:
  - "houses which facilitate the flow of air would be good, very good"
  - "plant trees. There used to be a lot of trees, but they have been chopped off. Unlike Singapore, they've got a lot of big trees, even Penang, but not here."
  - "trees are okay, but they should not make the house dark. It is not good in Chinese belief (Feng Shui)."

Discussion time: 60 minutes

General Comments: This group detailed many demand side management options that they would be willing to become involved. As the final group of four discussion groups, very few totally new ideas were raised, but this group added some interesting cultural dimensions, particularly relating to the issues of housing and landscaping.

Concluding Comments: Although this group had a very low comprehension of the concept of energy efficiency at the outset of the discussion, they made several valid suggestions as to how they would be willing to work to bring it about. They expressed a greater need for government intervention in support of conservation initiatives than did other groups.

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APPENDIX 4 - FOCUS GROUP DISCUSSION GUIDE

Notice to Moderators: All questions should initially be asked as open ended questions so that respondents can answer freely. Additional information has been provided to prompt discussion on relevant issues should participants initially be reluctant to offer answers to the questions posed.

In the text which follows, the research objectives have been highlighted and the specific questions to be asked have been underlined.

OBJECTIVE 1. To determine which products are currently consuming electricity in Malaysian homes and to get participants thinking about electricity consumption in their homes.

Information is to be obtained by asking participants:

What types of electricity consuming goods do you currently have in your home?

If answers do not flow freely the moderator could start making suggestions such as iron, rice cookers, air conditioner, etc.

This question should get people thinking in terms of what is consuming electricity so that they are better prepared to participate in the following discussion.

Time allotted: 5 minutes

OBJECTIVE 2. To determine peoples' opinions on what factors will influence household electricity consumption in the future.

Information is to be obtained by asking participants:

What factors do you believe will contribute to increased electricity consumption in the household sector?

Based on discussions with experts, the answers are likely to fall into two areas. Additional information should be sought in each of these categories. Also, should participants raise other issues they should be noted and discussed.

A. Acquisition of additional electrical appliances.

1. What types of electrical appliances do you (representing your household) anticipate acquiring either as a new purchase or as the replacement of an existing appliance?

B. Demographics

1. What (other) trends do you feel will impact future household electricity consumption?

Possible answers may include: (for prompting purposes only)
- household formation and family size, urbanization trends, education, rising income levels, etc.

Time Allotted: 10 minutes

OBJECTIVE 3 - To determine peoples' awareness of the concepts of energy conservation and Demand Side Management

The following question should be asked:

1. How do you define the term "conservation" as it relates to electricity conservation?

The following definition of conservation should then be presented and posted, with Objective 4 being discussed within this definition of conservation.

Conservation: increasing the efficiency of energy use. This does not imply that people have to do without electricity, but rather conservation looks at ways of doing the same tasks, but with lower rates of electricity consumption or altering the timing of consumption. Example: note the initial cost of the equipment is higher but the total cost, including electricity, is lower.

Type of Bulb	*Compact Fluorescent Lighting*	*Incandescent Bulbs*
Watts Consumed	*18*	*75*
Bulb Lifetime (hours)	*8000*	*1000*
Number of bulbs	*1*	*8*
Bulb cost ($MR)	*$40*	*8 x $2 = $16*
Electricity Use for 8000 Hours	*18x8000/1000 = 144 kWh*	*75x8000/1000 = 600 kWh*
Electricity Cost for 8000 Hours at $0.23/kWh	*$33.12*	*$138.00*
Total cost ($MR)	*$73.12*	*$154.00*

Some benefits of electricity conservation include:

- a reduction in the consumer's monthly electricity bill (as illustrated in the previous example)

- reduced social conflicts over natural resource exploitation (eg. coal and hydroelectric dam construction)

- spending less money on power plants which helps to keep tariff rates stable in the long term

- building and operating fewer power plants resulting in the burning of less non-renewable fossil fuels which serves to reduce the negative impacts of fossil fuel consumption on the environment

- energy efficiency creates employment opportunities in the market for energy efficient products and services

Time Allotted: 30 minutes

OBJECTIVE 4. To determine what types of programs individuals would be willing to participate in to conserve electricity in their homes.

Information is to be obtained by asking participants:

1. <u>What types of programs, products, etc. do you feel would encourage you, and members of your household, to conserve electricity?</u>

Solicit participants suggestions first before obtaining their opinions on the appropriateness of the following Demand Side Management/conservation techniques:

Awareness

- education, awareness and information distribution
- publicity programs/campaigns
- teaching energy efficiency in schools
- pilot programs to provide examples of how to conserve electricity
- advisory services on how to save electricity in the home
- household audits

Products

- acquisition of energy efficient appliances
- easy access/wide distribution of energy efficient appliances (Tenaga franchise stores)
- product labelling of energy efficient goods
- customer rebates or discounts for acquiring energy efficient goods
- promotion of manufacturing standards (appliances, bulbs, etc.)

Price

- stiffer tariff structure
- higher prices for electricity
- time of day pricing - lower rates for off peak hours

Construction

- energy efficient housing design (incorporating ideas such as proper ventilation for natural cooling, windows with the ability to reduce heat absorption in the home, etc.)
- retrofitting (eg. new windows, tighter seals around doorways, etc.) existing homes to prevent cooling loss

Other

- natural cooling -- ie. increased vegetation around homes
- peer pressure
- regulations

Time Allotted: 60 minutes

Discussion of related issues and wrap up

Time Allotted: 15 minutes

REFERENCES

Agus, Mohd. Razali, Othman, Mohd. Nor, and Sim, Ong Fon, A Study of Residential (Tariff A) Consumers of Electricity in Subang Jaya and Bandar Baru Bangi, Institute for Advanced Studies, University of Malaya, Kuala Lumpur, 1993.

Ang, Beng Wah, ASEAN Energy Demand - Trends and Structural Changes, Institute of Southeast Asian Studies, Singapore, 1986.

Arismunandar, A., State of the Art of Energy Efficiency in Indonesia, Ministry of Mines and Energy, Jakarta, Indonesia, 1992.

Asian Development Bank, Electric Utilities Data Book for the Asian and Pacific Region, Fourth Edition, Asian Development Bank, Manila, Philippines, 1993.

Asian Development Bank, Energy Indicators of Developing Member Countries of ADB, Asian Development Bank, Manila, Philippines, 1992.

Asiaweek, Short of Breath, Asiaweek, March 24, 1993, pp. 50 - 54.

Asiaweek, The Asian Way, Asiaweek, March 2, 1994, pp. 22 - 25.

Asiaweek, Wise Men of the New Asia, March 2, 1994, pp. 25.

Astbury, Sid, Shifting Out of Overdrive, Asian Business, March 1993, pp. 36 - 46.

Astbury, Sid, KL Stresses the Realities of Research, Asian Business, August 1993, pp. 10.

Astbury, Sid, and Selwyn, Michael, How Malaysia Aims to Dazzle, Asian Business, February 1993, pp. 22 - 27.

Baker, Barbara, D., and Battle, Ellen, F., Demand Side Management for Electricity: Pushing Back Barriers, Canadian Energy Research Institute, Canada, 1992.

Bello, Walden, F., Dragons in Distress - Asia's New Miracle Economies, Institute for Food and Development Policy, San Francisco, 1990.

Berlamino, Cheri, Designing the Qualitative Research Project: Addressing the Process Issues, Warner-Lambert Company, 1990.

Bevington, Rick, and Rosenfeld, Arthur, H., Energy for Buildings and Homes, Scientific American, Volume 263, Number 3, September 1990, pp. 77 - 86.

Bhattarai, Gopal, B. and Shrestha, Ram, M., Electricity planning with demand-side management in Nepal, Energy Policy, July 1993, pp. 757 - 766.

British Petroleum Company, BP Statistical Review of World Energy, Employee Communications and Services, London, England, 1993.

Chateau, B., and Lapillonne, B., Energy Demand: Facts and Trends, Springer-Verlag Wien, New York, 1982.

Cherniack, Mark, Kraft-Oliver, Terry, and McDonald, Susan, In the Philippines: Setting the Stage for Conservation, E-Notes, Volume III, No. 4, October -- December 1993, pp. 3.

Chou, S.K., and Ho, J.C., A National Strategy for Energy Management in Singapore, Energy, Volume 10, Number 9, 1985, pp. 1017 - 1985.

Consumers Association of Penang, The Bakun Dam controversy, Utusan Konsumer, Penang, Malaysia, December 1993, pp. 6 - 7.

Consumption likely to rise, The Star, March 23, 1993.

Crovitz, Gordon, L., Nobody Elects the Press - Mahatir speaks out on media, culture and trade, Far Eastern Economic Review, April 7, 1994, pp. 20 - 21.

Cushing, D. H., and Walsh, J. J., The Ecology of the Seas, Blackwell Scientific Publications, Oxford, 1976.

Davidson, Mark, Ecological Considerations of the Solar Alternative, University of California, Berkeley, California, 1977.

Davis, Ged, R., Energy for Planet Earth, Scientific American, Volume 263, Number 3, September 1990, pp. 55 - 62.

DeCicco, John, M., Bernow, Stephen, S. and Beyea, Jan, Environmental concerns regarding electric power transmission in North America, Energy Policy, January 1992, pp. 30 -39.

Demand peaks in a normal weekday, The Star, March 23, 1993.

Department of Administration - State Energy Office, A Planner's Handbook on Energy (With Emphasis on Residential Users), State of Florida, 1975

Department of Electricity Supply, Annual Report 1992, Government Publishers, Kuala Lumpur, Malaysia, 1992.

Department of Electricity Supply, The National Energy Efficiency Efforts, Energy, Research, Engineering, Development and Commercialisation Forum, November 1993.

Department of Statistics, Malaysia, Yearbook of Statistics 1992, Government Publishers, Kuala Lumpur, Malaysia, July 1993.

Derauh, Dr. Harun (editor), Information Malaysia, 1992 - 93 Yearbook, Berita Publishing Sdn. Bhd., Kuala Lumpur, Malaysia, 1992.

Economic and Social Commission for Asia and the Pacific (ESCAP), Energy Conservation in the Commercial and Domestic Subsectors, United Nations, New York, 1992.

Economic and Social Commission for Asia and the Pacific (ESCAP), State of the Environment in Asia and the Pacific 1990, United Nations, New York, 1992.

Electricity Generating Authority of Thailand, General Information EGAT Power Development Plan, Systems Planning Department, Government of Thailand, September 1992.

Fesharaki, Fereidun, The Energy Supply and Demand Outlook in the Asia-Pacific Region, East-West Centre, Honolulu, Hawaii, May 1992.

Fesharaki, Fereidun, and Sharma, Shankar (editors), Energy Markets and Policies in ASEAN, Institute of Southeast Asian Studies, Singapore, 1991.

Fickett, Arnold, P., Gellings, Clark, W., and Lovins, Amory, B., Efficient Use of Electricity, Scientific American, Volume 263, Number 3, September 1990, pp. 65 - 74.

Freedman, Bill, Environmental Ecology - The Impacts of Pollution and Other Stresses on Ecosystem Structure and Function, Academic Press, Inc., SanDiego, 1989.

Goldemberg, Jose, and Reddy, Amulya, K. N., Energy for the Developing World, Scientific American, Volume 263, Number 3, September 1990, pp. 111 - 118.

Government of Malaysia, Sixth Malaysia Plan 1991 - 1995, National Printing Department, Kuala Lumpur, Malaysia, 1991.

Greenbaum, Thomas, L., Outside moderators maximize focus group results, Public Relations Journal, September 1991.

Hafele, Wolf, Energy from Nuclear Power, Scientific American, Volume 263, Number 3, September 1990, pp. 136 - 144.

Hall, June, D. and Arthur J. Hanson, A New Kind of Sharing - Why We Can't Ignore Global Environmental Change, International Development Research Centre, Ottawa, Canada, 1992.

Hirst, Eric, and Reed, John, The Role of Evaluation in Creating the Analytical Foundation of Utility Demand-Side Management Programs, Energy Systems and Policy, Volume 15, September 1992, pp. 257 - 267.

Hooper, Martha, C., In Crisis or Calm, Focus Groups Hit the Mark, Association Management, March 1989, pp. 117 - 119.

Hunaker, Karen, The Focus Group, Association Management, August 1991, pp. 53 - 57.

Idris, Mohamed, S.M., Malaysian Consumers and Development, Consumers Association of Penang, Sun Printers Sdn Bhd, Penang, Malaysia, 1986.

International Energy Agency, Natural Gas Prospects and Policies, International Energy Agency, Paris France, 1991.

International Institute for Energy Conservation, Demand Side Management for Thailand's Electric Power System -- Five-Year Master Plan, International Institute for Energy Conservation, Bangkok, Thailand, November 1991.

James, William, E., Energy Conservation in the Asian Region, Asian Productivity Organization Resource Systems Institute, East-West Centre, Tokyo, Japan, 1991.

Jayakrishnan, S., Crucial area in economic growth and environmental impacts, New Sunday Times, Kuala Lumpur, Malaysia, February 13, 1994.

Jayasankaran, S., High Tension, Far Eastern Economic Review, September 1, 1994, pp. 60 - 64.

Katayama, Hans, Asia's Energy Crunch, Asia, Inc., August 1992, pp. 30 - 35.

Kuliasha, Micheal, A., International Energy Conference on Use of Efficiency Standards in Energy Policy Proceedings - Opportunities and Prospects for Energy Efficiency in Asian Countries, International Energy Agency & Organization for Economic Cooperation and Development, Paris, France, 1992.

Lee, Joycelyn, Time has come for the efficient use of energy, New Sunday Times, Kuala Lumpur, Malaysia, February 13, 1994.

Lefevre, Thierry (editor), Sectoral Energy Demand Studies in Asia, United Nations Development Program, Bangkok, Thailand, 1992.

Leng, Goh, Kim and Yoke, Teh Hoe (editors), Malaysia's Economic Vision - Issues and Challenges, Pelanduk Publications, Petalying Jaya, Malaysia, 1992.

Lovins, Amory, B., Soft Energy Paths - Toward a Durable Peace, Friends of the Earth International, San Francisco, 1977.

Majid, Shaik Osman, Ensuring strong vibrant growth, New Straits Times, Kuala Lumpur, Malaysia, October 30, 1993, pp. 1.

Malaysian Business Council, Malaysia, the Way Forward (speech by YAB Dato' Seri Dr. Mahathir Mohamad), Prime Minister of Malaysia, Setiakawan Printers Sdn. Bhd., Malaysia, 1991.

Meinert, David L., Energy Conservation in Housing, Vantage Press, New York, 1990.

Meyers, Stephen, et al, Evolution of the Power Sector in 13 Major Developing Countries, Lawrence Berkeley Laboratory, Berkeley, California, September 1989.

Ministry of Energy, Telecommunications and Posts, Malaysia, National Energy Balance Malaysia 1980 - 1991, Masadah Sdn. Bhd., Malaysia, 1991.

Ministry of Energy, Telecommunications and Posts, Malaysia, Project Information - Bakun Hydroelectric Project, March 1986.

Ministry of Energy, Telecommunications and Posts, Malaysia and Tenaga Nasional Berhad, Energy Efficiency Seminar '93, Kuala Lumpur, Malaysia, 1993.

Ministry of Foreign Affairs, National Steering Committee on Environment and Development, Country Report Malaysia, Setiakawan Printers, Malaysia, May 1992.

Monk, Tracie, E. and Tinker, Elizabeth Hernandez, Southeast Asia - The Future is Now, Private Power Executive, July - August 1993, pp. 16 - 31.

Ng, Cheng Cheong, Singapore Energy Consumption and Conservation, Energy, Volume 5, Number 8, 1981, pp. 759 - 764.

O'Brien, Dr. Dennis J., Asia Pacific Oil Markets in the 1990's: Implications for the Region, National Petroleum Refiners Association, 1990.

Ohmae, Kenichi, The Borderless World - Power and Strategy in the Interlinked Economy, Harper Collins Publishers, London, 1990.

Parkaran., K., 5pc Tenaga rebate for six month, The Star, November 18, 1993.

Pertz, Kalus, J., editor, Policies for Rational Use of Energy, McGraw Hill Book Company, Singapore, 1989.

Powell, Bill, Who Needs Democracy?, Newsweek, November 22, 1993, pp. 25.

Ramani, K.V., Hills, Peter, and George, Grace (editors), Burning Questions: Environmental Limits to Energy Growth in Asian-Pacific Countries during the 1990s, Asian and Pacific Development Centre, Kuala Lumpur, Malaysia, 1992.

Reddy, A.K.N., Barriers to Improvements in Energy Efficiency, Asian and Pacific Energy Planning Network, Asian Pacific Development Centre, Kuala Lumpur, 1992.

Regional Energy Resources Information Center (RERIC), Energy Efficiency in ASEAN Countries: A Survey, RERIC News, Volume 16, No. 2., June 1993, pp. 1 - 4.

Rowley, Anthony, et al, Energy - Heart of Darkness, Far Eastern Economic Review, January 28, 1993, pp. 44 - 46.

Samdani, Justice K. M. A., and Armstrong, J. R., Energy Conservation Legislation in Developing Countries, International Energy Conservation Symposium Proceedings, Pakistan, 1988.

Sani, Sham, Environment and Development in Malaysia - Changing Concerns and Approaches, Institute of Strategic and International Studies, Kuala Lumpur, Malaysia, 1993.

Sharma, Shankar, and Tan, Joseph (editors), Global Oil Trends - The Asia-Pacific Market in the 1990s, Institute of Southeast Asian Studies, Singapore, 1991.

Shrestha, Ram M., Environmental Implications of Electricity Supply in Selected Asian Countries, Asian Institute of Technology, Bangkok, Thailand, 1990.

Singh, Daljit (editor), Southeast Asian Affairs 1992, Institute of Southeast Asian Studies, Singapore, 1992.

Singh, Daljit (editor), Southeast Asian Affairs 1993, Institute of Southeast Asian Studies, Singapore, 1993.

Tai, Dominic, Letters, Far Eastern Economic Review, January 20, 1994, pp.4.

Tenaga Nasional Berhad, Corporate Report 1992, Tenaga Nasional Berhad, Kuala Lumpur, Malaysia, 1992.

Tenaga Nasional Berhad, Information Booklet, Tenaga Nasional Berhad, Kuala Lumpur, Malaysia, 1992.

Tsuruoka, Doug, Hey, big spenders, Far Eastern Economic Review, July 9, 1992, pp. 9.

Tsuruoka, Doug, Less haste, less speed, Far Eastern Economic Review, January 7, 1993, pp. 61.

Tsuruoka, Doug, National Gridlock - Malaysian, Singapore power cuts stir controversy, Far Eastern Economic Review, October 15, 1992, pp. 15.

Tsuruoka, Doug, Not so fast - Malaysian growth slows from breakneck pace, Far Eastern Economic Review, February 25, 1993, pp. 25.

Tsuruoka, Doug, Power Plays - Environment lobbies challenge big projects, Far Eastern Economic Review, January 28, 1993, pp. 48.

Vale, Brenda and Robert, Green Architecture - Design for a Sustainable Future, Thames and Hudson, London, 1991.

Valigra, Lori, Matsushita: new markets for an old master, Far East Business, June 1989, pp. 39 - 43.

Vatikiotis, Michael, Less haste, less speed, Far Eastern Economic Review, January 7, 1993, pp. 61.

Webster, Douglas R., The Rise of the Urban Middle Income Group: Implications for the Reversal of Urban Environmental Degradation in ASEAN Cities, 1992.

Weinberg, Carl, J., and Williams, Robert, H., Energy from the Sun, Scientific American, Volume 263, Number 3, September 1990, pp. 147 - 155.

World Health Organization, WHO Commission on Health and Environment, Report of the Panel on Energy, Geneva, 1992.

World Resources Institute, World Resources 1992 - 93, Oxford University Press, Oxford, 1992.

Zeisel, John, Inquiry by Design - Tools for Environment-Behavior Research, Cambridge University Press, Cambridge, 1991.

Zhai, Dr. Y., Household Energy Demand in Selected Asian Developing Countries: A Comparative Analysis, Energy Technology Division, Asian Institute of Technology, March 1991.

UNPUBLISHED SOURCES OF INFORMATION

Papers

Energy Conservation in Singapore, paper presented by Abdul Rashid bin Ibrahim, Head of the Energy Conservation Division, Corporate Planning Division, Public Utilities Board, at the seminar on Efficient Energy Utilizations, Conservation and Options, Singapore, March 20, 1992.

Energy Efficient Technology, paper presented by Gabrielle E. Powell, P.E., Engineering Manager, Southeast Asia, The Bentley Company, at the Energy Efficiency Conference, Kuala Lumpur, Malaysia, October 11, 1993.

Natural Gas as a Viable Energy Use For Industries, paper presented by Ken Kawakubo, General Manager Marketing, Gas Malaysia Sdn. Bhd., at the Energy Efficiency Conference, Kuala Lumpur, Malaysia, October 12, 1993.

The National Energy Efficiency Efforts, paper presented by Ir Mohd Annas bin Haji Mohd Nor, Director General Department of Electricity Supply, at the Energy, Research, Engineering, Development, and Commercialisation Forum, Langkawi, Malaysia, November 26, 1993.

Presentations

Energy Efficiency speech made by Amory B. Lovins at The Institute for Strategic and International Studies, Kuala Lumpur, Malaysia, 1990, (recorded on tape).

PERSONAL COMMUNICATION

Puan Aminah Ang, Research Officer, Standards and Industrial Research Institute of Malaysia, November 30, 1993, Kuala Lumpur, Malaysia.

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