

**ENERGY CONSERVATION PROGRAM IN GOVERNMENT  
BUILDING**

**PROGRAM PEMULIHARAAN TENAGA DI BANGUNAN  
KERAJAAN**

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FACULTY OF BUILT ENVIRONMENT  
UNIVERSITI TEKNOLOGI MALAYSIA

2009

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May this work contribute information and references for further possible actions aiming to improve energy efficiency practices in government building, reduced government burden on energy costs and lowering CO<sup>2</sup> emissions in Malaysia.

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## ABSTRACT

Buildings are responsible for at least 40% of energy used in most Countries. The absolute figure is rising fast, as construction booms, especially in developing countries including Malaysia. Since energy consumption is identified as one of the major cause in climate change issues, effort to reduce energy consumption in building is considered an important strategy. Energy conservation in building can be achieved through three strategies; i.e.; the physical design of the building; through electrical equipment used in the building; and the behaviour of the building users. This report discusses the study done on building user behaviour and practices in Energy Conservation. It is essential to investigate the status of awareness, knowledge and practices among building users because building users determine the pattern of energy consumption. Government of Malaysia has been actively developing policies, initiatives and programs in energy conservation not only to improve Energy Efficiency practices in the country but also in combating global warming through the reduction of fossil fuel consumption in building sector. Government also set 10% reduction target of energy consumption in all government building in 2006. However the response by the public is still slow. This report presents the investigation carried out on the level of awareness and practices among government employees. The survey has been carried out on employee to examine the level of understanding and the initiatives organised in government offices. The results show that, up to 70% of government employee understand about energy and 85% understand EE, however practices on energy conservation individually and collectively are still low (about 50%). This can be the reason why the program initiated by the government cannot be implemented successfully. Other reason for the low EE practice is due to the lack of initiative and program within the organisation/department. The report also suggests that strategies to organise training and campaign should be done to increase Energy Conservation Practices among government employees to achieve EE target set by the government.

**Keywords:** Energy Conservation, Energy Efficiency, Awareness & user behaviours, Education, Government Building.

## ABSTRAK

Bangunan menggunakan sekurang-kurangnya 40% jumlah tenaga dikebanyakan Negara. Jumlah tersebut meningkat dengan cepat disebabkan pesatnya pembinaan, terutama di Negara-negara membangun termasuk Malaysia. Oleh kerana penggunaan tenaga dikenalpasti sebagai satu dari penyebab utama kepada “Perubahan Cuaca”, usaha untuk mengurangkan adalah strategi yang penting. Pemuliharaan tenaga di bangunan boleh dicapai melalui tiga strategi; iaitu rekabentuk fizikal bangunan, melalui penggunaan alatan elektrik pada bangunan, dan cara pengguna menggunakan bangunan. Laporan ini membincangkan kejain yang dijalankan ke atas sikap dan amalan pengguna bangunan berkaitan pemuliharaan tenaga. Adalah penting untuk mengkaji status kesedaran, kefahaman dan amalan dikalangan pengguna bangunan, kerana pengguna bangunan menentukan corak penggunaan tenaga di bangunan. Kerajaan Malaysia telah aktif membangunkan polisi, inisiatif dan program dalam pemuliharaan tenaga bukan sahaja untuk meningkatkan Kecekapan Tenaga (KT) di dalam negara malah untuk menangani Kepanasan Global melalui pengurangan penggunaan bahan api fosil di sektor bangunan. Kerajaan telah mensasarkan 10% penurunan di semua bangunan kerajaan pda tahun 2006. Walaubagaimanapun tindakbalas dari orang awam masih lambat. Laporan ini mempersembahkan kajian terhadap kesedaran dan amalan dikalangan kakitangan kerajaan. Soalselidik telah dijalankan ke atas kakitangan kerajaan untuk mengkaji tahap kefahaman dan inisiatif yang dijalankan di pejabat-pejabat kerajaan. Kajian mendapati sehingga 70% kakitangan kerajaan memahami mengenai tenaga dan 85% memahami kecekapan tenaga. Walau bagaimanapun amalan terhadap pemuliharaan tenaga masih rendah (sekitar 50%). Ini berkemungkinan menjadi sebab mengapa program yang dicadangkan kerajaan tidak dapat dijalankan secara berkesan. Sebab lain mengapa amalan KT yang rendah adalah disebabkan kurangnya inisiatif dan program oleh organisasi/jabatan dalam pejabat kerajaan. Laporan ini mencadangkan strategi untuk mengadakan latihan dan kempen bagi meningkatkan amalan pemuliharaan tenaga dikalangan kakitangan kerajaan bagi mencapaio sasaran KT yang ditentukan oleh kerajaan.

**Katakunci:** Pemuliharaan tenaga, Kecekapan Tenaga, Kesedaran & Sikap Pengguna, Pendidikan, Bangunan Kerajaan.

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## LIST OF ABBREVIATIONS

Btu	-	British Thermal Unit
CETREE	-	Centre for Education and Training in Renewable energy and Energy Efficiency
CER	-	Certified Emission Reduction
CDC	-	Curriculum Development Centre, MoE
DANCED	-	Denish Co-operation for Environment and Development
EC	-	Energy Conservation
EE	-	Energy Efficiency
EAGB	-	Energy Audit in Government Buildings Project
EMP	-	Energy Management Program
ESM	-	Energy saving measures
GhG	-	Green house gases
HVAC	-	Heating Ventilation and Air-conditioning
KeTTHA	-	Ministry of Energy, Green Technology and Water
LEO	-	Low Energy Office
MEU	-	Mobile Exhibition Unit
MoE	-	Ministry of Education
MoF	-	Ministry of Finance (Malaysia)
MEWC	-	Ministry of Energy, Water and Communication
NST	-	New Strait Taime Press
PTM	-	Malaysia Energy Centre
RE	-	Renewable Energy
RH	-	Relative Humidity
ST	-	Energy Commission (Malaysia)
USM	-	Universiti Sains Malaysia
UTM	-	Universiti Teknologi Malaysia.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Research Background**

Energy Efficiency (EE) is defined as technologies and measures that reduce the amount of electricity and/or fuel required to do the same work, such as powering homes, offices and industries (ruralresidentialliving.com.au 2008).

EE can also be defined as designing buildings to use less energy for the same or higher performance as conventional buildings. All building systems can contribute to higher energy efficiency (galleyecocapital.com 2008).

Buildings are responsible for at least 40% of energy use in most Countries (George David et.al, 200x). The absolute figure is rising fast, as construction booms, especially in countries such as China and India. It is essential to act now, because buildings can make major contribution to tackle climate change and energy usage.

Since climate change issue has been a pertinent issue discussed in many platforms and meeting of top government worldwide, Malaysia is not silent in this issue. As a rapid developing country, Malaysia has been seriously involved in programs related to energy usage and initiatives in reducing fossil fuel consumptions.

Policies, initiatives and programs have been developed and implemented continuously through several agencies.

One of the focused sectors in combating global warming is through the reduction of fossil fuel consumption in building sector. Below is Malaysia's national policy on energy (1979) which focuses on three (3) principle objectives:-

- Supply Objective : Ensure the provision of adequate, secure and cost-effective energy supply
- Utilisation Objective: Promote the efficient utilization of energy and the elimination of wasteful and non-productive patterns of energy consumption
- Environmental Objective : Minimize negative impacts of energy production, transportation, conversion, utilization and consumption on the environment

In the 2006 budget (MoF 2006), the Prime Minister of Malaysia has stated that

- *"...measures will be taken to promote efficient usage of energy and avoid wastage..."*
- *... "all government agencies will be given target to save 10% of their energy consumption in 2006..."*

For 2008 budget the Prime Minister and Minister of Finance (YAB Dato' Seri Abdullah Hj Ahmad Badawi) on the 7<sup>th</sup> September 2007 stated that (MoF 2007),;

- (117).... To further **promote energy efficiency** and the use of renewable energy, the Government proposes several significant improvements in terms of tax incentives, including increasing the Investment Tax Allowance on expenditures for energy conservation and energy saving initiatives for company use.
- (118).... Malaysia **has the potential to gain from investments made to reduce greenhouse gas emission that contribute to global warming**. Under the Kyoto Protocol, companies that succeed in reducing emission of greenhouse gases are given a certificate of Certified Emission Reduction (CER) which can be traded. To encourage companies to participate in this project, income derived from trading of CER certificates will be given tax exemption.

The above references, clearly state that the Malaysian government has initiate certain effort in promoting EE in building sector. This also reflects government's concern on utility spendings. The Malaysia Federal Government is also identified as one of the

single largest consumer of energy (mainly electricity). Currently the government pays RM1.2 billion per year on electricity bills, RM9.5 million per year on power factor penalty and most Government buildings use more energy than they need and saving more than 10 % of energy is definitely attainable. It is believed that with the above spending, Good House keeping and good maintenance program could provides effective energy saving with NO or minimum cost (Henrik Rytter Jensen 2000).

#### Electricity Consumers in Commercial Buildings

Consumption Range Per Annum (kWh)	Government		Non-Government	
	No. of Installation	MWh	No. of Installations	MWh
10,000,000	28	498.74	83	1492.44
9,000,000	7	66.02	15	142.03
8,000,000	6	51.52	25	161.45
7,000,000	4	30.69	30	222.6
6,000,000	11	70.18	41	265.27
5,000,000	10	53.20	51	275.95
4,000,000	17	76.93	111	492.05
3,000,000	26	90.33	153	525.41
2,500,000	31	83.99	137	290.36
<b>Total</b>	<b>140</b>	<b>1,021.60</b>	<b>646</b>	<b>3,867.56</b>

Table 1a: Government and non-government installation and energy consumption.

Comparing to other country, Malaysia is currently one of the country which has high energy intensity. The graph below comparing Malaysia with other Asian counties and Japan.

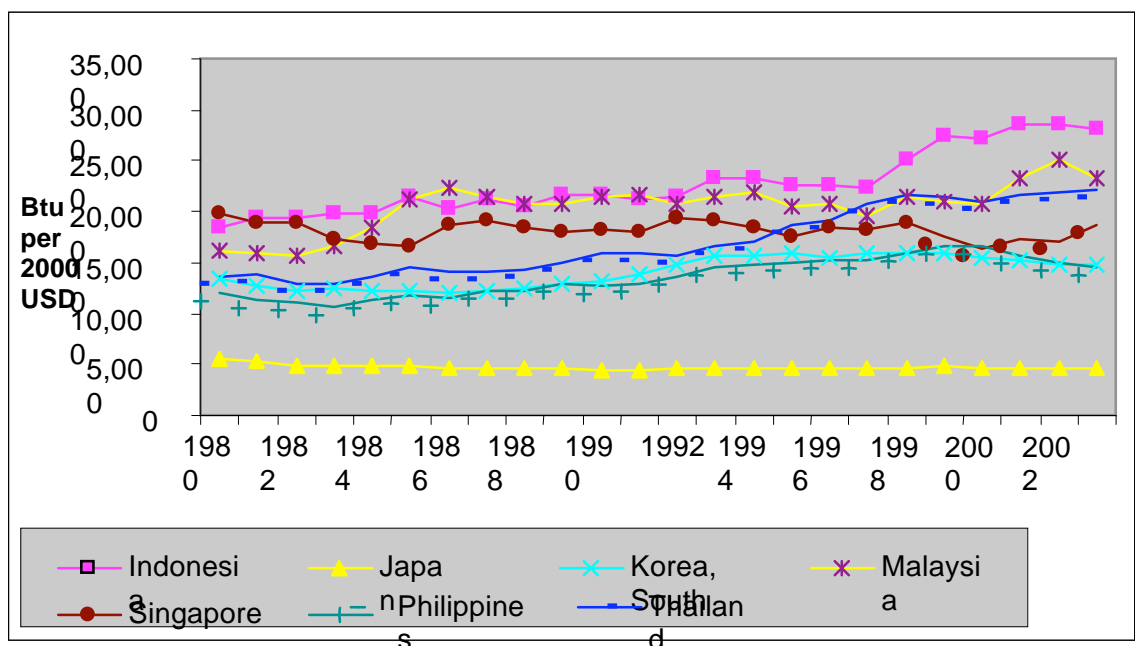


Fig 1a: Total Primary Energy Consumption Per Dollar of Gross Domestic Product, 1980-2003 (Btu per 2000 U.S. Dollars Using Market Exchange Rates)

Source: Table E1g – World Primary Energy Consumption (Btu), 1980-2003, Energy Information Administration, USA <http://www.eia.doe.gov>

Starting from the year 2007, the government had organised a national campaign on EE. November 2007 was announced as ‘energy month’. 1<sup>st</sup> November 2007 marked the official launch which was done at Berjaya Time Square Hotel & Convention Centre Kuala Lumpur (Ministry of Energy 2007).

This effort shows the seriousness of government to implement EE especially in government building and sectors. A five million ringgit project of Energy Audit in Government Buildings has been implemented for a span of five years. Some of the stated objectives are to create awareness and disseminate relevant information regarding energy efficiency (EE) among the government organizations and implementation of energy saving measures.

## 1.2 The Problem Statement

The consumption of electricity in Malaysia shows continuous increase since 1980’s. New development, new areas for residential, commercial and industrial in general are the main reason. Low knowledge on EE among building operators and users (government employees) is the reason for high energy consumption in government building apart from the building design that does not consider ‘low energy building’ design.

The government of Malaysia through its agencies have developed EE awareness program to increase public and private participation on EE programs focuses industrial, commercial and public sectors. Some of the strategies and programs include;

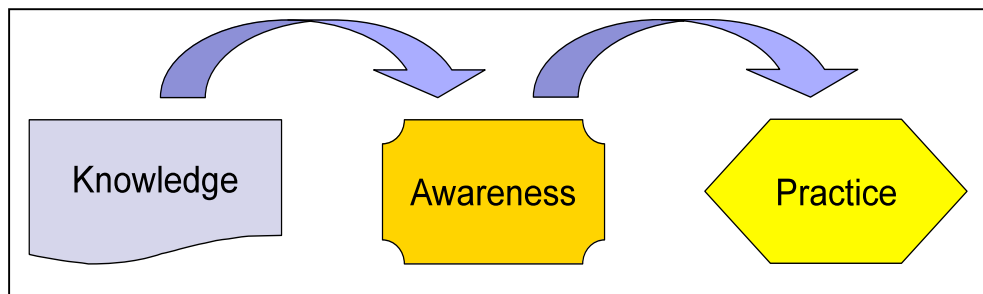
- Enforcement of the EE Regulation
- Extension of Financial, Fiscal Incentives & Demonstration projects
- Demand Side Management (Retrofit & District Cooling Programmes, Load Management & Appliance Labeling).

- Establishment of key agencies to promote and implement EE & RE programs.

Despite these efforts, what is the impact on public and government employees awareness and practices? They must play a major role in helping to achieve EE target set by the government.

### 1.3 Research Hypothesis

We believe that the government policies and objectives could not be achieved successfully without clear and systematic implementation of Energy Conservation Program throughout government offices nationwide. The program should not only promote **awareness** but also improve **knowledge and practices** among employees. In every office, the program should be lead by the top officers in each department.



*Figure1b: Knowledge, Awareness and Practice Relationship.*

According to a study on **Malaysian public awareness and practices** on RE & EE done by the Centre for Education and Training in Renewable energy and Energy Efficiency (CETREE) to Malaysian **General Public in 2001 and Malaysian Teachers in 2002**, revealed that the average of 42.6% of the general public did not know how to explain energy and **approximately 84.8% of the general public had no understanding of energy efficiency** (Mohd Zin 2003).

Knowledge	General(%)	Teacher(%)
Explain energy	57.4	61.5
Energy efficiency	15.2	57.9
Energy efficiency appliance	27.3	63.6
Identify appliance with EE features	16.6	39.6

Understand renewable energy	21.8	50.4
-----------------------------	------	------

Table 1b: Summary of the result on EE awareness survey.

The study was not done to the government office employee in the government administrative building.

The hypothesis of this study is that; Government employees in general have inadequate or low knowledge, awareness and practices on Energy Efficiency (EE). This can be a reason for the ineffectiveness of the government Energy Conservation or EE policies & programs. Hence **the aim of this study is to prove the hypothesis** and come up with some recommendation and policies related to the fundamental aspect such as **training, campaign and awareness must be developed and implemented** before any policy can be proposed.

#### 1.4 Research Questions

The study is based on several government intentions and policies on EE as discussed in paragraph 1.1. The prime question is whether the government has achieve its target or the very fundamental question is whether among government employees are aware of their responsibilities to achieve EE target?

To limit the study, the following questions will be addressed:-

- Q1. What is the level of awareness & knowledge on energy among government employee?
- Q2. Is the awareness & knowledge on EE among government employee at sufficient level?
- Q3. Is there any effort or initiative organised to improve EE awareness and knowledge among government employees?
- Q4. Is there any policy or mechanism related to EE program and how are the information delivered to the general staff level in their organisation?
- Q5. What is the level of practices on EE in their own home and in the office? Is there any relationship?

- Q6. Does knowledge & awareness on energy & environment lead towards their EE practices in their office?
- Q7. What are their opinions on EE program in their office and what should be the possible steps to improve EE practices?
- Q8. What are their limitation, support requirement and options to implement EE practices?

**Awareness** is defined by having knowledge; conscious; informed; alert; knowledgeable; mindful or heedful: Aware implies knowledge gained through one's own perceptions or by mean of information. Awareness is also defined as alert, stresses quickness to recognize and respond,

**Knowledge** in the other hand is a noun that mean acquaintance with facts, truths, or principles, as from study or investigation. Knowledge is also understood as familiarity or conversance, as with a particular subject or branch of learning. Acquaintance or familiarity gained by sight, experience, or report. Knowledge is also understood as the fact or state of knowing; the perception of fact or truth; clear and certain mental apprehension.

**Practices** in the other hand is habitual or customary performance; operation. Practices can been seen as repeated performance or systematic exercise for the purpose of acquiring skill or proficiency. **Practices** are a condition arrived at by experience or exercise, the action or process of performing or doing something. These nouns denote patterns of behavior established by continual repetition. Habit applies to a behavior or practice so ingrained that it is often done without conscious thought

## 1.5 Research Objective

1. To determine the **level of awareness, knowledge and practices** among **building operators** in government building.
2. To determine the **level of awareness, knowledge and practices** among **users or occupants** in government building.

3. To find out whether the EE policies made by the government is implemented in all government offices.
4. To find out any reason and implication of such situation.
5. To recommend any possible strategy & solution to the problems.

## **1.6 Scope and Limitations**

The scope of this study is to investigate the level of knowledge, awareness & practice among government employee. The field survey is done in government office in Johore. Since there are enough representation of all government agencies in Johore including all Federal and State government agencies, the study is considered to represent the whole government staff in Malaysia.

## **1.7 Importance of the Research**

Through out the years, there are always statements and promises from the government and through its representative to improve EE and to increase environmental performance in the country. Well known notion “Leading by Example” in Malaysian administration, the government sector should set the best example in practicing EE in government offices before private sectors are requested to do so. Due to this reason, the outcome of this study is very important and will reveal the level of awareness, knowledge and practices among government employees. The study will also discover the mechanism required, ensuring the stated EE effort can be implemented throughout the whole division of government machineries. The findings of this study will also provide important alternative to tackle any weaknesses and problems associated to the inefficient use of energy to combat wasteful culture in government offices.

## **1.8 Organization of this Research Report**

The study is divided into five chapters as summarized below;



**Chapter one** introduces the main issue of this research. This chapter discusses the research background, problem statements, hypothesis of the study, research questions, objective, scope and limitations of the study, importance of the research and the overall study structure is also presented in this chapter.

**Chapter two** presents the literature review of EE theory and concept, condition and status of study in EE awareness, knowledge and practices among people in Malaysia. This chapter introduces an overview of Malaysian behavior on EE.

**Chapter three** discusses the research design and the methodology implemented in the study. The justification of selecting the methodology for this study is also elaborated. Further, development of the survey procedures, assumptions, limitations, condition and the overall setting-up of the sampling are also described. The reliability and validity of the methods are also discussed. The estimation of the sampling for the research is also presented. Finally, the data analysis criteria are discussed, which is used to analyze the results of the study.

**Chapter four** presents the results and analysis of the current situations. The principle findings of the study are also summarized. The results of the research are analyzed as follows :

- examine respondent's general knowledge on energy & EE
- examine respondent's specific knowledge on energy & EE
- Examine respondent's commitment based on his/her knowledge & practices on EE at his own individual level as well as his/her surrounding.

**Chapter five** concludes the study by summarizing the major findings of the study. It also outlines the suggestions for future research.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0. Introduction**

This chapter review terms, definitions and background of the energy conservation (EC). EC policies, strategies and program in Malaysia are also discussed.

#### **2.1. Overview on Energy Conservation (EC) and Energy Efficiency (EE)**

Energy efficiency (EE) is a generic term which refers to using less energy to produce the same amount of services or useful output (Patterson, 1996).

In commercial buildings, energy cost is one of the highest utility operating cost elements. As occupant's satisfaction remains priority in office building, they require high indoor air quality and good lighting in most part of the buildings. In a tropical climate such as Malaysia, moisture control is one of the primary air quality issues in office buildings. Without an integrated approach to EE in the whole building design, equipment selection and operations, this would easily lead to an excessively high level of air-conditioning loads, which represent the highest energy end-uses in office (between 60 and 70% of the total electricity consumption).

Figure 2a Shows continuous increase of energy consumption in three sectors which one way or another also reflects the practices of consuming energy consumption by Malaysian population.

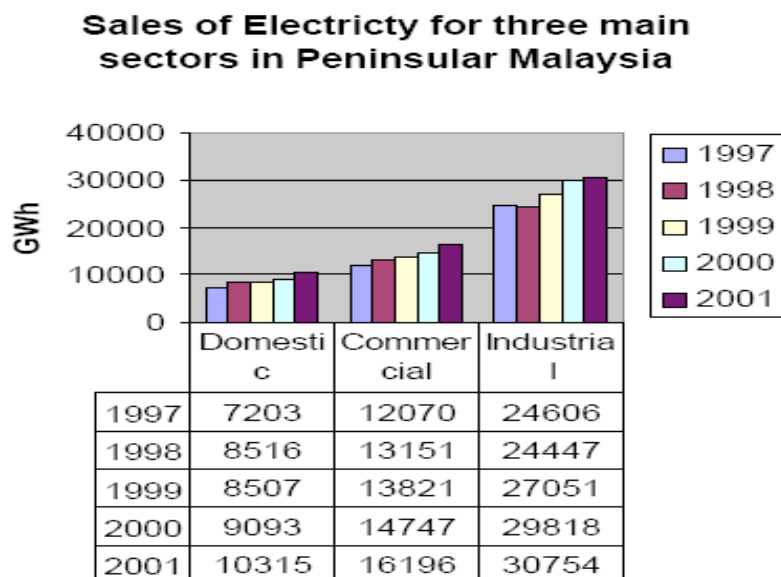


Figure 2a : Sale of Electricity in Malaysia

In residential sector, a study in 1998 estimated that an average family in a low cost house spends about RM65 per month, while the electricity in the medium cost house is approximately RM110 per month, and in a bungalow can go up to RM350 per month. The electricity consumption per household depends very much on family size, living habits, number and age of electrical appliances and their hour of use. Wise use of electricity, as well as the use of efficient appliances will reduce energy, hence the electricity bills (Faridah bte Mohd Taha, 2003).

In general, Energy Efficiency (EE) in commercial buildings is usually associated with a high comfort level, while not compromising the indoor air-quality. If considered early in the design stage of the office building, EE measures are easier and relatively cheaper to implement than retrofitting of currently operated office buildings. In addition, implementing sustainable EE program that integrates the EE into the building operations and maintenance is very effective in reducing energy operating costs in office buildings.

According to Anwar Al-Mofleh et.al (2009), there are three factors affecting Energy Efficiency; a). Design construction: Issues such as the layout of the building, its insulation standards, the efficiency of its services plant and the extent of automatic

controls; b). Operation and maintenance: Issues such as structural repairs, replacement cycles for consumable component, boiler servicing and the regular calibration/ adjustment of control system; c). Occupant activity: Issues such as how many equipment installed and how they are used, and staff working practices can also influence the amount of energy used for lighting and other building services.

Before this report discusses in detail issues related to occupant activities, it will discuss other issues related to not only building EE but also overall framework that determine EE issues in the country.

## **2.1 Policies**

The serious challenge of tackling climate change is by promoting clean energy and achieving Energy Efficiency (EE) in all sectors in the country including building sector. Without drastic measures, current national energy consumption would be 50% higher if energy efficiency program had not been put in place, based on estimates by the government. National energy demand is expected to grow by 60% over the next 25 years. Energy efficiency provides secure, reliable and affordable energy services that are fundamental to economic stability and development, and also helps to avoid the difficulties posed by rising energy demand in the country. As governments consider policies to reduce greenhouse gas emissions, energy efficiency must achieve its long identified promise.

This study establishes the hypothesis that energy efficiency measures failed to deliver 10% as anticipated savings targets by the government due to poor EE implementation program, including poor compliance and enforcement.

However, while there appeared to be broad awareness of the existence of a problem of poor compliance across a wide range of sectors and policy measures, many agencies are lack of available information to fully understand and quantify the extent of this problem. This applies also to evaluation-related information.

Although the need for credible information on the costs and benefits of energy efficiency programmed has never been more needed, the lack of knowledge about the real impacts is itself symptomatic of a lack of attention to adequate monitoring and evaluation procedures. Regarding the consequences of poor compliance, too often low rate of compliance with policy measures lead to a gap between the intended goals of a policy and its actual outcomes. Industry representatives also noted other serious consequences resulting from perceptions that compliance with both mandatory and voluntary policy measures are not being upheld. They noted that wholehearted participation by industry is threatened when investments in Energy Efficiency are not safeguarded by effective compliance regimes.

The risk of not addressing these issues is that government fails to meet targets for energy or greenhouse savings, or improvements to energy security. Yet examples also exist to indicate that it is possible to ensure effective and cost efficient compliance, monitoring and evaluation procedures. Measures to increase Public Awareness on Energy Efficiency and Energy Conservation in Malaysia are focuses on several sectors such as EE in Industrial, commercial and in building sectors.

Government of Malaysia has developed a policy on Energy (1979) stated that “the utilisation objective: To promote the efficient utilization of energy and the elimination of wasteful and non-productive patterns of energy consumption”. However there are no concrete measures such as setting up agency to carry out the task to achieve the above objective until late 1990’s.

## **2.2 Agencies & Program**

### **2.2.1 Malaysia Energy Centre (PTM).**

The setting of Malaysia Energy Centre (Pusat Tenaga Malaysia – PTM) in 1997, (Registered on 12 May 1998) as a not-for-profit company limited by guarantees, and not having share capital, is an important step. PTM was launched by the Prime Minister on 8<sup>th</sup> June 1999, and administered by the Ministry of Energy, Water and communication (MEWC), recently named as the Ministry of Energy, Green Technology and Water (KeTTHA).

PTM's key functions are as an agent for public and private energy sectors, guardian/repository of national energy database, "Think-tank" on energy through consultancy services, Promoter of national energy efficiency & renewable energy programmes and lead manager & coordinator in energy research, development and demonstration projects.

Among projects carried out by PTM includes Energy Audit in Government Buildings Project (EAGB) which started on 18<sup>th</sup> Aug 2002. It is a five (5) year RM 5-million Energy Audit in Government Building project.

The project objectives are to gather baseline data on energy consumption in government buildings, to promote a sustainable EE programme in the management of government buildings and start-up package for EE business and capacity buildings.

Other Objectives are to create awareness and disseminate relevant information regarding energy efficiency (EE) among the government organizations. Developed Energy Audit Guideline for Commercial Buildings and Technical Reference as part of the project was published. Ultimately the project wishes to demonstrate retrofitting building/ implementation of energy saving measures. However the awareness program was not successfully implemented.

On the 24<sup>th</sup> October 2000, Henrik Rytter Jensen DANCED Group Project Steering Committee presented Malaysian Energy Report of the Development of Malaysia Energy Management Program. He reported that Electricity consumption in Government facilities in West Malaysia an average of 70 Government facilities consume 500.000 kWh/month and about 900 Government facilities consume more than 50,000 kWh/month. From the selected government facilities table below shows potential savings with capital payback period of energy saving measures (ESM).

<b>Universiti Malaya</b>	<b>Energy Savings</b>	<b>Simple Pay Back Period</b>
Lighting	25%	6.4
Load Management	12%	6.8
VSD	18%	5.9
Aircon	20%	3.7

<b>Damansara Town Centre</b>	<b>Energy Savings</b>	<b>Simple Pay Back Period</b>
Air con	25%	4.0
Air handling Units	70%	1.4
Cooling Towers	18%	5.5
Lighting	23%	4.4

<b>Hospital Seremban</b>	<b>Energy Savings</b>	<b>Simple Pay Back Period</b>
Lifts - VSD	12%	6.8
Heat Storage	57.3	1.7

Table 2a: Energy Saving Potential of Selected building. Ref. (Henrik Rytter Jensen, 2000)

In term of Regulation to improve EE in building, Malaysia has published two publications on EE Standard or codes:-

- a). 1989 – Min. of Energy, Telecommunications and Posts issued Guidelines for EE in Buildings.
- b). 2001 - “Code of Practice on EE and Use of RE for Non-residential Buildings” – MS 1525: 2001 was introduced to promote EE practices in buildings.

In year 2000, the government shows their commitment by building a Low Energy Office (LEO) for Ministry of Energy, Water & Communications (MEWC) at par with their ‘Lead by example’ policy.

This is to increase knowledge and awareness on EE building design among the relevant professionals. LEO is Exemplary, EE building for future building in Malaysia where the design of the building incorporates extensive EE features for both passive and active.

### **2.2.2 Centre for Education and Training in Renewable Energy and energy Efficiency (CETREE).**

Further effort was made to create awareness and knowledge on RE & EE in Malaysia. In the 8th Malaysian Plan (2000-2005), the Centre for Education Training in Renewable Energy & Energy Efficiency (CETREE) is mentioned to be Malaysia's new Education and Training Center on RE & EE. The centre is established in October 2000 under the preview of the Ministry of Energy Water and Communication (now KeTTHA) of Malaysia. Supported by DANCED (Danish Cooperation for Environment and Development) until March 2004, KeTTHA as Executing Agency and Implementing Agencies is given to Ministry of Education (MoE) and Universiti Sains Malaysia (USM), (Mohd Zin et.al 2005).

The main objective of the establishment of the centre is to increase the role and utilisation of renewable energy and energy efficiency by way of creating and increasing awareness and knowledge on RE & EE.

CETREE functions as a national centre dedicated to promote the practice and application of RE & EE in the country via awareness activities, education and training program. Six (6) tasks group were established and each focus on specific tasks.



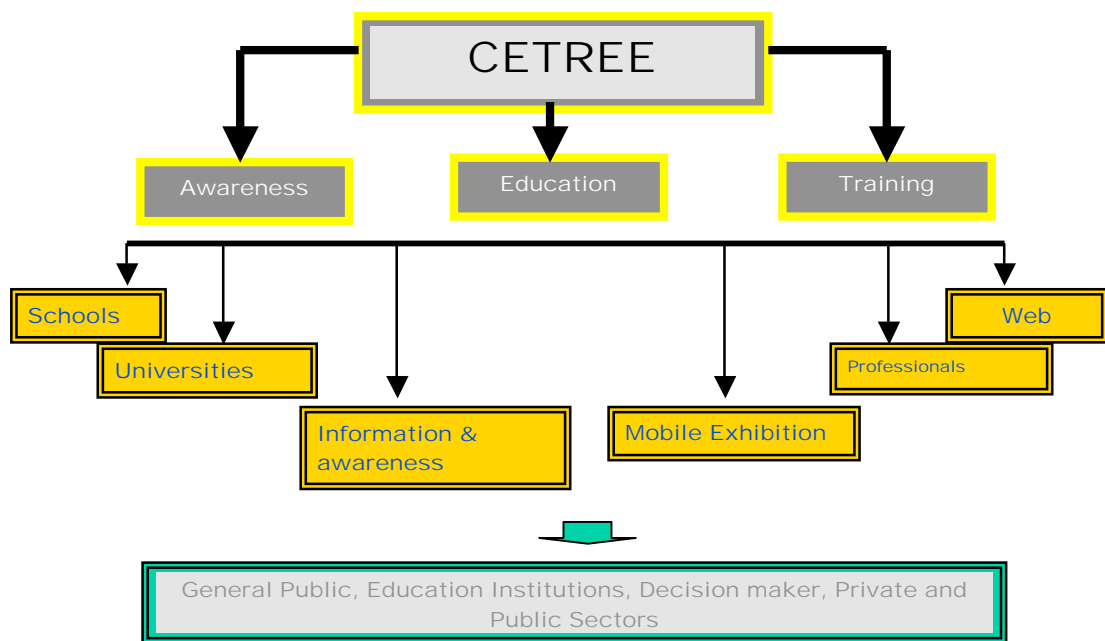


Figure 2b: CETREE functions and scope, (Mohd Zin, 2003a).

Since 2001 CETREE has developed teaching modules with Curriculum Development Centre (CDC) Ministry of Education develop & manufactured experimental kits, publication of teaching modules, train 80 education officers & 940 teachers

To further enhance awareness and knowledge CETREE has design and create Mobile Exhibition Unit (MEU) outreach demonstrating RE & EE hands-on educational experiment kits for students, teachers and general publics. Until 2005 about 500,000 students, 20,000 teachers and more 100,000 peoples from general publics were exposed with the exhibitions. CETREE continuing it activities with a bigger mobile vehicle and more demonstration program today.



Figure 2c: CETREE Mobile Exhibition Unit, (Mohd Zin, 2003a).

As part of the program, public awareness survey on energy, RE & EE were carried out and effort to increase public awareness on RE & EE was done.

Baseline Survey on RE&EE done by CETREE reveals that general public has low level of knowledge on EE (15.2%), (Mohd Zin, 2003).

Knowledge	General public (%)	Teacher (%)
Explain energy	57.4	61.5
Energy efficiency	15.2	57.9
Energy efficiency appliance	27.3	63.6
Identify appliance with EE features	16.6	39.6
Understand renewable energy	21.8	50.4

Table 2a: Percentage of awareness among general public and teachers in Malaysia



Figure 2d: Publications of RE&EE materials by CETREE for public & school consumption

Campaigns are also implemented in the form of newspaper campaign and competition. Between the years 2003 to 2006 CETREE continue to publish materials for public awareness, organising seminar on RE&EE, assisting journalist through workshop on writing articles and news on RE & EE to ensure general publics exposed with the issues of inefficient use of energy. Financial support is also applied to implement newspaper campaign, TV and radio spot.



Figure 2e: CETREE activities aiming to create awareness and to increase knowledge among its target groups.

In the 2008 budget (MoF, 2007) government also allocated RM9.7 bilion to carry out maintenance culture to improve effectiveness of public properties. In the 2009 budget (MoF, 2008) the government urged the public to improve the effort to improve the effectiveness of energy usage and expediting the development of renewable energy such as photovoltaic system. The government reduces import duty of RE equipment such as PV system and reduces tax on high efficient product such as efficient motors, fridge, air-conditioning, fan, television and insulations manufactured in Malaysia.

To ensure public awareness improvement on RE & EE, the Ministry of Energy Water and Communicatio together with CETREE, PTM & ST announced November 2007 as National Energy Month.





Figure 2f : National Energy Month Program 2007

In the speech (Ministry of Energy (2007), on 1st November 2007 the minister says, “Energy Month is an effort by the government to improve awareness and culture among Malaysian communities and further to protect a sustainable environment. The effort is also to promote effective use of energy”

With the continuous effort by the government agencies and institutions, government employees in Malaysia are expected to be exposed and receive the benefit of the EE awareness program.

## **2.3 Energy in Building**

The energy consumption in buildings is closely related to the climate. Malaysia's hot humid climate has main characteristics such as; a). Very small variation in monthly temperatures (less than 8°C); b). High temperature with mean daily temperature of the hottest month (February/March) is 27.8°C; c). Monthly humidity exceed 70% with a mean annual value of 83% with RH exceeds 55% most of the time; d). Wind speeds are quite low with a mean value of 1.2 m/s; and e). High rainfall exceeds 200 mm/month for 8 months in a year.

The above characteristics, occupants in commercial and office building require thermally comfortable. Almost all buildings in Malaysia have resorted to mechanical cooling technologies that inevitably consume high electricity. Building consumes approximately 40% of energy demand in the country.

Worldwide, buildings consume about one-third of the world's energy and the energy consumption for buildings is expected to grow from 45% in 2002 to 2025 (Klee, 2007). In the ASEAN region alone, commercial buildings consume well over one-third of all electricity and will account for more than 40% of the demand for additional generating capacity in the near future (MECM, 2001).

In Malaysia, the building industry produces about 20% of green house gases (GHG) the third after transportation (27%) and industries (21%) (NST, 2006). According to United Nation Development Programme's, Human Development Report 2007/2008, instead of reducing by 5% as committed in the Kyoto Protocol Malaysia's GHG emission was more than double the amount in 1990. According to the report, Malaysia ranked as the world's 26th largest emitter (NST, 2007). In Europe, buildings accounts for 40 to 45% of energy consumption and the emission of GHG into the environment. (Omer, 2006, van der Putte, 2007).

### **2.3.1 Energy efficiency potential in Building**

Building consumes approximately 40% of energy demand in the country. Specifically, Office building uses 50% to 65% air conditioning, 15% to 25% lighting and 20% office equipment. Implementing energy efficiency in existing building, reduction in energy consumption from 5% to 35% is attainable. There are several steps that can be implemented to achieve the above saving as simple as good housekeeping to proper building energy management and implementing retrofitting project. Figure 2g shows steps that can be implemented in EE program in existing building.

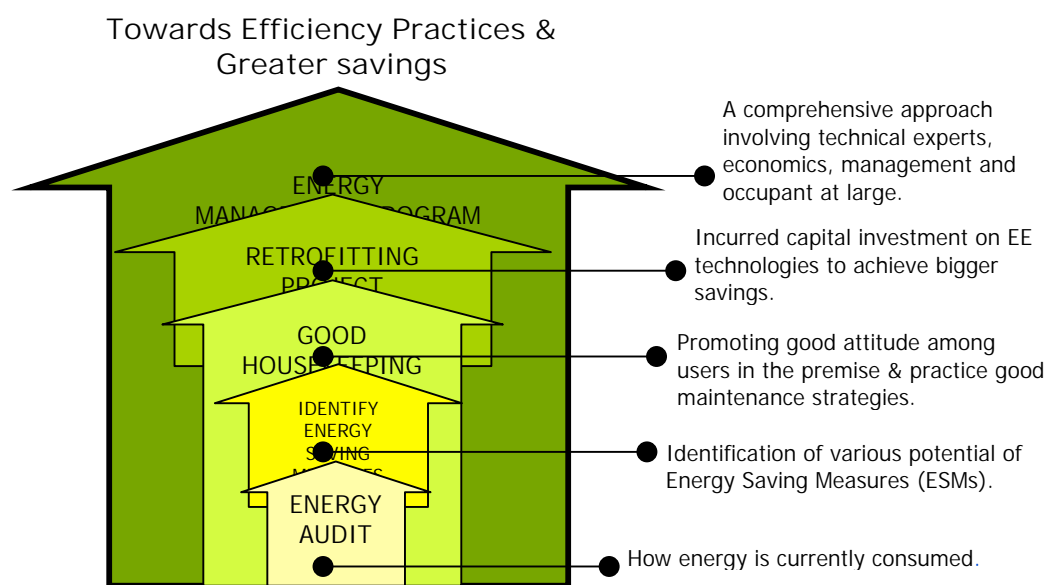


Figure 2g : EE potential programs in existing building (Mohd Zin Kandar et.al, 2005).

### 2.3.2 Energy Management Program

Energy Management is considered part of the company's management activities. Energy Management Program (EMP) controls the energy use situation in the company, to ensure efficient exploitation of the energy to provide cost-saving without impairing normal building functions or occupant comfort and productivity. EMP became important since the oil crisis in 1970's where drastic increase of oil price and oil shortage was pressing the production of energy to be reduced and avoiding waste. The term EMP was coined during the time of the 1973 energy crisis

and oil embargo. Today, EMP is considered common aspect in modern organisation and part of the organisation management activities. To be always

competitive, any cost reduction, including cutting energy cost will be one of the strategies.

EMP in building includes;

1. Energy Audit.
2. Good housekeeping and awareness programmes.
3. Identification of Energy Saving Measures (ESMs).
4. Target setting & improve maintenance strategy.

Back to the history of EM, the 1970's brought with it a new wave of concerns due to the impact of the 1973-74 OPEC embargo and the ensuing oil shortages. In response, University of Toronto (U of T) was one of the first universities to create a permanent staff position to handle energy issues and spearhead conservation initiatives University of Toronto (2007).

Thus EMP is an activity organized to optimize the use of energy by avoiding or recovering unused energy in processes or facilities. EM primarily seeks to utilize energy (electricity and fuel) more efficiently without reducing production levels or lowering product quality, safety and environmental standards.

### **2.3.3 Good housekeeping program**

Good housekeeping is a program which creates energy consciousness among operators and users. Good housekeeping is a program promoting good attitude among users in the premise and practice good maintenance strategies by maintenance team in the building. It does not require a big capital investment; in fact it can usually be carried out by the existing technical staff in any organisation. Some simple activities are:-



- Closing doors and windows in an air-conditioning room.
- Switching off light, fan and our desk top computer when we leave our room during lunch time.
- Raise the air-conditioning of the room thermostat instead of putting our blazer on.
- Experiences shows that implementing good housekeeping program can save up to 15% energy bill.

**Good housekeeping** has been implemented in British Telecom (BT) UK and reduces 15% of its energy consumption. BT is one of the world's 500 largest companies; by the early 1990s it was employing 240,000; occupying over 9,000 buildings and spending approximately £130 million (RM900 mil) per year on energy. BT Management estimated in the early 1990s that a well informed and highly motivated workforce could reduce the company's energy consumption significantly through simple good housekeeping measures costing little or nothing to implement. The energy awareness campaign, launched in late 1993, was therefore seen to be an essential ingredient in a corporate energy management programme that aims to reduce BT's energy consumption by 15%. The energy awareness campaign targeted over 165,000 employees and prepared the way for the programme to cut total energy consumption by 15% within 5 years saving over £16million (RM112 mil) per year.

#### 2.3.4 Energy Audit

Energy Audit (EA) is defined as investigations of energy consumption and the building system in view to find out the building energy index, identify any potential of improving efficiency of the building energy system through the elimination of any energy wastage in the organisation to improve cost saving and environmental comfort for the occupant. EA is an important step towards the implementation of Energy management Program (EMP). EA investigate and identify;

- How energy in is currently consumed.
- Identification of various potential of Energy Saving Measures (ESMs).
- Calculate Costs and Simple Payback Periods for all recommended ESMs.

### 2.3.5 EE Improvement & Retrofitting program.

As part of the EMP, the action and important aspect is how identified potential saving can be implemented. EE improvement and retrofitting program are programs that implement any recommendation written in the audit report.

Energy saving measures can be implemented in four stages:-

1. No-Cost Measures – Saving between 5-10%.
2. Low Cost Measures – Saving between 10-15%.
3. Medium Cost Measures – saving up to 35%.
4. Capital investment – saving up to 50%.

Among the simple approach is replacing lamps or re-lamping of existing inefficient light bulb. Conventional light bulb compare to Energy Efficiency light bulb revealed that Energy Efficiency uses less energy for same output and reduces CO<sub>2</sub> emissions

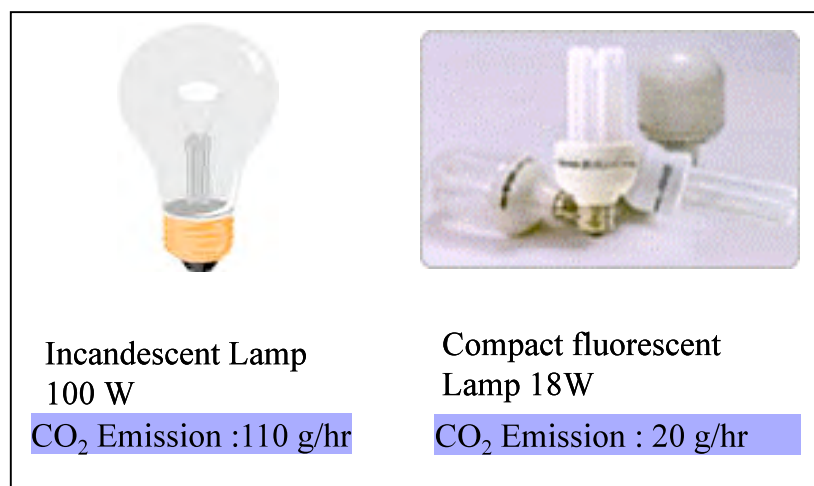


Figure 2h : Incandescent Lamps vs Compact fluorescent lamp (EE bulb).

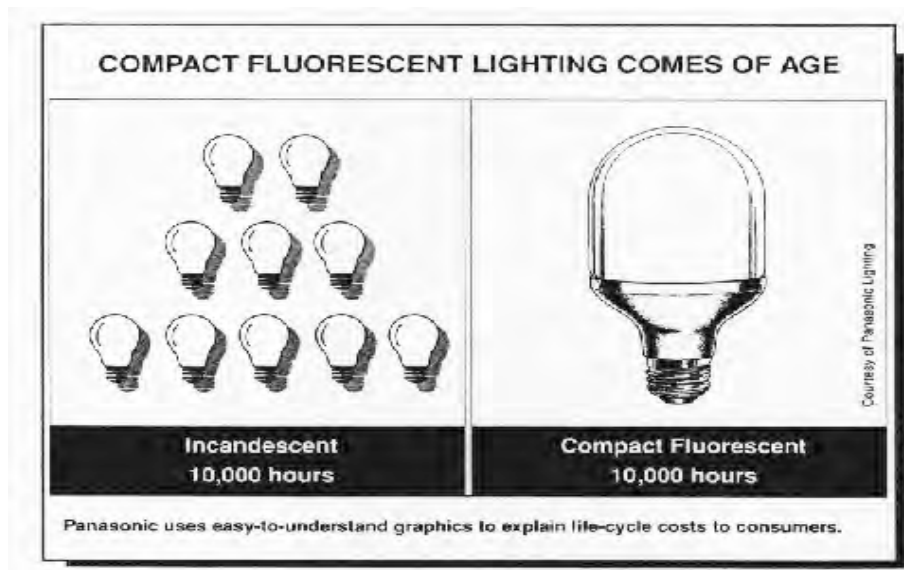


Figure 2i : Incandescent Lamps vs Compact fluorescent lamp (EE bulb) in term of life span.

#### **a. Energy Saving Measures (ESMs) in University of Toronto**

Following the oil embargo in 1974, a number of projects implemented in the University of Toronto (U of T) cumulatively resulted in a dramatic decrease in electrical consumption. Most significantly, a computerized building management system, called the Central Control and Monitoring System (CCMS), was installed on campus. This system allowed operators to remotely customize temperatures in different rooms and buildings on campus, with the aim of limiting wasted energy. Other energy saving projects in this era included the removal of excess fluorescent lamps and the disconnection of unnecessary fixtures in various buildings. Over a four-year period these projects successfully reduced electricity consumption on campus by 17%, which is equivalent to a total of 23,078 MWh saved, or enough energy to power 2200 homes.

In 1994, a campus wide retrofit of fluorescent lighting led to savings of 6 million kWh annually. Between 1997 and 1999, 80 variable speed drives were installed at various locations across campus. These devices save energy because instead of only running at 100% capacity, they can be regulated, saving 4 million kWh annually.

In 2000 the University undertook the installation of a flue gas heat recovery system at the Central Steam Plant. Through a combination of direct and indirect contact heat exchange, heat is harvested from the hot exhaust gas that would normally be wasted rising up the chimney. The low-grade hot water is then piped to a number of buildings including Lash Miller, Medical Sciences, and the Bahen Centre, the latter receiving its primary heat from this source. This project has resulted in energy savings of 72,695 GJ.

The University also began a large lighting and cooling retrofit initiative in 2006. As part of the project, more efficient lighting is being installed in Robarts Library, the Ontario Institute for Studies in Education (OISE), and Medical Sciences buildings. Moreover, 18 chillers that produce primary cooling for air conditioning 21 buildings will be replaced, improving their efficiency by 30% and eliminating the use of ozone-depleting chlorofluorocarbon refrigerants on campus. Once completed, these retrofits will reduce the University's greenhouse gas emissions by 3100 tonnes of CO<sub>2</sub>, the equivalent to taking 600 cars off the road.

Due to the energy conservation projects carried out over the last 15 years, the University's electricity use is 14% lower than it otherwise would be. Moreover, the University is committed to a process of continual improvement in energy efficiency (University of Toronto, June, 2007).

#### **b. ESM in Universiti Teknologi Malaysia (aseanenergy.org, 2001)**

The Sultanah Zanariah Library of the Universiti Teknologi Malaysia (UTM) was the recipient of a 10-year energy retrofit project provided by the Institute Sultan Iskandar (ISI) and ENCEFF/E-EYE. During the period 1993-1997, lighting and air handling units were retrofitted, which resulted to two major findings as follows:

- a. Total savings amounted to 318 kW. This included the lighting retrofit, AHU retrofit and the reduced chiller load. The savings achieved represent a reduction of 36.5% of the original load before retrofit.

b. Improvement in comfort condition of the library. The airflow rates were reduced which brought the library comfort zone closer to top the ASHRAE comfort zone limits.

### **i. Lighting**

White light lamps with electronic ballasts are used. This increases the lumen per watt of the fittings. The high efficiency reflectors (0.8) such as the silver coated (sputtering technology) reflectors increase the occurrence of light reflection vertically to the floor and laterally across the top of the room. This reduces the kW consumption of the Library.

Electronic ballast reduces flicker, heat generation and noise in the lighting system. Light level of the library was reduced where it was found to be too high and maintained at the same level in some areas. It was improved in some places like staircase or book shaft where the improvement was more than 80%.

### **ii. Air Handling Unit (AHU)**

The energy used by the fan motor is proportional to the air flow rates cube therefore reduction in the airflow by 33% resulted in a 30% kW reduction from the pre-retrofit measured value. Additional savings were obtained from the reduction in fan kW which indirectly reduced the chiller load due to lower heat generation (which is then cooled by the HVAC system). The works undertaken to reduce the flowrates and increase the efficiency of the system were:

- Replacement of old oversized motor with new Super-E type
- Replacement of old fan and motor pulleys with optimally designed size
- Alignment of pulleys to reduce transmission losses
- Electrical connection to motor and necessary adjustment of over load relay setting

- Control and monitoring

The Sultanah Zanariah Library of the Universiti Teknologi Malaysia (UTM) was the runner-up of Asean Energy Award 2001 for the excellent achievement in EMP.

#### **2.4. Awareness & Attitude in EE**

As described in paragraph 2.3.2 above awareness program to BT employee occupying building of British Telecom has saved £16million (RM112 mil) per year of organisation's money. There are actually many more benefits when awareness of the employees are upgraded.

Literatures on EE awareness are very limited, however many researches studying the relationship of behavioral change in Environment Education which similar context are referred.

EE Awareness and Attitude change are actually behavioral change. Behavioral approach is one of the key successes in energy conservation in Building. Employee occupying the building is also an important group of people to be educated on Energy Conservation in facility management sector (Druckman, 2004). Other key barriers in implementing Energy Conservation in Building are lack of knowledge and motivation of the operation and maintenance (O&M) staff. (Yik, F.W.H., Lee, W.L., 2002). Energy awareness is significant in energy conservation program (Vesma, 2002, Wong, 1997, stated that one of the most successful means of motivating employees to conserve energy is through awareness. Besides that, according to Camp (2005), staff awareness plays a crucial role in reducing utility bill and can make a big impact and therefore, raising awareness is large part of the solution. When an organization practices good EMP, top management and employees become more aware of how energy is used, the actual cost of energy and the methods and equipment that can be used to control and reduce energy waste (Tapera Mangezi, (Undated).

For that reason, serious attention to the building users' behavior is extremely important aspect as widely experienced in energy conservation programme implemented in the United Kingdom (Energy Efficiency Office, 1993).

Awareness and Attitude in EE Program is a grass root effort to control rising utility costs in the organisation. The program includes emphasizing lowering operating costs without expending capital costs to achieve energy saving results. A series of informal ideas exchanges ideas and knowledge to explore the possibility of reducing utility costs with little or no capital investment. The concept of the Awareness EE Program is relatively easy to describe and understand, yet difficult to implement in an effective and consistent manner.

Ramsey & Rickson, (1977) introduce the relationship of behavioral change understood as a traditional model (Figure 2j).

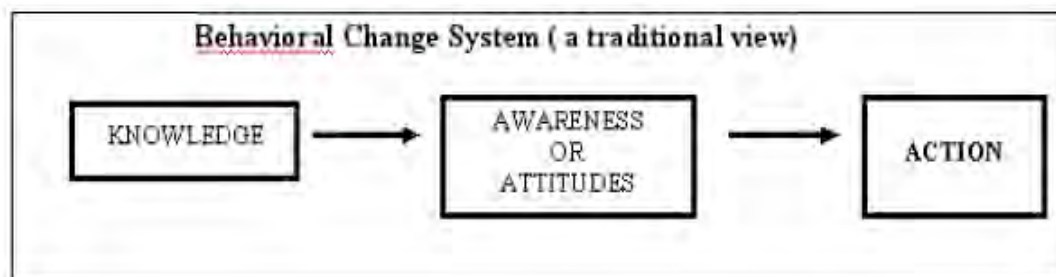


Figure 2j : A traditional model of Behavioral Change System.

Monroe and Dissinger (1994) stated that the Environmental Education practised in the United States follow this traditional model. The components can be defined as below:-

**Awareness** to help social groups and individuals acquire an awareness and sensitivity to the total environment and its allied problems.

**Knowledge** to help social groups and individuals gain a variety of experiences in and acquire a basic understanding of the environment and its associated problems.

**Attitudes** to help social groups and individuals acquire a set of values and feelings of concern for the environment and motivation for actively participating in environmental improvement and protection. According to Thomas A. Heberlein in most theories of attitudes, two components are noted, an emotional dimension

involving feelings and a cognitive aspect which refers to dispassionate facts and beliefs

Choong Weng Wai et.al, describes behavioral change require three stages as shown in figure 2k.

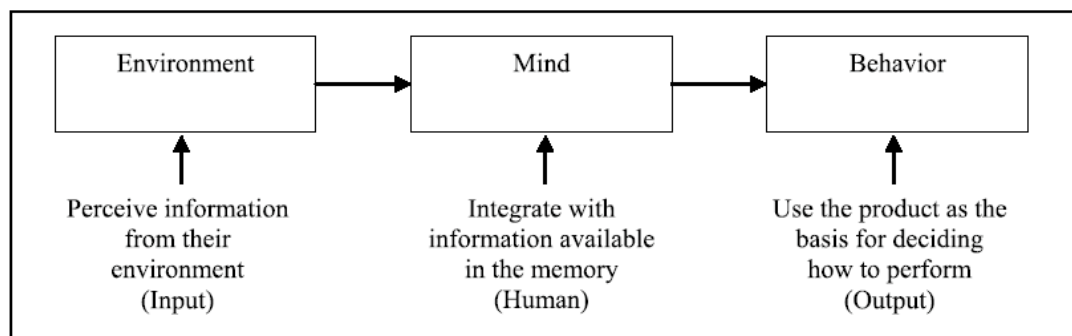


Figure 2k : Major stages of awareness development process

To ensure there will be a behavioral change in the organisation, several steps should be implemented. The principles are outlined below:-

a. Management team must be committed to the program and involved fully in all aspects of the process. With only lip service or a "command from above" the results will be from poor to nonexistent. On the other hand, the program does not require excessive amount of time from the manager, only approximately 1-2 hours per week initially to get the program off the ground is sufficient. Next, it is extremely important that the entire team be involved. After all, everyone in the building uses energy not just the maintenance staff.

b. Two valuable components of the energy team that are often under-utilized are the security and housekeeping staffs. Security can be a real asset in identifying and monitoring energy reduction plans. Who else but security is on the property day and night to observe which lights are left on all night? Often, found that once trained and motivated, security staffs have many new ideas to offer to the Energy Awareness



Program process. As for housekeeping, who else is in those remote corners of the buildings with the lights being left on 24/hrs per day, often with a light switch already there for the turning off.

The process works best if a "champion" is chosen. This person does not have to be the most technical person on staff, but can be anyone that is motivated to the program and is good at follow-up.

c. Then, monthly meetings are held to review past tasks and accomplishments and, more importantly to generate new ideas to implement. These meetings generate a wealth of ideas and the information required to train, motivate and track the results of the team.

How do you keep it alive? The Energy Awareness Program is a management program, not an equipment program. The biggest challenge is not to reduce energy costs, that's relatively easy by expending the effort; the real challenge is once the savings are achieved, is maintaining them. A solution to keeping the program and the savings ongoing is to "institutionalise" Energy Awareness Program. Every decision, every operating time and every maintenance procedure should be a part of the center's formal Operations Plan, updated and referred to continually. In the monthly meeting agenda should be:-

1. Review results/minutes from last meeting.
2. Review utility bills - compare this year to last year.
3. Develop new ideas.
4. Assign responsibilities.
5. Set tasks due at the next meeting date.

Apart from the above, each year for Energy Awareness Month can be useful to be organised in line with national energy month. The top management should provide

materials and ideas to help agencies and departments in the organization promote energy-saving practices. Materials include posters and other outreach materials that carry organisation's energy awareness message.

Outreach materials with energy saving messages include the theme poster and related handout items, as well as posters that highlight projects and employees exemplifying extraordinary actions and leadership in energy management.

#### **2.4.1 Status of Awareness on EE in Malaysia**

Public awareness study or campaign specifically on EE has not been found in any publication. The earliest publication is in the form of report on Public Education & Awareness of Climate Change Issues done by Gurmit Singh (undated). The survey done in February 1998 concluded that Malaysian Public awareness of climate change issues is inadequate. Among government and private sector officials, the understanding is still superficial, with confusion between ozone depleting gases and GHGs.

Industrial building sectors is identified the highest energy consumed which also contributing the highest contributor of GHG emission in the country. Due to that reason, Malaysia has put a priority to improve EE awareness in industrial sector due to the huge percentage of energy being used by this sector. Program such as Malaysian Industrial Energy Efficiency Program carried out by PTM include “Remove Barriers” on EE and the potential of saving is approximately 5-35% targeting to 8 energy-intensive sub-sectors in industrial sector.

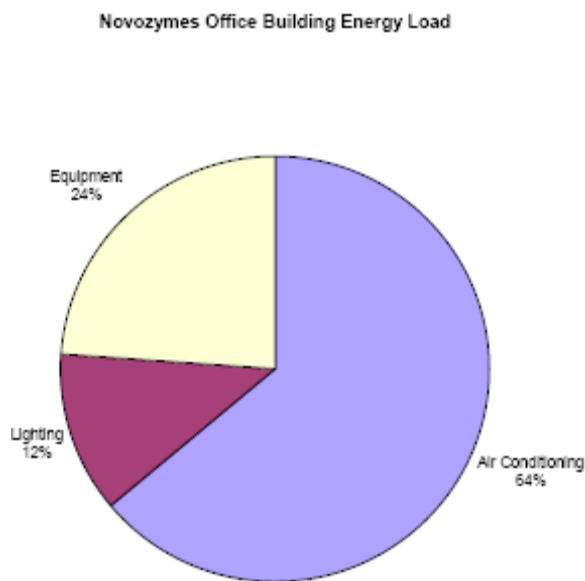


Figure 21 : Energy Consumption Load Apportioning of Novozymes Office

In February 2003, Danida and ECO-Energy Systems conducted an energy audit on the office of Novozymes Malaysia Sdn Bhd office building in Technology Park Malaysia. In 2002, the 987 m<sup>2</sup> single storey office consumed 232,050 kWh giving it an energy consumption index of 235 kWh/m<sup>2</sup>/year. The breakdown was 64% for air conditioning, 12% lighting and 24% general equipment (Chan Seong Aun, 2004).

Yap Kok Seng (...) suggested EE Awareness as a key program and since the program is newly introduced in Malaysia; several important steps are needed to develop competence. The key activities are: a). Information systems for management and implementation; b). Awareness raising initiative; c). Analysis of macro-economic consequences for implementation of EE program; d). Implementation of EE operation; e). Federal-State initiative and; f). Public Awareness raising programs.

To ensure awareness and practices on EE well implemented in the organization Choong Weng Wai et.al (...) suggested nine phases' conceptual frameworks, namely energy awareness stimulus, transference method, interpretation, comprehension,

awareness, reinforcement, short term motivation, obedience and long term motivation which is yet to be validated and evaluated.

## **2.5. Summary**

Energy Efficiency now is a central focus of many national energy policies and at the front of the debate on energy sustainability issues. Although Malaysia is considered quite late in implementing EE program and projects compared to many developed countries (generally only implemented extensively in year 2000 compared to many develop country), many policies, programs and projects have been introduced and implemented for the last 7 years, targeting school children and general public.

The following chapters discuss the research methodology and how the questionnaire is developed and the surveys carried out.

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

This research is divided into three main stages. First, research design; second, developing questionnaires and third field survey and data analysis. The methodologies planned for the research are described in this chapter. The methodology were reviewed from selected literatures and redefined specifically for the purpose of this research.

This chapter explains and discusses methodology of the research, developing questionnaires, field survey carried out as data gathering. Several tasks are as follows:-

##### **Stage 1 - research design;**

Secondary data information through literature review were carried out. Some of the important literature discovered including;-

- a) Issues and rational to implement energy conservation in government building.
- b) EE Potential in Building including Government Offices
- c) EE Knowledge, Awareness and Practices - concept and scope.
- d) Significance of goodhousekeeping activities among employees.

##### **Stage 2 - Developing Questionnaire;**

Developing questionnaire for the field survey is carried out in two stages:-

- Pilot survey and verification of questionnaires
- Identifying Sampling to be surveyed.

**Stage 3 – Field survey;**

Field survey were carried out by submitting the questionnaires to selected identified sampling population chosen by random. The comprehensive survey were done between January to June 2008.

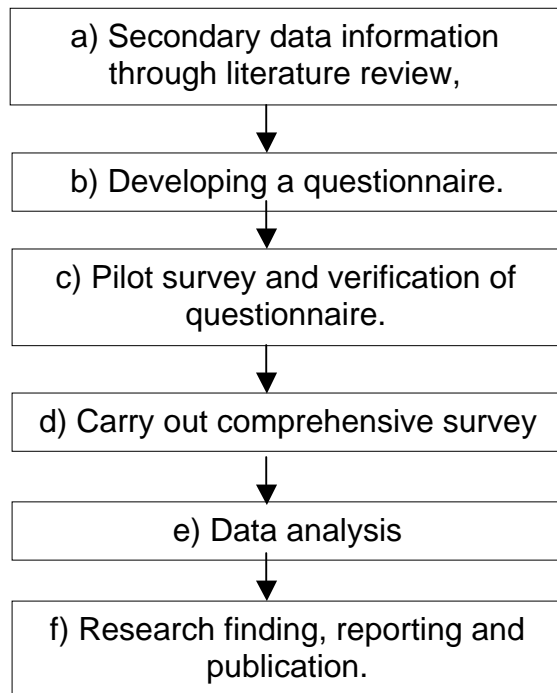


Figure 3a: Research flow diagram

The research based on the Ramsey & Rickson, (1976) behavioral change traditional model which will investigate knowledge, awareness and attitude of government employee. (Figure 3b).

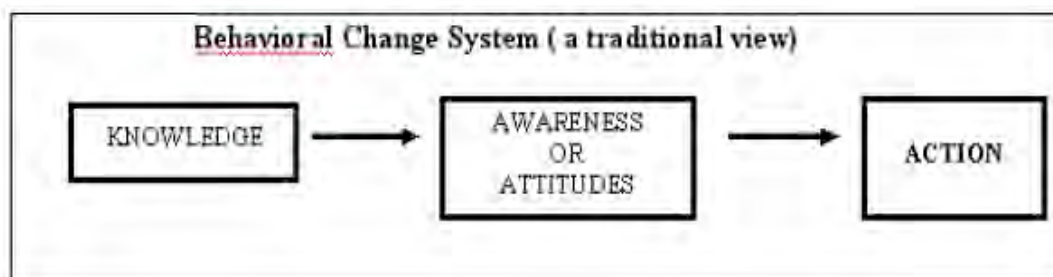


Figure 3b : A traditional model

### 3.2. Developing questionnaires

Generally the questionnaires are divided into several sections:-

- a. EE and Energy Awareness;
- b. EE & Energy Knowledge;
- c. EE & Energy Practices.

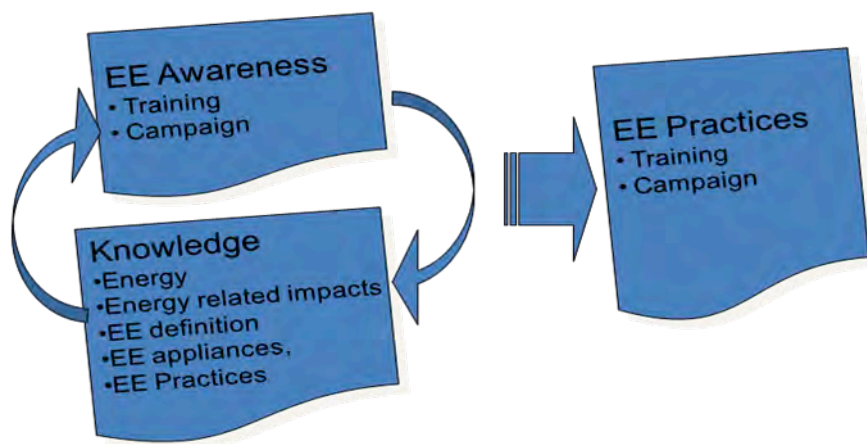


Figure 3c : Relationship between awareness, knowledge and practices

To ensure that the respondent answer correctly in accordance to their knowledge, awareness and practices, the questions are developed in such a way they include self-verification. The questionnaires are divided into six parts (Part A to Part F) with three stages questions

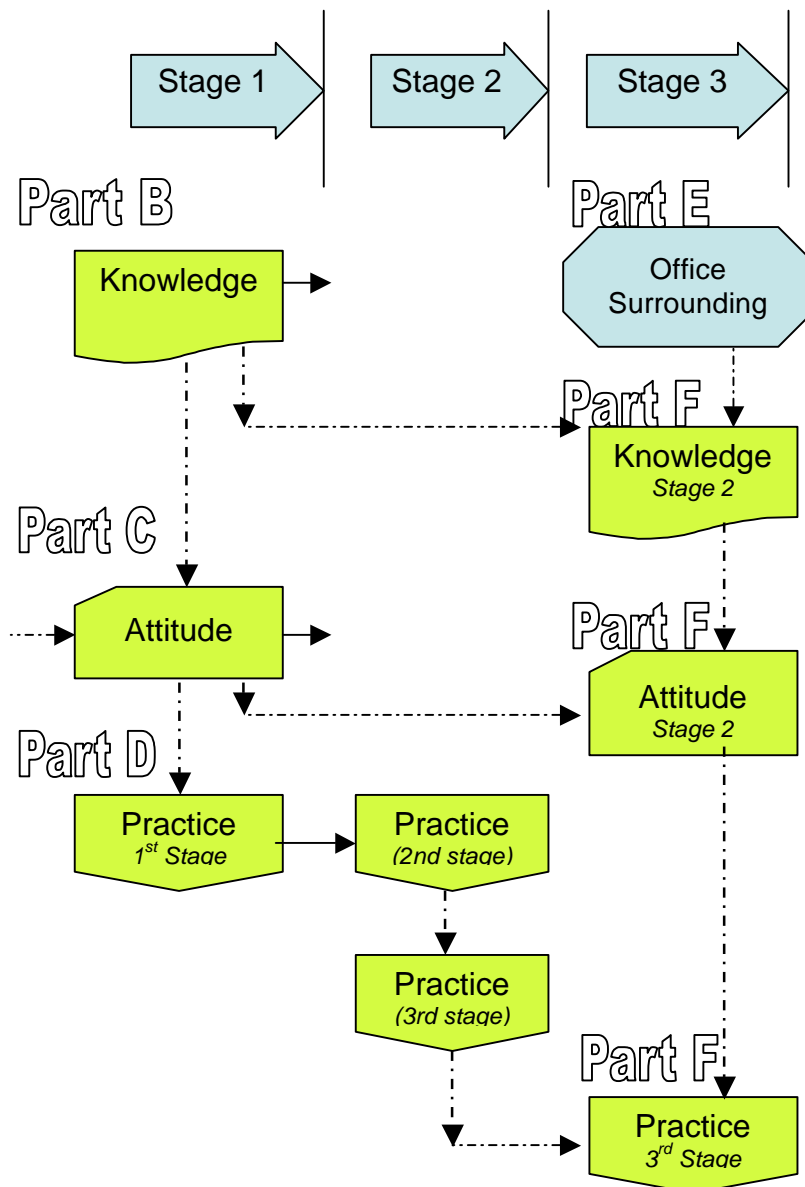


Figure 3d: Main section of Questionnaires - the flow of questions

Stage 1 questions is to examine respondent's general knowledge on energy & EE

Stage 2 questions is to examine respondent's specific knowledge on energy & EE

Stage 3 questions is to examine respondent's commitment based on his/her knowledge & practices on energy & EE at his own individual level as well as his/her surrounding.



### A. Part A Questionnaire

The questionnaires were purposely written in Bahasa Melayu assuming that the majority of the respondents have no problem in understanding Bahasa Melayu and for effective data collection.

Part A is to understand demographic information of the respondents.

**Part B Questionnaire** is to survey general understanding on Energy, energy consumption and the impact of using energy. We shall assumed that general public (especially government employee) have sufficient understanding and practices since there were general campaign on Energy organised by several bodies as explained in the previous chapter.

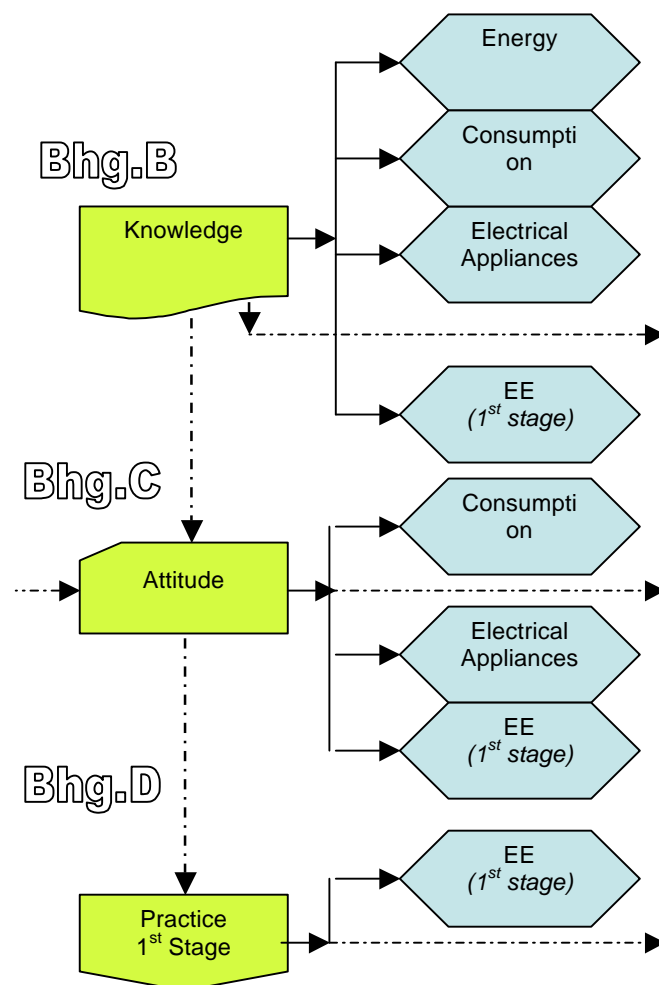


Figure 3e: Part B, C & D of Questionnaires - the flow of questions

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*BAHAGIAN B: PENGETAHUAN / Part B: KNOWLEDGE*

- 1. PENGETAHUAN UMUM MENGENAI TENAGA DAN ALAM SEKITAR / General Knowledge on energy and environment.*
- 2. PENGETAHUAN TENTANG TENAGA ELEKTRIK DAN ALATAN ELEKTRIK / Knowledge on electrical energy and electrical equipment.*
- 3. PENGETAHUAN TENTANG KECEKAPAN TENAGA / Knowledge on Energy Efficiency.*

**Part C Questionnaire** is to survey general attitude on energy consumption, the impact of using energy and followed by their attitude and practices.

*BAHAGIAN C: KESEDARAN /KEPEKAAN/ SIKAP / Part C: Awareness.*

- i) KESEDARAN/SIKAP TERHADAP KECEKAPAN TENAGA ELEKTRIK / Awareness on electrical energy.*

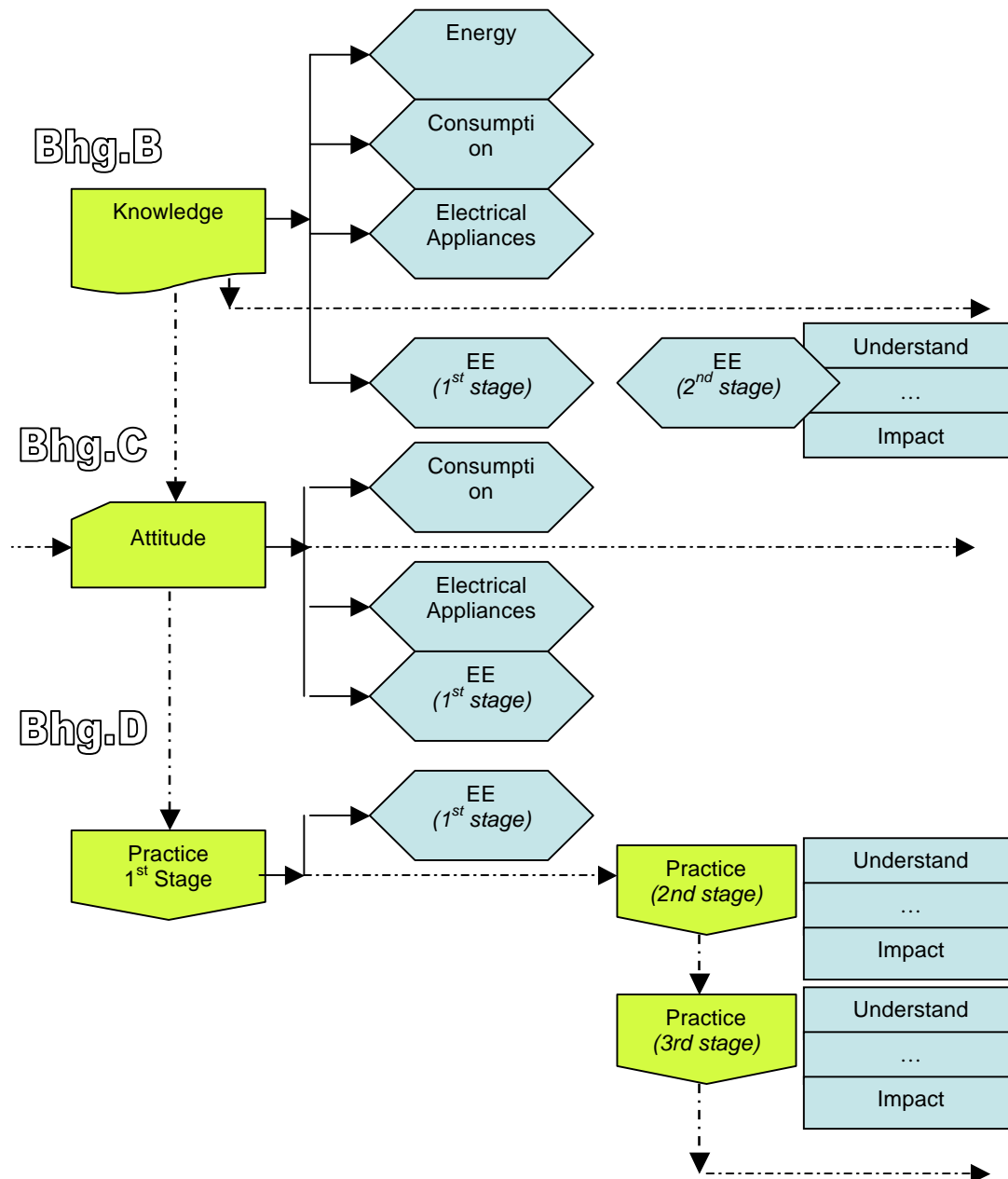


Figure 3f: Part B, C & D of Questionnaires – Extended questions

**Part D Questionnaire** is to survey general practices on energy consumption, the impact of using energy and followed by their attitude and practices.

*BAHAGIAN D: TINDAKAN* / Part D: Practices.

- i). Antara berikut peralatan elektrik manakah yang ada di pejabat anda?
- ii). Antara peralatan elektrik berikut apakah tindakan bentuk amalan anda ?

The question is on the practices regarding the use of electricity appliances / office electricity equipment.

**Part E Questionnaire** is to examine understanding of very specific questions on EE program available in the country. We aspect that only those who came across, read or participate to certain program related to EE will be able to answer question posted.

*BAHAGIAN E: PERSEKITARAN DAN KEADAAN TEMPAT KERJA* / Part E: Working environment.

- i) Persekitaran tempat kerja anda: Tandakan pilihan anda mengikut skala di bawah*
- ii) Mengenai usaha-usaha 'Kecekapan Tenaga' di tempat kerja anda ?*
- iii) Pandangan anda mengenai usaha meningkatkan kecekapan penggunaan tenaga elektrik ?*

The question is to find out activities, effort or initiatives done in their office.

**Part F Questionnaire** is recording the environment situation in the office. The EE practices and situations is recorded in random by the researcher in writing and taking photographs.

*BAHAGIAN F: Maklumat Bangunan & Penghuni* / Part F: Information regarding Building & Occupants.

- i). Penghuni / Occupants.*
- ii). Fizikal & rekabentuk bangunan / Building design & it physicals.*

### **3.3. Pilot survey and verification of questionnaires**

Pilot survey were carried out to ensure the appropriateness of the questionnaires and can be understood clearly by the respondent. The pilot survey was done by distributing few drafts of the questionnaires to the staff at Department of Architecture UTM and at the Department of Education Johor Bahru.

Based on the returned questionnaires, new revised questionnaires were rewritten and become final version of questionnaires.

### 3.4. Identifying Sampling to be surveyed.

The target population for this study is government or public employees. Before questionnaires were distributed to the target group, the sampling population were identified and planned. The 95% confidence is expected and samples were identified and questionnaires were distributed to the respondents.

Government or public sectors can be divided into five categories;

- a. Federal government;
- b. State government;
- c. Federal government agencies; .
- d. State government agencies, and
- e. Local authorities.

#### 3.4.1 Overview of Government or Public Departments & Agencies

This study chooses government or public building in Johore state as sampling population and sample to be surveyed. In Johore, five government sectors were available and well distributed. Table 3b Shows numbers of government agencies throughout the country compared to numbers available in Johore shown in table 3a.

NO.	AGENCIES	NUMBER	%
1	Federal	138	19
2	State	250	35
3	State agencies	74	10
4	Federal agencies	111	15
5	Local Authorities	144	20
	Total	717	100

Table 3a: Public agencies in Malaysia

NO.	Office	Number	%
1	Federal	13	18
2	State	30	42
3	State agencies	12	17
4	Federal agencies	2	3
5	Local Authorities	15	20
		72	100

Table 3b Government offices in Johore

### 3.4.2. Johor State Government

The Johor state government is headed by the Chief Minister or *Menteri Besar*, which is currently hold by Dato' Abdul Ghani Othman. The Chief Minister is assisted by executive councils (excós), whose members are selected from the state assembly members.

The state of Johor is divided into 10 districts. Each district have local authority and/or district office. Table 3c shows each district and each territorial areas.

No.	District	Government Building/Territorial areas
1	<b>Johor Bahru</b> (2)	Dewan Bandaraya Johor bahru, Majlis Perbandaran Johor bahru Tengah
2	<b>Kulai Jaya</b>	Majlis Perbandaran Kulai (Majlis Perbandaran Kulai) (Covers an area of Senai, Kulai Town, Sedenak, Ayer Bemban)
3	<b>Pontian</b>	Majlis Daerah Pontian
4	<b>Kota Tinggi</b>	Majlis Daerah Kota Tinggi
5	<b>Kluang</b> (2)	Majlis Perbandaran Kluang (Majlis Daerah Kluang Utara) Majlis Daerah Simpang Renggam (Majlis Daerah Kluang Selatan)
6	<b>Segamat</b> (2)	Majlis Daerah Segamat (Majlis Daerah Segamat Utara) Majlis Daerah Labis (Majlis Daerah Segamat Selatan)
7	<b>Muar</b>	Majlis Perbandaran Muar (Majlis Daerah Muar Selatan)
8	<b>Ledang</b>	Majlis Daerah Tangkak (Majlis Daerah Tangkak)
9	<b>Batu Pahat</b> (2)	Majlis Perbandaran Batu Pahat (Majlis Daerah Batu Pahat Barat) Majlis Daerah Yong Peng (Majlis Daerah Batu Pahat Timur)
10	<b>Mersing</b>	Majlis Daerah Mersing
11	<b>Pasir Gudang</b>	Majlis Perbandaran Pasir Gudang (MPPG)

Most of the government offices in Johore are located in **Johor Bahru** town. Majlis Bandaraya Johor Bahru (Abbreviation as MBBJ or City Hall of Johor Bahru) itself covers an area of Daerah Sentral JB, Tampoi, Pelangi, Pasir Pelangi, Rinting, Tasek Utara, Pandan, Permas Jaya, Kangkar Tebrau, Kempas, Larkin, Majidee, Mount Austin, Kawasan Tebrau).

Majlis Perbandaran Johor Bahru Tengah (MPJBT), It covers the area of Masai, Plentong, Ulu Tiram, Gelang Patah, Skudai, Pulai, Nusajaya, Ulu Choh and Lima Kedai

Majlis Perbandaran Pasir Gudang (MPPG) covers area of Pasir Gudang Industrial Estate, Kota Masai, Pasir Putih, Air Biru, Tanjung Langsat, Scientex, Nusa Damai, Kong Kong, Sg. Tiram.

### 3.5 Information gathering

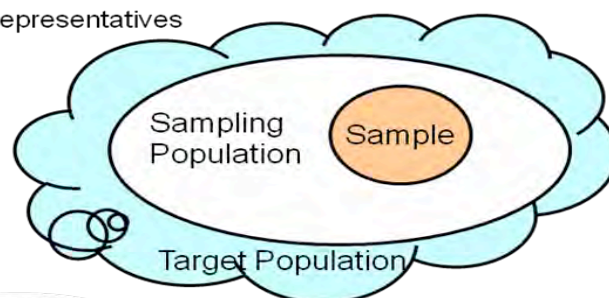
The information about the awareness and practice on energy efficiency among government employees were gathered through the questionnaires and observation of the offices. All the questionnaires were analysed.

#### 3.5.1 Sampling Population and sampling.

The target population is Malaysian government employees at federal and state level. After analysing target population in Malaysia, sampling population is government employees available in Johore state.

Sample is made by random after listing government department available in Johore.

Sampling and representatives



**Target Population → Sampling Population → Sample**

Figure 3g : Relationship between sample, sampling population and target population

#### 3.5.2 Sample for interview.

Several criterias are identified to ensure the sample represent the sample population.

Identified sampling to be surveyed;

Government offices to be surveyed;	Types of government office.	<ul style="list-style-type: none"> <li>➤ Federal government agencies.</li> <li>➤ State government agencies.</li> </ul>	
	Location & numbers.	➤ Johore	
	Personnel to be interviewed.	➤ Government agencies employees.	<ul style="list-style-type: none"> <li>➤ Executives</li> <li>➤ Supporting staff</li> </ul>
	Building and its operations to be observed & recorded in term of EE practices.	<ul style="list-style-type: none"> <li>➤ Federal government agencies.</li> <li>➤ State government agencies.</li> </ul>	➤

Table 3 d: Offices and employees interviewed in the survey.

Identifying Sampling to be surveyed;

Federal & state government, agencies & local authorities surveyed at Johore state.

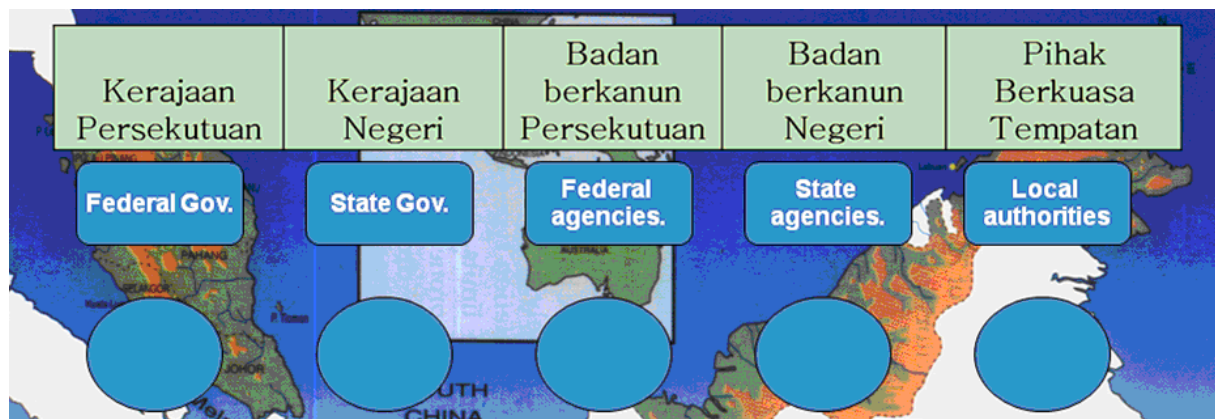


Figure 3h: State & Federal government office surveyed.

### 3.5 Field Survey

As one of the field survey task, detailed study was done to understand government department organizational structure.



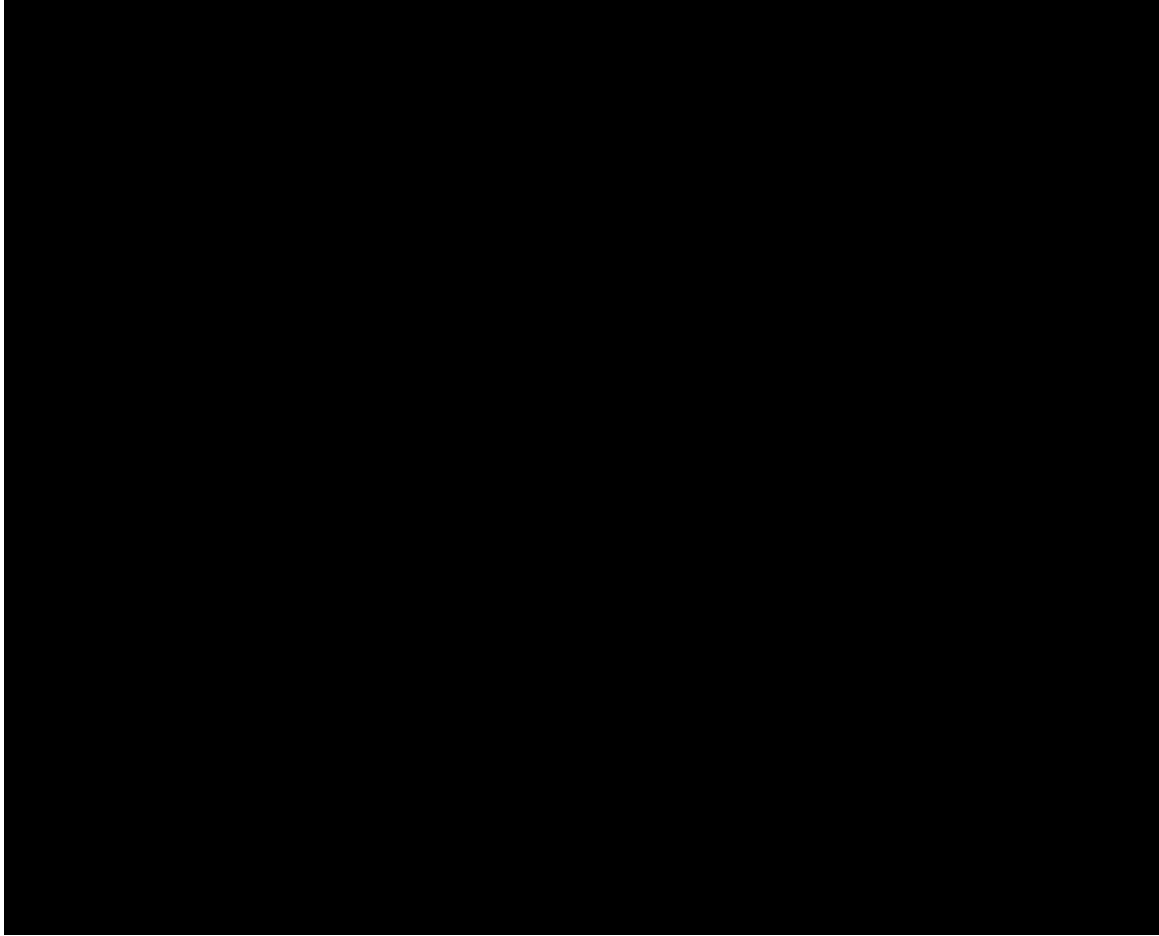


Figure 3i : Organisation Chart of a typical government office – as part of the field survey process.



Figure 3j :One of the government building in Johor Bahru.

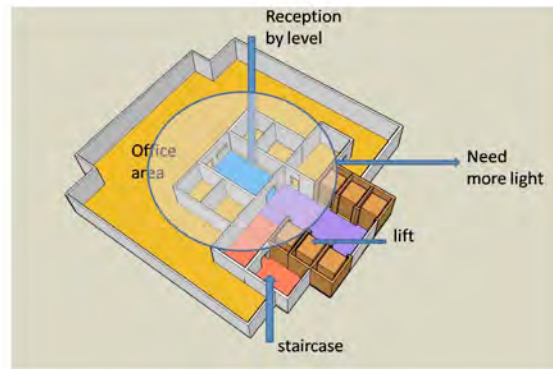


Figure 3k & 3l : Interior of a government office in Johor Bahru.



Figure 3m : Curtain in the office is used to avoid glare

Figure 3n : 4' fluorescent bulb is commonly used in government office.



Figure 3o: Curtains are used in office to avoid glare in workplace.



Figure 3p: One of the government officer answering questionnaires



Figure 3q : Observation in some of the government premises did not practice EE. The lighting is ON at mid-day.

### 3.6 Summary

This chapter presents methodology of the research project. The initial research program started with literature review and developing questionnaires. Detailed process of field survey was also elaborated.

## CHAPTER 4

### DATA ANALYSIS

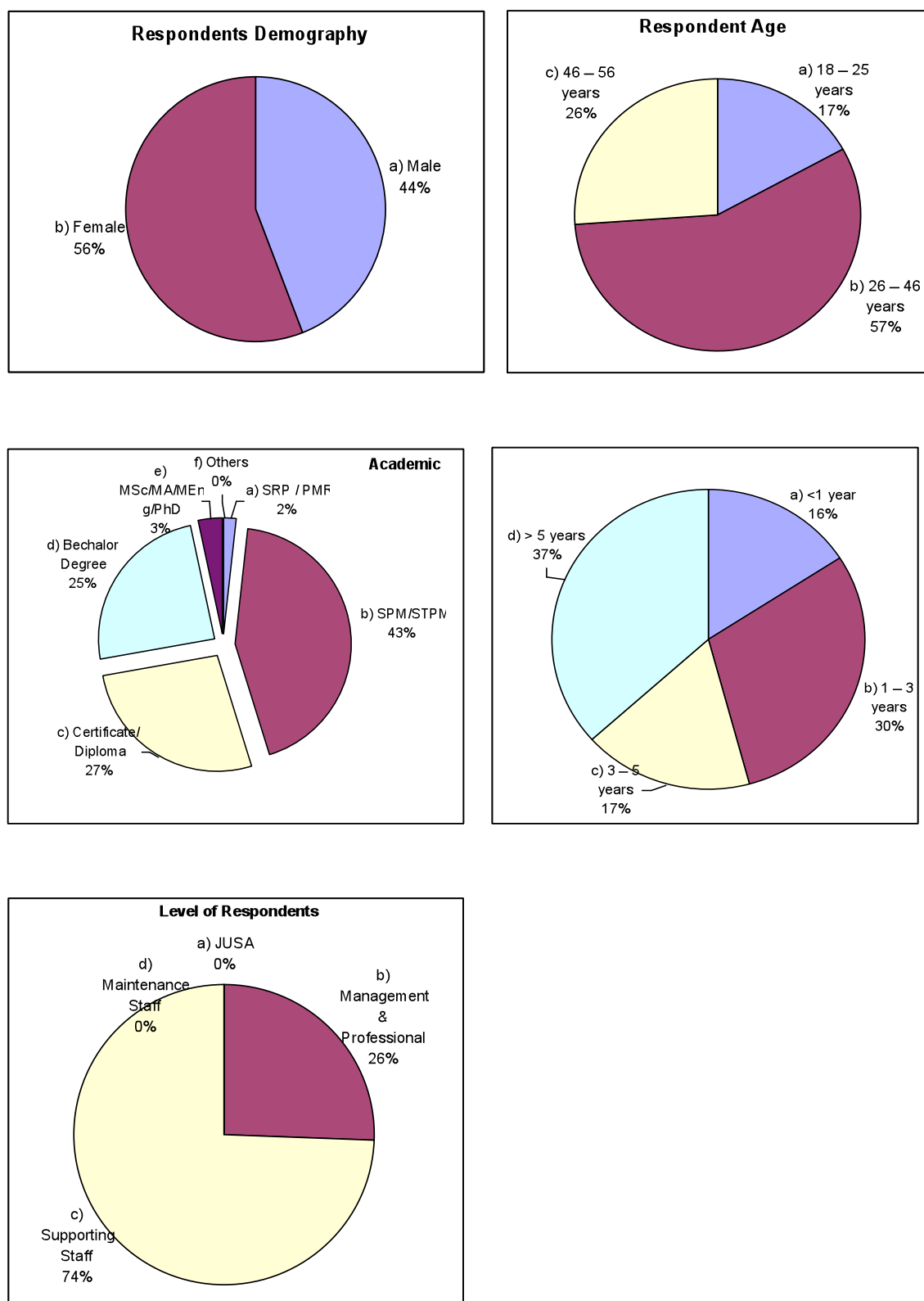


#### 4.0. Introduction

The survey was distributed to government employees based on the sampling population identified. 185 questionnaires were answered by employees from several government department and agencies including local authority, federal government office, state government office and other government agencies.

#### 4.1. Respondent composition

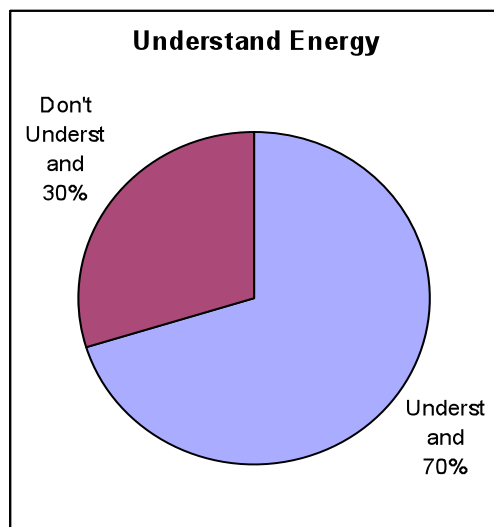
Graf 4a below shows the composition of respondents in term of gender, age, education, and period of service and level of responsibility. The composition covers all range. In terms of background education, the respondents came from all level, where more than 50% obtain diploma, degree and Master or PhD. Approximately, 54% of the respondent have worked more than 3 years. Only 16% have worked less than a year. With that composition, the respondents should have substantial knowledge about their office and credibility for their answers.



**Graph 4a to 4e:** Composition of respondents in terms of gender, age, education, and period of service and level of responsibility.

#### 4.2. Knowledge on Energy

The study reveals that 70% of respondents among government employees understand what energy is. 15% didn't understand energy and 15% didn't know or didn't answer. Comparing with the survey done by CETREE among teachers in Malaysia in year 2000, government employees in 2008 have higher knowledge on energy by 10%.

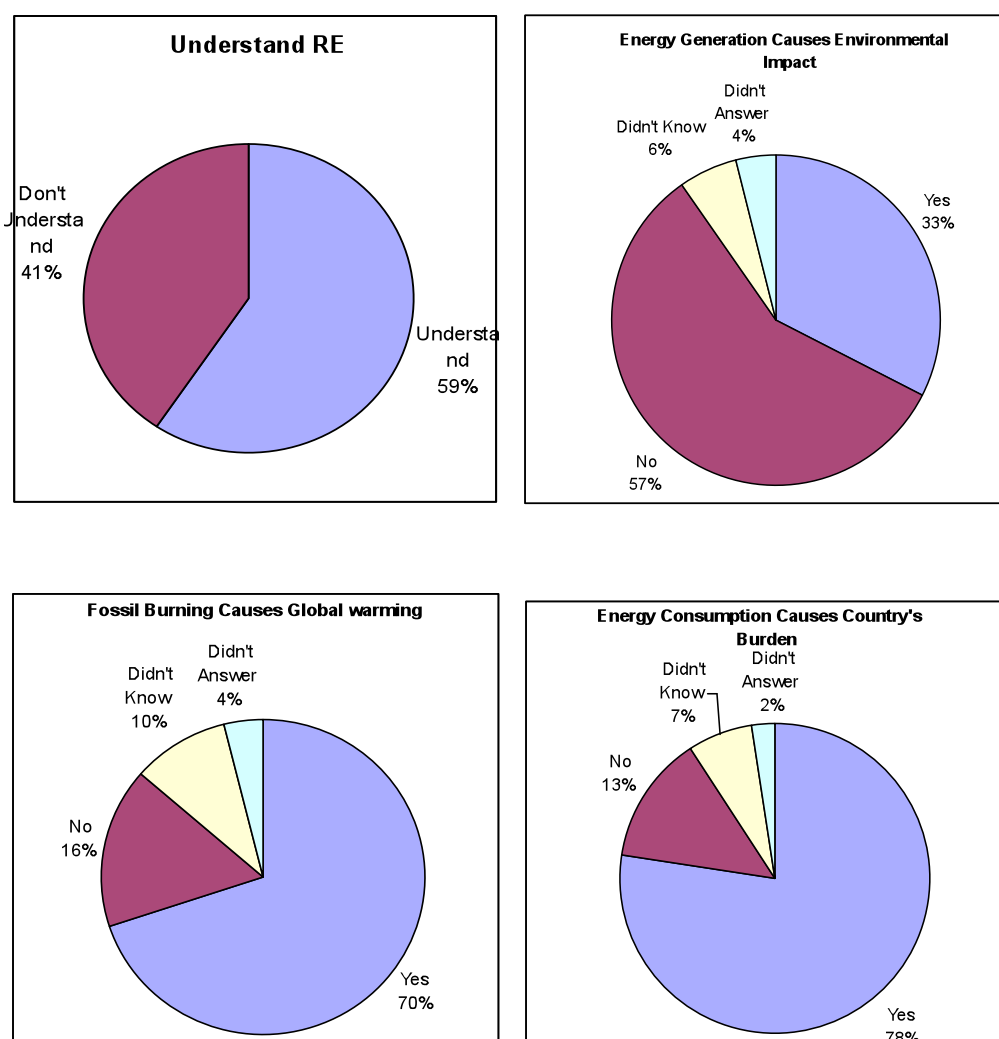


Graph 4f: Knowledge on Energy

#### 4.3. Knowledge on Renewable Energy

Regarding to the understanding on RE, 59% of respondents understand what renewable energy is. 15% didn't understand energy and 15% didn't know or didn't answer. It can be concluded that 41% did not understand RE.

On the question to examine their understanding on environmental aspect related to energy, only 33% of respondent among government employees understand energy generation causes environmental impact. However 70% of respondent among government employees understand fossil fuel burning causes global warming and 78% respondents agree, excessive energy consumption causes country's burden.



Graph 4g-4j: Knowledge on Renewable Energy (RE) and Impact on environment and government when energy is generated and used.

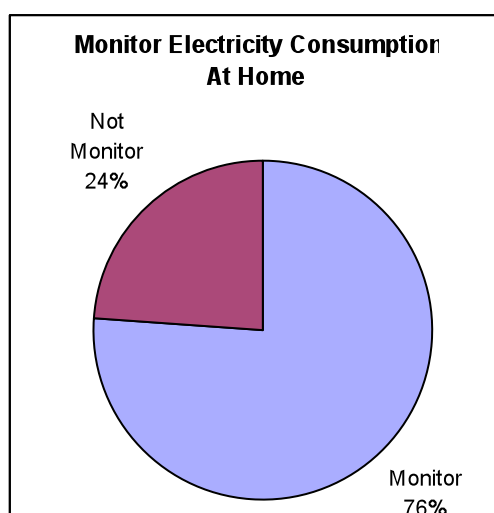
Knowledge	General(%) (2000) By CETREE	Teacher(%) (2000) By CETREE	Government employees (%) (2008)
Explain/understand energy	57.4	61.5	70
Explain/understand Energy efficiency	15.2	57.9	72
Energy efficiency appliance	27.3	63.6	
Identify appliance with EE features	16.6	39.6	
Understand renewable energy	21.8	50.4	59
energy generation causes environmental impact.			33
understand fossil burning causes global			70



warming			
excessive energy consumption causes country's burden			78
Understand what is EE practice			54
Understand the positive impact of practicing EE			86

Table 4a: Summary of the result: knowledge on energy, RE and EE survey.

#### 4.4. Awareness on Energy



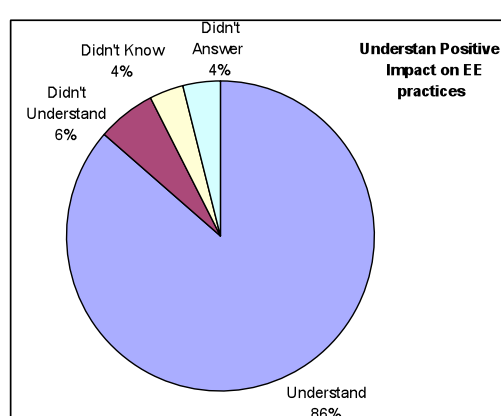
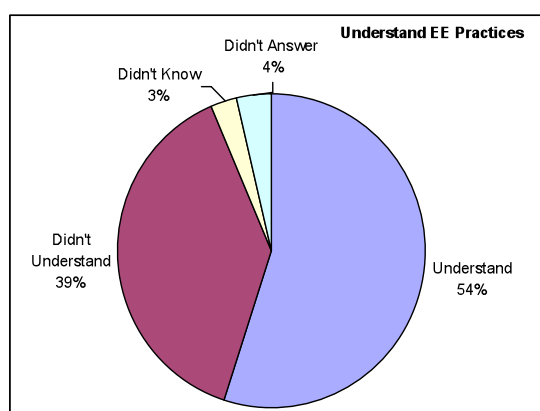
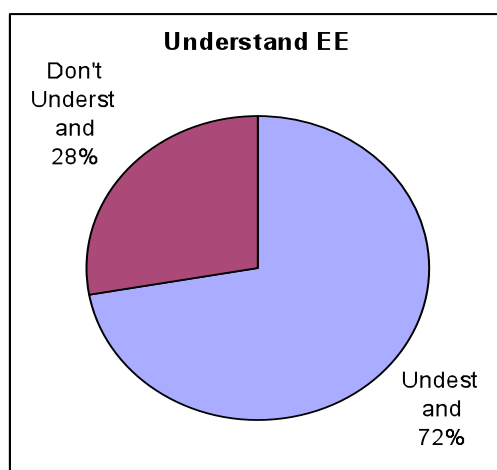
Graph 4k: Monitoring electricity at home.

76% respondents monitor energy consumption in their home which indicates their concern and awareness of what they consumed. 91 % are aware of their electricity at their home and 86% practice EE at home.

#### 4.5. Awareness on Energy Efficiency

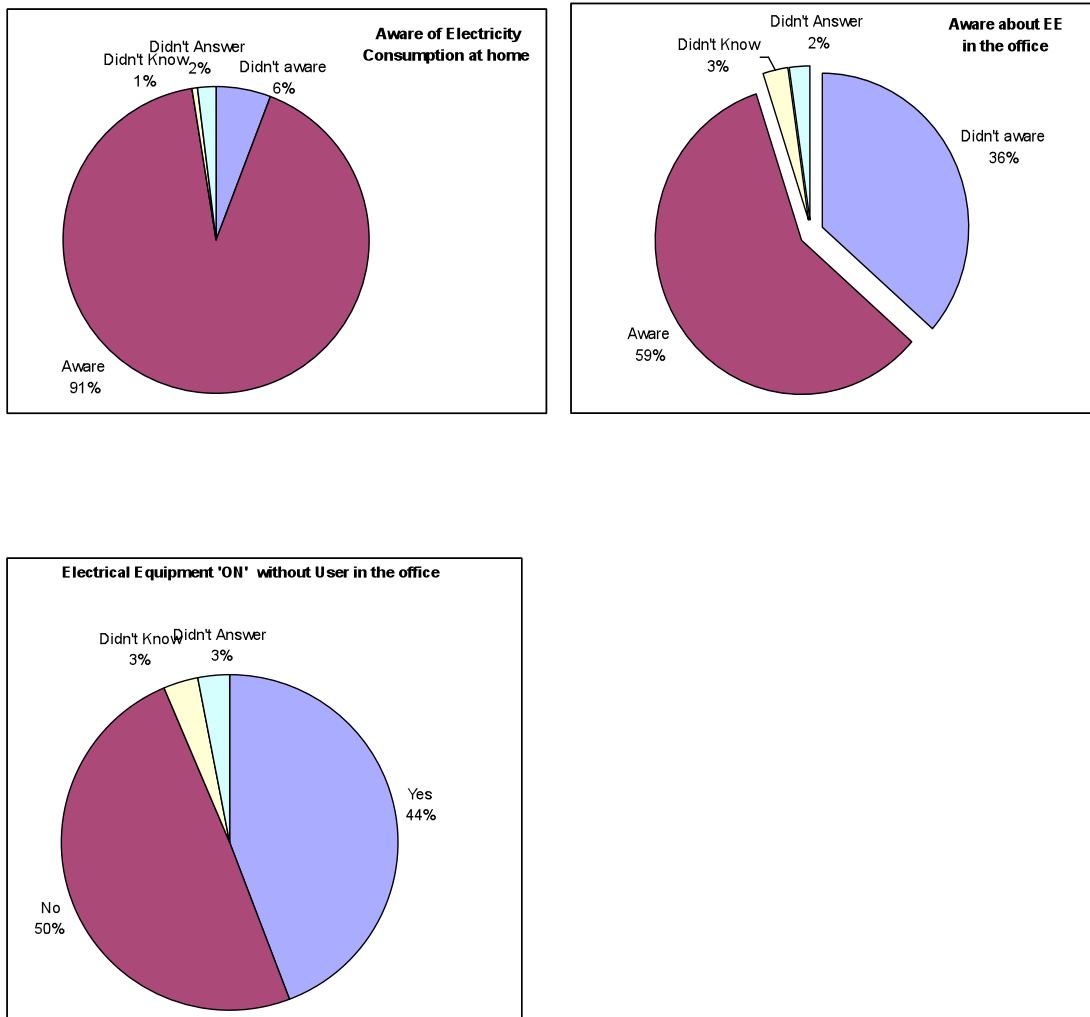
Several questions were asked such as EE definition and the differences between energy saving, optimum use of energy. The result is 72% of respondents understand EE, 54% of respondents understand EE practice and 86% understand the positive impact of practicing EE.





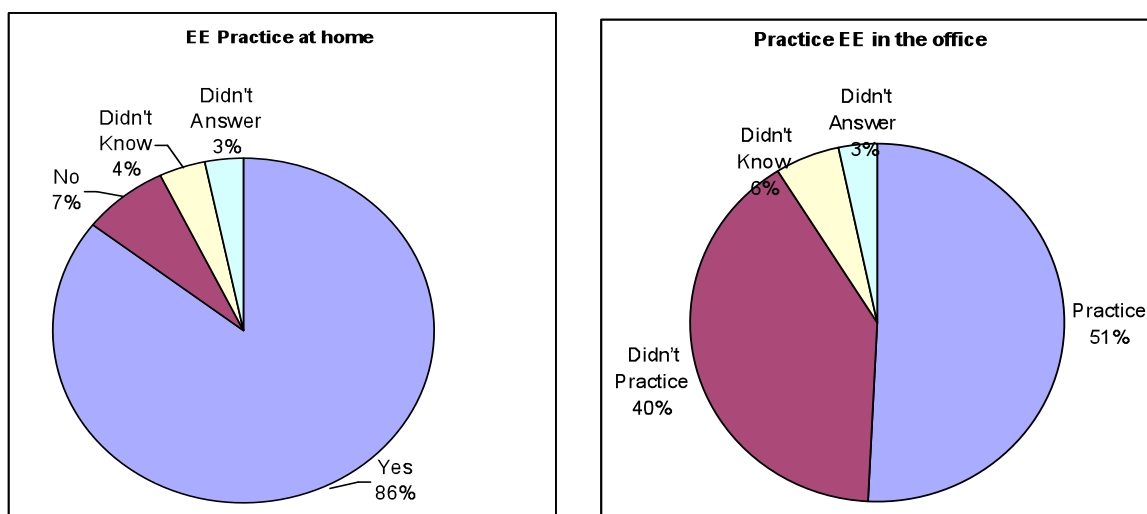
Graph 4l – 4n: Knowledge on Energy Efficiency (EE) and Impact on environment and government when energy is generated and used.

59% are aware of EE in their office, 44% agree that in their office, electricity equipment is always 'ON' without user. Unfortunately only 29% know there is a National EE month organised by central government.



Graph 4o-4q: Awareness on Electricity consumption at home.

86% says they practice EE at home, but only 51% practice EE in the office.



Graph 4r: EE practice at home compare to in the office

<b>Awareness</b>	<b>Respondents (%) (2008)</b>
Monitor energy consumption in their home	76
Aware of their electricity at their home	91
Aware about EE in the office	59
Aware that electricity equipment 'ON' without user in the office	44
Know there is a National EE month	29

Table 4b: Summary of the result of awareness on energy, renewable energy and EE survey.

#### 4.6. Practices on Energy Efficiency

86% says they practice EE at home, but only 51% practice EE in the office. Asked about any effort on EE implemented in their office, only 33% says yes.

<b>Practice on EE</b>	<b>Government employees (%) (2008)</b>
Practice EE at home.	86
EE initiative, program or effort in office at <b>their personal level</b>	51

Table 4c : EE practice at home and in their office

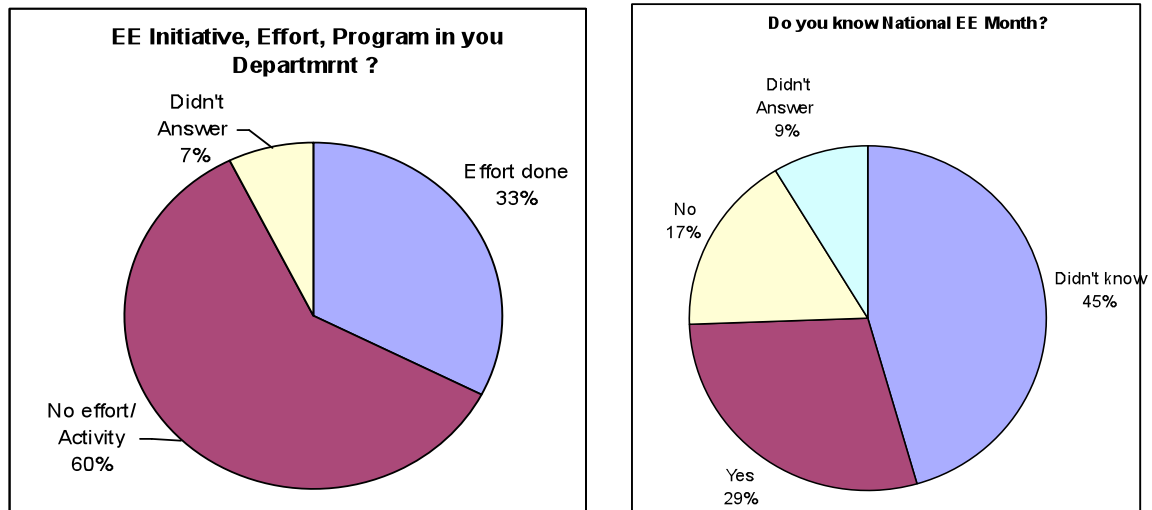
#### 4.7. Energy Efficiency Initiatives in government offices

The study also examine initiatives or effort at organisation or department level. The question investigate regarding 'memo' or 'instruction' circulated, program, project or any effort that can be implied as EE program or EE initiatives in their office. Analysis of the questionnaires reveals, only 27% says that there is 'memo' or 'instruction' to implement EE circulated in the office. Asked when was the memo circulated, 26% says that the memo was circulated in the year 2006, 14% says in 2007 and 12% says in 2008. From the 27% above, only 28% says the instruction was implemented (about 7% of the total respondent). On other question related to the EE activity, 24% says there is an EE

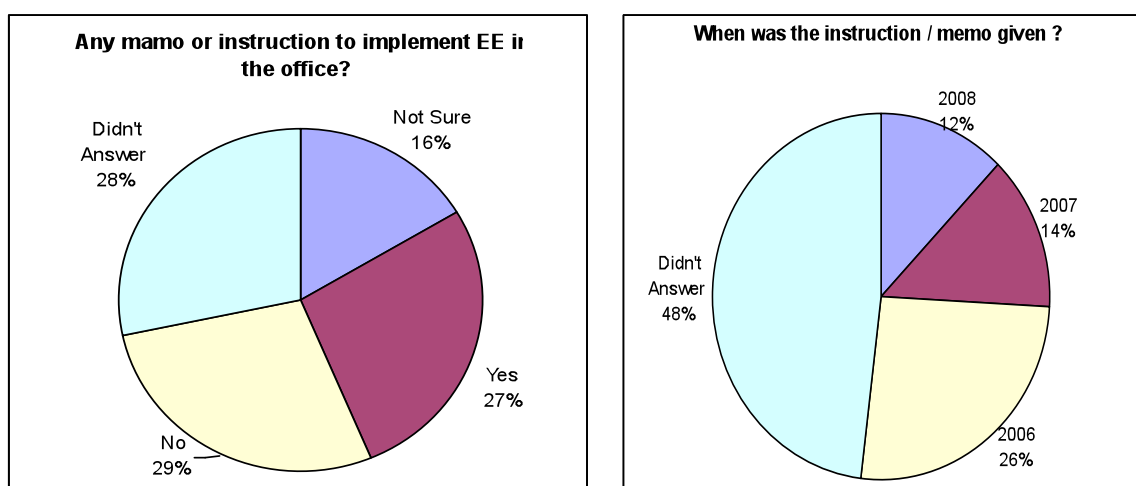
campaign in their office and only 5% of them declare there is a project on EE implemented in their office.

Only 33% agree there is an effort on EE in their office

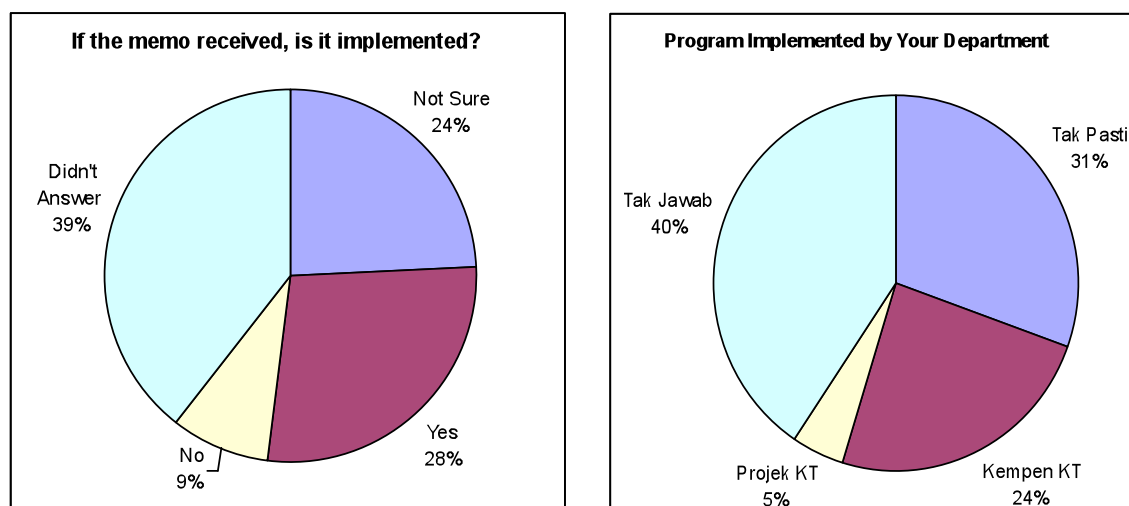
Only 29% know there is a National EE month.



Graph 4s-4t: Program & initiatives in government office



Graph 4u: Program & initiatives in government office



Graph 4v: Program implemented

EE initiatives	Government employees (%) (2008)
EE initiative, program or effort in their office	33
Memo or instruction circulated to implement EE in the office.	27
From 27% says about the memo, says implemented	28 (about 7% of the total respondent).
Says there is an EE campaign in their office	24
Says there is project on EE.	5

Table 4d: Summary of the result on EE initiatives.

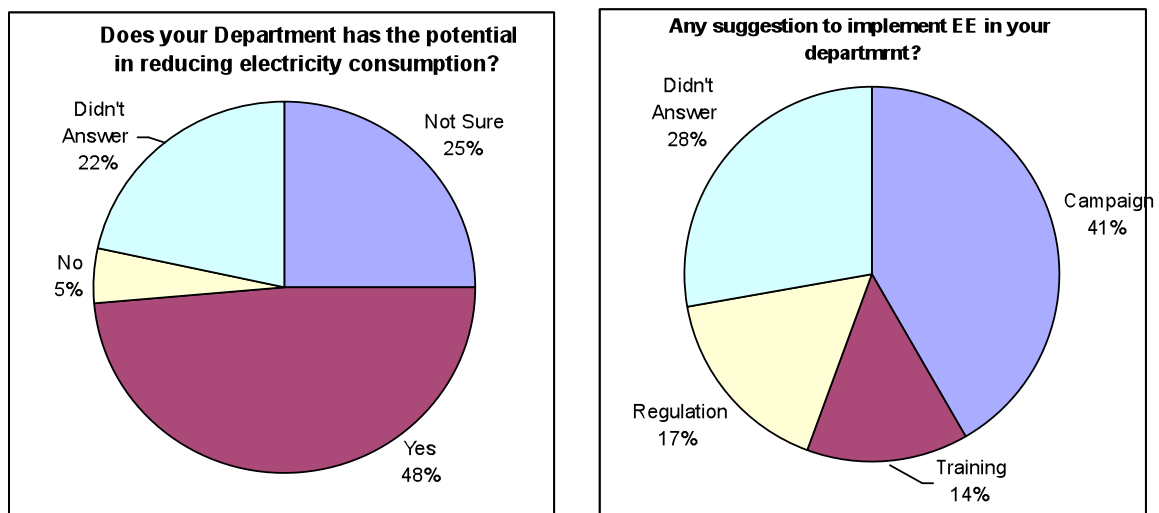
#### 4.8. Energy Saving Potentials

The study also investigate another level of government employees analytical views related to EE and energy saving potentials. Views and suggestion from respondents are received. The analysis reveals that 48% of government employees believe that there is a potential of electricity saving in their office and only 5% says no saving potential. However about 47% are not very sure about the potential savings.

Asked about choices to implement EE in their office, majority (41%) suggest through EE campaign (awareness and education), 17% suggest through regulation imposed in their office and 14% suggest through training.

48% says there is a potential of electricity saving in their office.

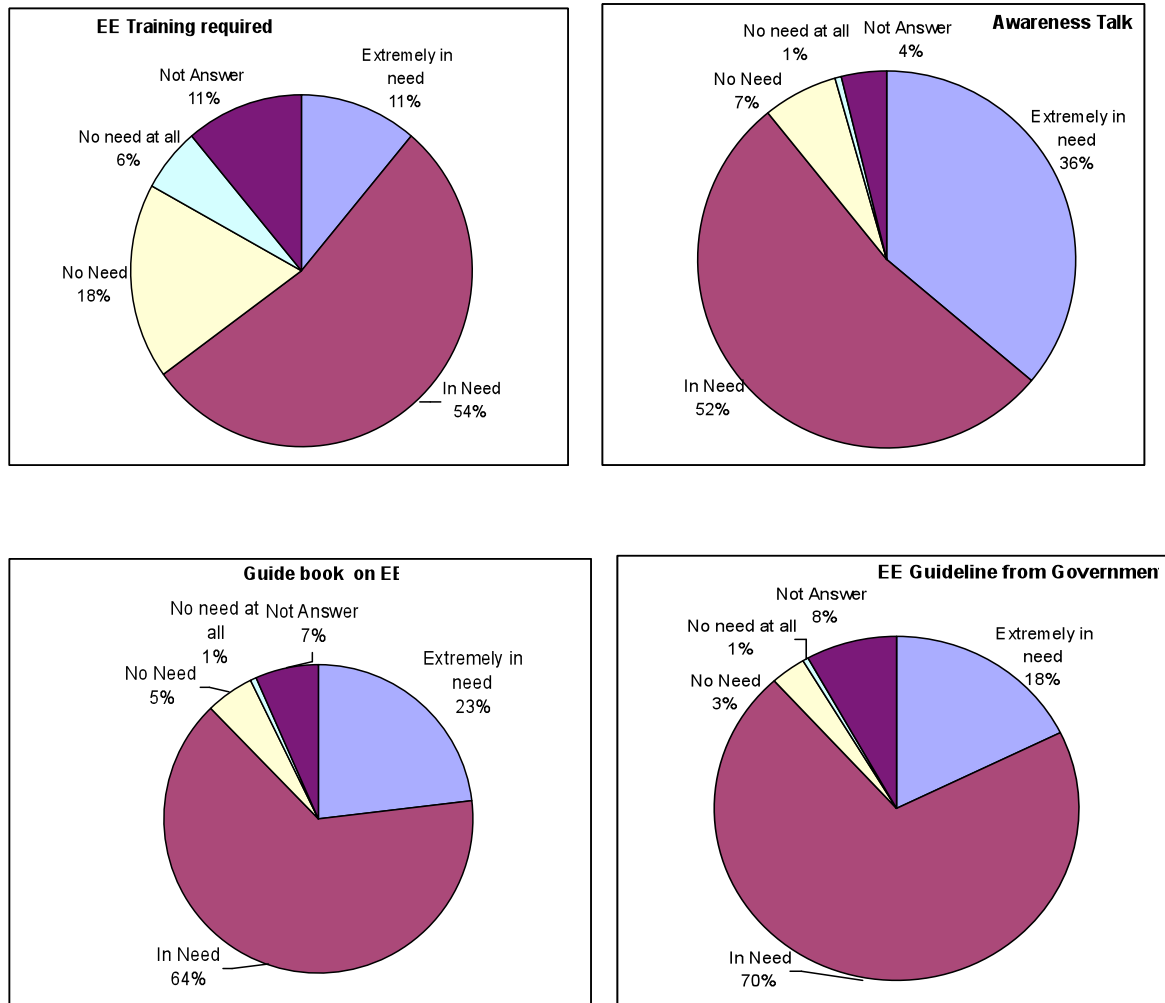
If there is a choice to implement EE in their office, 17% suggest through regulation, 14% suggest through training and 41% suggest through campaign.



Graph 4w-4x: Types of activities & program suggested.

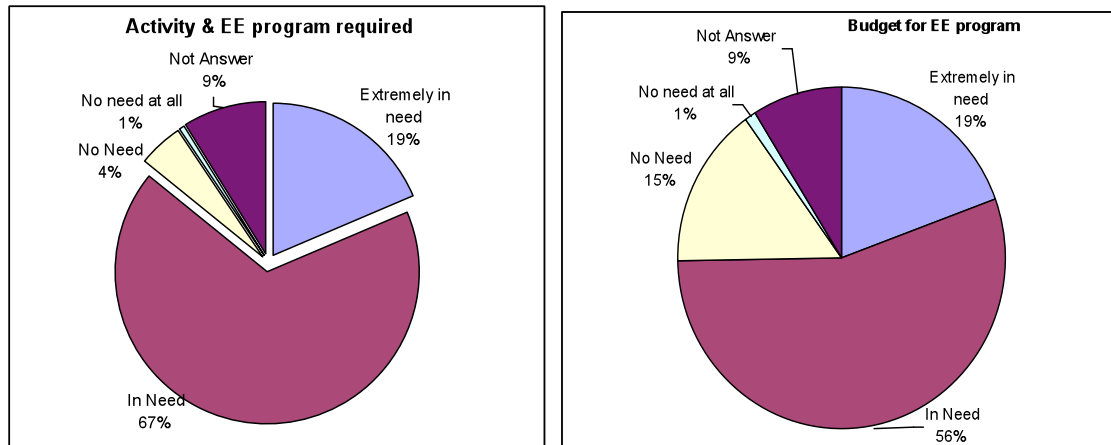
If training is suggested, 65% support and 18% do not require. If awareness talk suggested, 88% supported the idea.

Asked about a guide book on EE, 87% agreed it is required. 88% support guideline on how to implement EE from the government



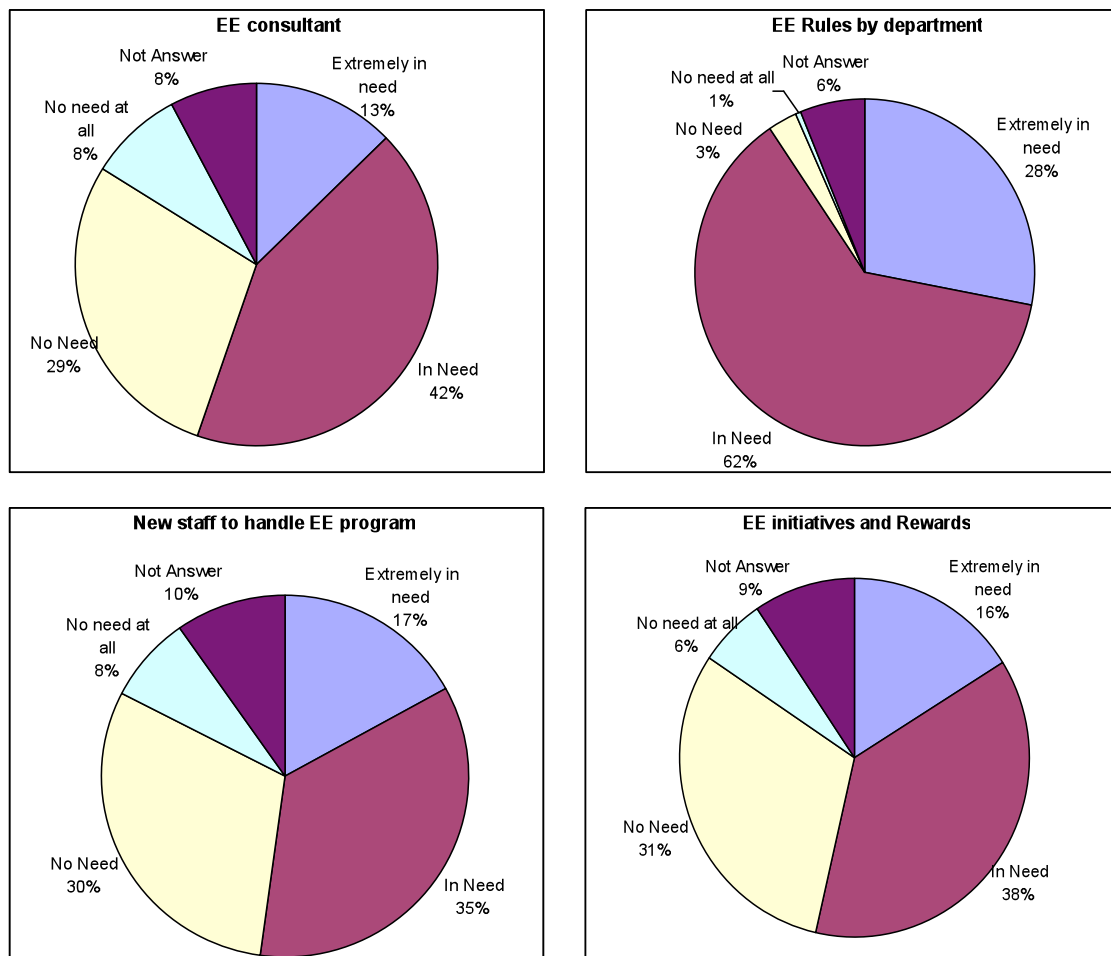
Graph 4y, 4z, 4aa &amp; 4ab Assistance required

76% says EE activities and program is required in their office. To organise EE program, 75% says they require budget. 55% say they require consultant to do EE. EE rules in the department is also required (90% agree)



Graph 4ac&amp;4ad: Assistance required

52% says require new staff to handle EE program. 54% says reward is required to implement EE.



Graph 4ae-4ah: Assistance required



Specific questions on training, majority of them (65%) support or agree the needs to organise training. Suggestion on EE awareness program or talks, higher percentage (88%) support the idea. And finally asked about a guide book on EE as campaign media or tools, 87% agreed.

Higher percentage of the respondents (88%) believe that guideline on how to implement EE is essential to assist and implement EE program.

Form of activity	Respondents (%) (2008)
EE training to government staff	65
EE awareness talk	88
EE guide book	87
EE guideline on how to implement EE	88
EE activities and program is required in their office	86

Table 4e: Form of activities required to implement EE in government office.

When asked about assistance offered for the government office to implement EE activities and programs, it was discovered that 86% of the respondents says EE activities and program is required in their office. The activities may be in the form of exhibition, awareness talks, EE competition and materials distributions. To organise those activities, several questions were asked and the survey found that 75% says they require budget and 55% says they require consultant to do EE program. 90% suggest EE rules and regulation in the department is essential; 52% says they require new staff to handle EE program and 54% says reward is essential to implement EE.

Assistance required	Respondents (%) (2008)
require budget to organise EE activity in the organisation	75
require consultant to carry out EE program/project.	55
require rule & regulation in the office to achieve EE	90
require new staff to handle EE program.	52
require reward to implement EE	54

Table 4f: Summary of the assistance required to implement EE program & project.

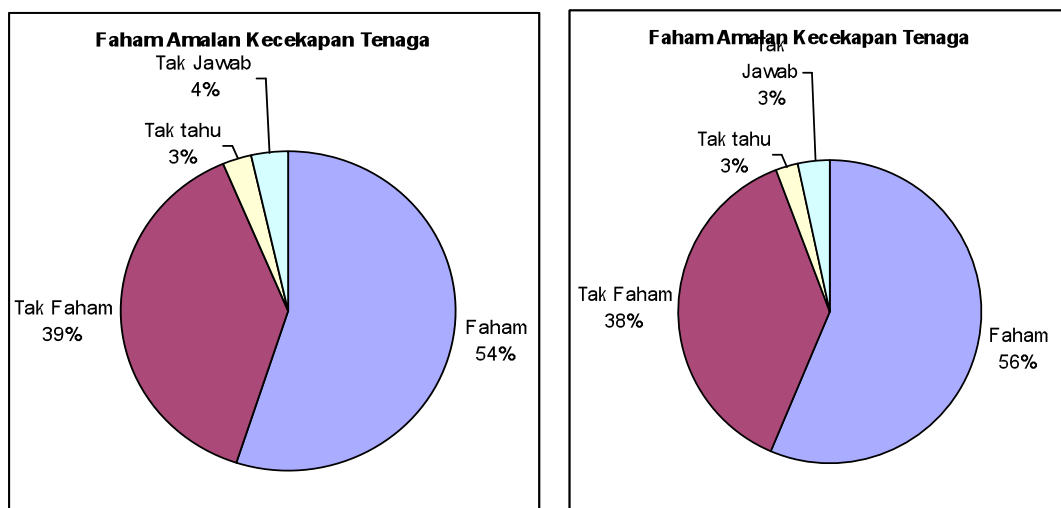
#### 4.9. Comparing executive and supporting staff.

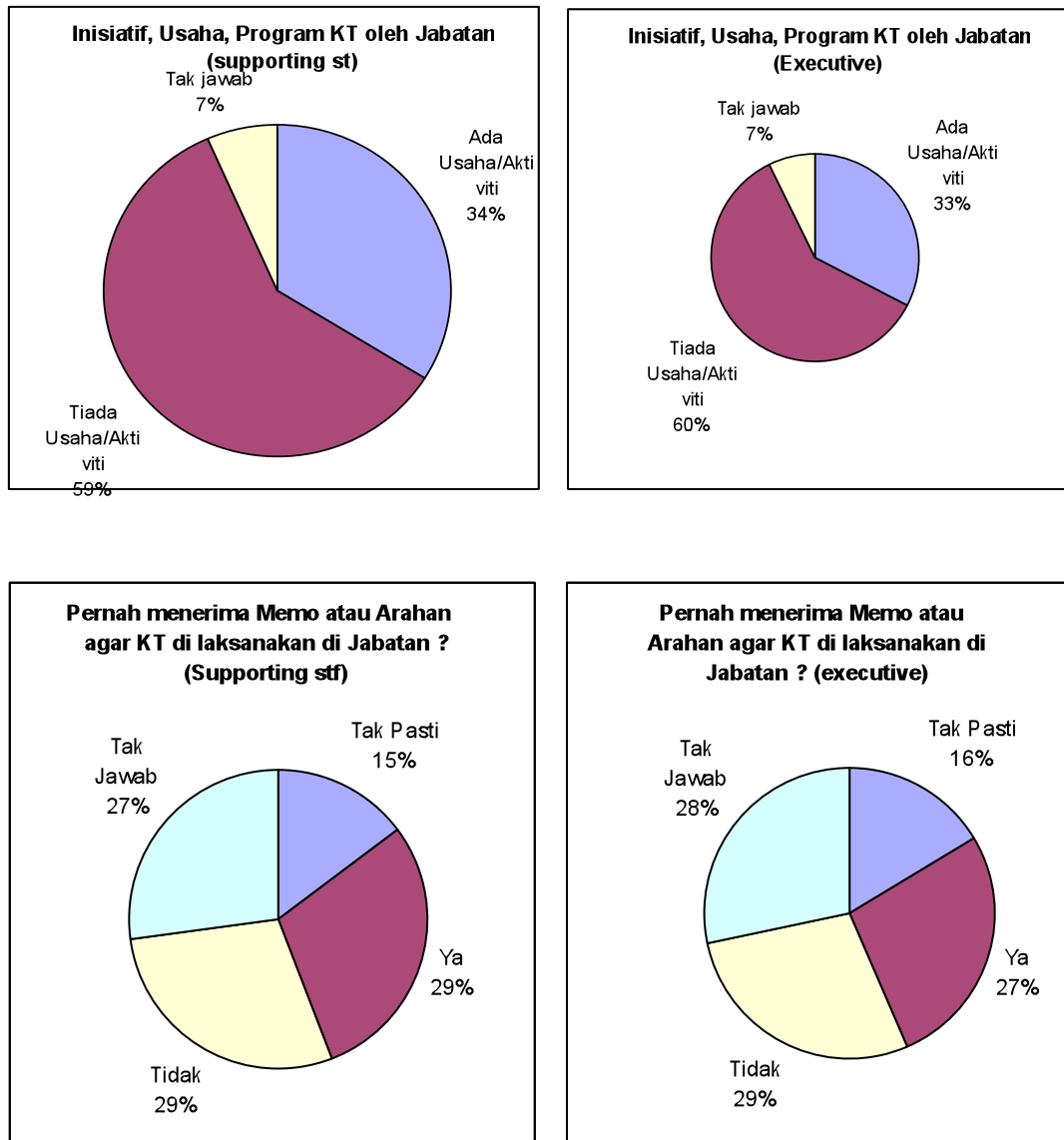
Comparing executive employee and supporting staff, the understanding on EE does not show any difference, substantial majority understood EE (85% executive and 88% supporting staff). The same percentage also shows their understanding on EE practices (54% executive & 56% supporting staff).

Booth executive (60%) and supporting staff (59%) have generally reveal similar answers that no effort and activities on EE were initiated in their office.

Only small percentage (executive 27% and supporting 29%) received memo or circulation to implement KT in their office or department.

Both executive and supporting staff has similar knowledge, understanding, awareness, views and practices.





**Graph 4ai-4an: Comparison between Supporting Staff & Executive level**

#### **4.10. Summary.**

This chapter present data collected and analyse using excel spreadsheet software. The analysis presents percentage of respondents answer. The results show there are generally high percentage of understanding and awareness on energy and Energy Efficiency at their personal level. However practices on EE is generally at average level.

## **CHAPTER 5**

### **RESULTS AND DISCUSSION**

#### **5.1 Introduction.**

This section present results and discusses what can be interpreted and understood from the analysis. This section interprets and find out the reason behind the result. Some relationship and co-relation between the results is also analyzed.

Respondent composition covers all ranges. In terms of background education, the respondents comprised of all level, where more then 50% obtained diploma, degree and Master or PhD. Approximately 54% of the respondent have work more than 3 years. Only 16% have worked less than a year. With that composition, the respondents should have substantial knowledge about their office and credibility for their answers.

#### **5.2 Level of Knowledge on Energy, RE & EE**

The study reveals that 70% of respondents among government employees understand what energy is. 15% doesn't understand energy and 15% didn't know or didn't answer. Comparing with the survey done by CETREE among teachers in Malaysia in year 2000, government employees in 2008 have 10% higher knowledge on energy. Regarding to the understanding on RE, 59% of respondents understand what renewable energy is. 15% doesn't understand energy and 15% didn't know or didn't answer. It can be concluded that 41% did not understand RE. On the question to examine their understanding on environmental aspect related to energy, only 33% of respondent among government employees understand energy generation causes environmental impact. However 70% of respondent among government employees understand fossil fuel burning causes global warming and 78% respondents agree, excessive energy consumption causes country's burden.

Several questions were asked such as EE definition and the differences between energy saving and optimum use of energy. The result is 72% of respondents understand EE, 54% of respondents understand EE practices and 86% understand the positive impact of practicing EE.

### 5.3 Level of Awareness on Energy & EE

76% respondents monitor energy consumption in their home which indicates their concern and awareness of what they consumed. 91 % are aware of their electricity at their home and 86% practice EE at home. 59% are aware of EE in their office, 44% agree that in their office, electricity equipment is always „ON" without user. Unfortunately only 29% know there is a National EE month organised by central government.

Awareness	Respondents (%) (2008)
Monitor energy consumption in their home	76
Aware of their electricity at their home	91
Aware about EE in the office	59
Aware that electricity equipment 'ON' without user in the office	44
Know there is a National EE month	29

Table 5a: Summary of the result of awareness on energy, renewable energy and EE survey

### 5.4 Level of Practices on Energy Efficiency

86% says they practice EE at home, but only 51% practice EE in the office. Asked about any effort on EE implemented in their office, only 33% says yes.

Practice on EE	Government employees (%) (2008)
Practice EE at home.	86
EE initiative, program or effort in office at their personal level	51

Table 5b : EE practice at home and in their office

The study also examine initiatives or effort at organisation or department level. The question investigate regarding 'memo' or 'instruction' circulated, program, project or any effort that can be implied as EE program or EE initiatives in their office. Analysis of the questionnaires reveals, only 27% says that there is 'memo' or 'instruction' to implement EE in the office were circulated. Asked when was the memo circulated, 26% says that the memo was circulated in the year 2006, 14% says in 2007 and 12% says in 2008. From 27% answered above, only 28% says the instruction was implemented (about 7% of the total respondent). On other question related to the EE activity, 24% says there is an EE campaign in their office and only 5% of them declare there is a project on EE implemented in their office.

EE initiatives	Government employees (%) (2008)
EE initiative, program or effort in their office	33
Memo or instruction circulated to implement EE in the office.	27
From 27% says about the memo, says implemented	28 (about 7% of the total respondent).
Says there is an EE campaign in their office	24
Says there is project on EE.	5

Table 5c: Summary of the result on EE initiatives.

### 5.5 EE Potential & Willingness to Implement EE program.

The study also investigate another level of government employees analytical views related to EE and energy saving potentials. Views and suggestion from respondents are received. The analysis reveals that 48% of government employees believe that there is a potential of electricity saving in their office and only 5% says no saving potential. However about 47% are not very sure about the potential savings.

Asked about choices to implement EE in their office, majority (41%) suggest through EE campaign (awareness and education), 17% suggest through regulation imposed in their office and 14% suggest through training.

Specific questions on training, majority of them (65%) support or agree the needs to organise training. Suggestion on EE awareness program or talks, higher percentage (88%) support the idea. And finally asked about a guide book on EE as campaign media or tools, 87% agreed. Higher percentage of the respondents (88%) believe that guideline on how to implement EE is essential to assist and implement EE program.

Form of activity	Respondents (%) (2008)
EE training to government staff	65
EE awareness talk	88
EE guide book	87
EE guideline on how to implement EE	88
EE activities and program is required in their office	86

Table 5d: Form of activities required to implement EE in government office.

When asked about assistance offered for the government office to implement EE activities and programs, it was discovered that 86% of the respondents says EE activities and program is required in their office. The activities may be in the form of exhibition, awareness talks, EE competition and materials distributions. To organise those activities, several questions were asked and the survey found that 75% says they require budget and 55% says they require consultant to do EE program. 90% suggest EE rules and regulation in the department is essential; 52% says they require new staff to handle EE program and 54% says reward is essential to implement EE.

Assistance required	Respondents (%) (2008)
require budget to organise EE activity in the organisation	75
require consultant to carry out EE program/project.	55
require rule & regulation in the office to achieve EE	90
require new staff to handle EE program.	52
require reward to implement EE	54

Table 5e: Summary of the assistance required to implement EE program & project.

## CHAPTER 6

### CONCLUSION AND RECOMMENDATION

#### 6.0 Introduction.

This section presents conclusion of the study done. Some recommendations to improve EE in government office are also presented. Potential follow-up and further research is also discussed.

#### 6.1. Conclusions

This study concludes that government employees in general have adequate or high level of knowledge, awareness and practices on Energy and Energy Efficiency (EE). The study also reveals that the knowledge and awareness on EE is quite high at home (91% of respondents), due to their understanding on the impact of using high energy including cost implication on their income, their knowledge on environmental impact (global warming) and their concerns on high government spending on energy (more than 70%). However there was inconsistency in their EE practices. About 87% says they practice EE at home but only 53% practice in their office. Although they aware about inefficient EE practices in their office (44%), but the drive to initiate EE individually is low. The main reason is due to the poor implementation program of EE at departmental level. Only about 26% of the government employees say there is a memo on EE circulated to remind them to practice EE in their office and from that population, only 28% says the EE program is implemented (about 7% of the total respondent). And 24% says there is an EE campaign in their office and there is 5% project on EE. Although the government has developed national policies on EE, officially announced and implementation of National EE Month which started from 1st November 2007, but only 29% are aware about the program.



This study strongly recommends that the government should focus on EE implementation program at all level of government ministries, agencies and departments. Since the potential to reduce energy in government building is obvious as proven by programs and projects carried out by PTM and the study reported by Henrik Rytter Jensen (October 2000), EE program through good housekeeping can save millions of government utility cost. This study also concludes that several approaches are important to be implemented such as through strong regulations, trainings and through EE campaign and talks in government offices. Finally we believe that the government policies on EE and Energy Conservation objectives could not be achieved successfully without clear and systematic implementation of Energy Conservation Program throughout government offices nationwide. The program should not only promote awareness but also improve knowledge and practices on EE among government employees through budget allocation to implement program and consultancy projects. Finally it is also important that in every office, EE programs should be lead by the top management officers of all agencies and monitored continuously to ensure at least 10% electricity consumption reduction at all government agencies can be achieved as decided and documented in government 2006 budget elaborated in previous paragraph.

## **6.2 Proposed program**

Immediate effort to improve the level of knowledge, awareness and practices of Energy & EE among government building operators and government employees are crucial and important. Further research to develop awareness materials and training modules is also important to enhance government employee human capital & skills. Strategies to collaborate activities and training between local authorities and government agencies related to EE in government building should be coordinated to achieve the government objectives on energy conservation.

The government should actively campaign the awareness of energy efficiency and conservation through road shows and seminars for the public. This campaign should also encompass the various government bodies and ministries, professionals and organizations within the building industry in order to promote the application and improvements of policies, regulations and technologies of energy saving initiatives. With the implementation and proper

follow-up of these measures, Malaysia would be in a better position to reduce its energy costs while still maintaining a comfortable and sustainable lifestyle.

### **6.3 Suggestions for Further Research**

#### **6.3.1. Proposed improvement strategies and retrofitting approach**

The energy management and maintenance still needs to be improved for most government building in order to achieve energy efficiency and save government utility bills. Maybe lack of sensitivity during design had caused discomfort and need to use more energy in order to gain comfort.

From the questionnaire, it's proven that some of the building occupants are still not aware and some are or maybe they just act like they know. The occupants of the building play the most important role in managing energy. Energy usage in the building can be controlled according to the list below:

- 1) Lighting
- 2) Air-conditioning
- 3) Mechanical-lift system
- 4) Space planning and building envelope.
- 5) Human Behaviors and awareness

Further research on those areas to identify energy saving potentials can be appropriate to help government building

#### **6.3.2. Training and Awareness Program in Government Building**

Energy consumption in government building depends on the behaviors of the employee themselves. If they are aware of energy usage, they react and control the usage of energy. Some people don't even notice at all. So, if human can control the energy, this will improve on energy management rather than just counting on machines. Based on the survey, it was found that government employees require assistance to carry out EE programs and activities.

Research and consultancy to organize program, writing policies and improve awareness and knowledge among top management as well as general government employees are crucial.

### **6.3.3. Education and training for architects, engineers, consultants and building operators.**

Education and training should be provided to architects, consultants or engineers, such as on how to design more energy efficient buildings and the use of tools to aid energy performance calculations. Incentive should be given to companies that purchase energy efficient technologies and software that helps improve application of energy efficient building designs. Energy saving knowledge should also be made a part of the educational syllabus at tertiary level. Specific research and modules can be useful to be developed and used as training modules to those responsible in building design and building operators.

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## APPENDIX A

### **Energy Conservation In Building: Study on Awareness and Practices among Malaysia's Government Employees**

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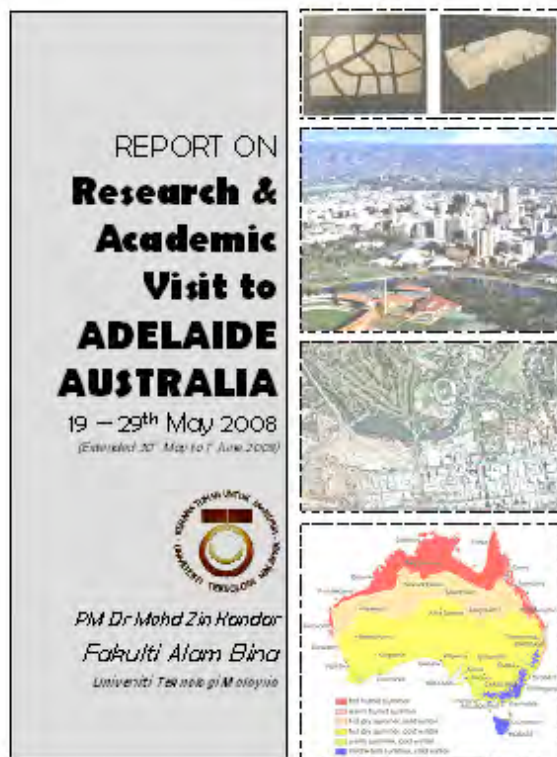
#### **Abstract**

Buildings are responsible for at least 40% of energy used in most Countries. The absolute figure is rising fast, as construction booms, especially in developing countries including Malaysia. Since energy consumption is identified as one of the major cause in climate change issues, effort to reduce energy consumption in building is considered an important strategy. Energy conservation in building can be achieved through three strategies; i.e; the physical design of the building; through electrical equipment used in the building; and the behavior of the building users. This paper discusses the study done on building user behavior and practices in Energy Conservation. It is essential to investigate the status of awareness, knowledge and practices among building users because building users determine the pattern of energy consumption. Government of Malaysia has been actively developing policies, initiatives and programs in energy conservation not only to improve Energy Efficiency practices in the country but also in combating global warming through the reduction of fossil fuel consumption in building sector. Government also set 10% reduction target of energy consumption in all government building in 2006. However the response by the public is still slow. This paper presents the investigation carried out on the level of awareness and practices among government employees. The survey has been carried out on employee to examine the level of understanding and the initiatives organised in government offices. The results show that, up to 70% of government employee understand about energy and 85% understand EE, however practices on energy conservation individually and collectively are still low (about 50%). This can be the reason why the program initiated by the government cannot be implemented successfully. Other reason for the low EE practice is due to the lack or initiative and program within the organisation/department. The paper also suggests that strategies to organise training and campaign should be done to increase Energy Conservation Practices among government employees to achieve EE target set by the government.

**Keywords:** Energy Conservation, Energy Efficiency, Awareness & user behaviour, Education, Government Building.

# Presented in the *International Conference on Construction Industry 2009 (ICCI 2009)*, 27thJuly-2ndAug. 2009, Universitas Bung Hatta, Padang Sumatera Barat, Indonesia

## APPENDIX B



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# Report Submitted to RMC UTM, July 2008



## APPENDIX C



# **Presented at** Short Seminar at Faculty of Architecture & Urban Design, University of Adelaide, Research & Academic Visit to ADELAIDE AUSTRALIA, 19 – 29th May 2008

## APPENDIX D



# Presented at Meeting and Seminar Presentation at Swanbury Penglase Architects office, Adelaide. Research & Academic Visit to ADELAIDE AUSTRALIA, 19 – 29th May 2008