

POSTER APPEAL IN FOSTERING ENERGY CONSERVATION BEHAVIOUR
AMONG GOVERNMENT OFFICE BUILDING USERS

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POSTER APPEAL IN FOSTERING ENERGY CONSERVATION BEHAVIOUR
AMONG GOVERNMENT OFFICE BUILDING USERS

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requirements for the award of the degree of
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DEDICATION

*Specially dedicated to my beloved mother in heaven, father and brothers
For their love, sacrifices, blessings and supports*

*To my lovely husband, Chin Hon Choong
For his patient and endless support*

*Associate Professor Dr. Choong Weng Wai
Associate Professor Dr. Fatin Aliah Phang
Professor Dr. Abdul Hakim Mohammed
For their guidance and sharing of knowledge*

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ABSTRACT

Energy is essential for a nation to achieve sustainable development. The need for Malaysia to achieve efficient energy usage was explicitly addressed in the Ninth and Tenth Malaysia Plan. Extended from that, the government has directed all government office buildings to reduce energy usage by 10%. However, the lack of energy saving behaviour among building users still remains a major challenge. Previous studies reveal that visual persuasion tool is useful to encourage voluntary behaviour change for efficient energy usage. Poster is one of the visual persuasion tool. Yet, the effectiveness of different types of poster appeal in energy saving context remains unknown. The objectives of this research are to identify different types of poster appeal to foster energy conservation behaviour among government office building users; and to investigate the effectiveness of different poster appeal in fostering energy conservation behaviour among government office building users. Lights-off behaviour in washroom has been selected as targeted energy conservation behaviour in this study, which is an outcome from a focus group discussion. The methodology for this study consisted of two major stages: Focus group and Quasi-experimental studies. In order to identify the types of poster appeal, energy saving posters were shown to the focus group participants which included the energy saving expertise, designers and representatives from Kota Iskandar. Fear appeal, fun appeal and guilt appeal were identified from the focus group discussion and used as the visual persuasion tool in a Quasi-experimental study. The Quasi-experimental study involve: (i) one month pre-experimental (baseline) and (ii) four month post-experimental (intervention) which was then followed by a one month follow up, conducted in Kota Iskandar, Johor. A control group (without poster) and three treatment groups (with poster) were involve in the observations. A total of 6,750 observations were conducted on the government office staffs throughout the six months Quasi-experimental study, involving a total of 68 washrooms. Mann-Whitney U test, Kruksal Wallis test, Wilcoxon test and Friedman test were conducted to analyse the collected data. The result indicates that there was an increase of lights-off frequency at the washroom for the three treatment groups while no changes were detected for the control group. The findings suggests that fear appeal has an immediate effect within a short period of time, but the effect did not last long. Over time, guilt and fun appeal were identified to be more effective than fear appeal and their effect were able to sustain after the removal of the poster. This study will contribute to existing literature by revealing the effectiveness of application of fear, fun and guilt appeal to foster lights-off behaviour. Facilities manager can utilise the appropriate poster appeal in fostering energy saving behaviour among the office building users.

ABSTRAK

Tenaga adalah penting untuk negara mencapai pembangunan mampan. Keperluan bagi negara Malaysia untuk mencapai penggunaan tenaga secara cekap telah dijelaskan dalam Rancangan Malaysia Ke-sembilan dan Ke-sepuluh. Berlanjutan dari itu, kerajaan telah mengarahkan semua bangunan kerajaan untuk mengurangkan penggunaan tenaga sebanyak 10%. Namun, kekurangan tingkah laku penjimatan tenaga di kalangan pengguna bangunan masih kekal sebagai salah satu cabaran utama. Kajian terdahulu mendedahkan bahawa instrumen pujukan visual adalah berguna untuk menggalakkan perubahan tingkah laku secara sukarela dalam penggunaan tenaga secara cekap. Poster merupakan salah satu instrumen pujukan visual. Namun, keberkesanan pelbagai jenis poster rangsangan dalam konteks penjimatan tenaga masih tidak diketahui. Objektif penyelidikan ini adalah untuk mengenal pasti pelbagai jenis poster rangsangan untuk memupuk tingkah laku pemuliharaan tenaga di kalangan pengguna bangunan kerajaan; serta mengkaji keberkesanan poster rangsangan yang berbeza dalam memupuk tingkah laku pemuliharaan tenaga di kalangan pengguna bangunan kerajaan. Tingkah laku tutup lampu di bilik air dipilih sebagai tingkah laku sasaran untuk pemuliharaan tenaga, di mana ia merupakan hasil daripada perbincangan kumpulan fokus. Metodologi kajian ini terdiri daripada dua peringkat: Kumpulan Fokus dan Kajian Quasi-eksperimen. Untuk mengenalpasti jenis poster rangsangan, poster-poster penjimatan tenaga telah ditunjukkan kepada para peserta kumpulan fokus yang terdiri dari pakar penjimatan tenaga, pereka dan wakil dari Kota Iskandar. Rangsangan ketakutan, rangsangan keseronokan dan rangsangan serba salah telah dikenalpasti daripada perbincangan kumpulan fokus dan digunakan sebagai instrumen pujukan visual dalam kajian Quasi-eksperimen. Kajian Quasi-eksperimen melibatkan: (i) Sebulan pra-eksperimen (Garis Dasar), dan (ii) Empat bulan pasca-eksperimen (Intervensi), diikuti dengan satu bulan susulan, di Kota Iskandar, Johor. Satu kumpulan kawalan (tanpa poster) dan tiga kumpulan rawatan (dengan poster) terlibat dalam pemerhatian. Sebanyak 6,750 pemerhatian dijalankan pada pengguna bangunan pejabat sepanjang enam bulan kajian Quasi-eksperimen, melibatkan sejumlah 68 bilik air. Ujian Mann-Whitney U, Ujian Kruksal Wallis, Ujian Wilcoxon dan Ujian Friedman telah digunakan untuk menganalisis data yang dikumpul. Keputusan analisis menunjukkan bahawa terdapat peningkatan frekuensi tutup lampu di bilik air bagi tiga kumpulan rawatan manakala tiada perubahan dikesan untuk kumpulan kawalan. Hasil kajian menunjukkan bahawa rangsangan ketakutan mempunyai kesan segera dalam tempoh yang singkat, tetapi tidak bertahan lama. Pada tempoh lama, rangsangan serba salah dan seronok didapati lebih berkesan daripada rangsangan ketakutan dan kesannya berkekalan selepas penyingkiran poster. Kajian ini akan menyumbang kepada literatur yang sedia ada dengan mendedahkan keberkesanan aplikasi rangsangan ketakutan, keseronokan dan serba salah dalam memupuk tingkah laku tutup lampu. Pengurus fasiliti boleh menggunakan poster rangsangan yang sesuai untuk memupuk tingkah laku penjimatan tenaga di kalangan pengguna bangunan pejabat.

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LIST OF ABBREVIATIONS

| | | |
|------|---|--|
| BIFM | - | British Institute of Facilities Management |
| gdp | - | Gross domestic product |
| GWh | - | Gigawatt-hour |
| ktoe | - | Kilo tonne of oil equivalent |
| kWh | - | Kilowatt-hour |
| MEIH | - | Malaysian Energy Information Hub |
| RM | - | Ringgit Malaysia |
| TTM | - | Transtheoretical Model |

LIST OF SYMBOLS

| | | |
|----------|---|-----------------------------|
| CDN \$ | - | Canadian dollar |
| n | - | Sample size |
| p | - | Probability statistic value |
| r | - | Effect size |
| χ^2 | - | Chi-square statistic |
| U | - | Mann-Whitney U statistic |
| z | - | Standard score |

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CHAPTER 1

INTRODUCTION

1.1 Introduction

According to the National Energy Balance (2014), Malaysia's total electricity consumption in the year 2014 was 128,330 GWh and had increased 4.3% as compared to the previous year which was 123,079 GWh. In addition, Malaysia's final electricity intensity has been distinctly increased from 0.117 GWh/ gdp at 2005 prices (RM Million) in year 2000 to 0.127 GWh/ gdp at 2005 prices (RM Million) in year 2014 (Energy Commission, Malaysian Energy Information Hub, retrieved on 2017 June 4). These Data indicate that there is a rising demand in electricity consumption in the country. According to Yang, Lam and Tsang (2008), the consumption of energy (per meter square) in large public buildings is accounted for 70-300 kwh, which is 10-20 times higher than residential buildings. In the Ninth and Tenth Malaysia Plan energy efficiency was clearly focused on. During the Ninth Malaysia Plan, the installation of energy efficient design and features together with energy audit has been applied in the government office building to achieve energy efficiency. To promote energy efficiency, a great struggle has been continued in the Tenth Malaysia Plan. To improve energy efficiency for energy saving potential and carbon emission reduction, an Energy Efficiency Master Plan has been designed in the Tenth Malaysia Plan. Malaysia is now setting on a journey to achieve energy efficiency goal as according to the master plan. However, one of the challenges is the lack of awareness and behaviour among energy users to achieve energy

efficiency (Yik and Lee, 2002, Attari *et al.*, 2010), majorly among office building users.

To accelerate energy conservation awareness and to develop and promote energy conservation behaviour among office building users, a strong action is extremely necessary. This very purpose of this research is to utilize visual persuasion tool to stimulate energy conservation behaviour among government offices users to conserve energy. The results of this research will be beneficial for the government office building as it will help them to further explore the use of visual persuasion in saving energy, reduce energy cost, as well as to mitigate greenhouse gases emission. The details and rational of the needs of this research will be explained in the following session.

1.2 Research Background

There is no denial in the fact that energy resources are always among the most important agendas of a country. Arabatzis and Myronidis (2011) suggest that energy resources can be regarded as a strategic pillar in supporting the development of the economic system as well as the well-being of social welfare of the country. Energy has been transformed and converted into various form to support human life and civilization (Mohamed and Lee, 2006). In modern society, electricity and fuel have been demanded and converted into power to support economic activities, transportation and domestic usage.

Akin to other developing countries, energy demands in Malaysia have also increased. According to Energy Commission (2017), the final energy demand recorded in year 2014 (52,119 ktoe) is almost double up for the final energy demand as denoted in year 2000 (29,699 ktoe). Figure 1.1 shows the final energy demand in Malaysia from year 2000 to year 2015. Along with it, there is an average annual growth rate of 6.30% for energy demand as reported in the Ninth Malaysia Plan (2006-2010) compared to 5.60% as recorded on the Eighth Malaysia Plan (2001-2005). On top of that, the average annual growth rate for energy demand was

presumed to reach 6.6% from year 2011 to 2015 as according to the Tenth Malaysia Plan. In terms of electricity consumption, 61,168 GWh of electricity consumption in year 2000 had been dramatically increased to 132,199 GWh in year 2015. Figure 1.2 illustrates the electricity consumption trend in Malaysia from year 2000 to year 2015.

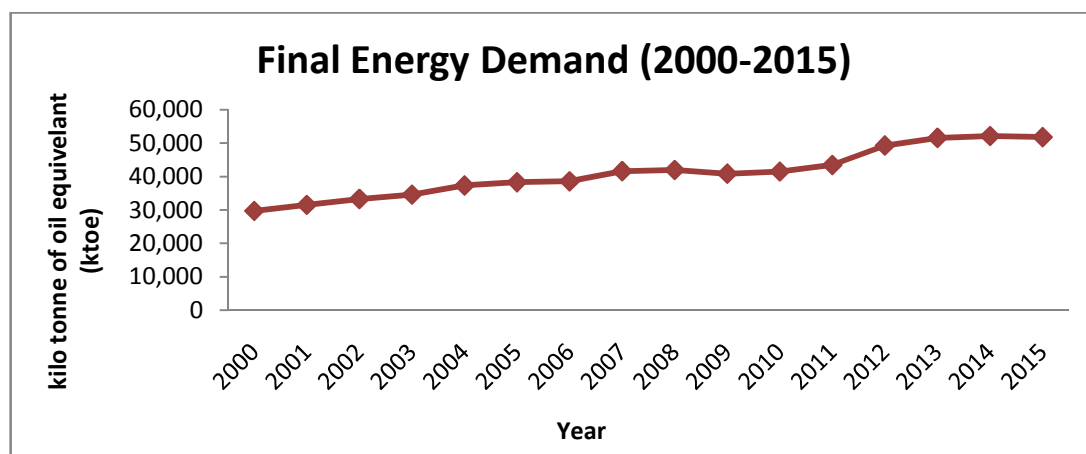


Figure 1.1: Final energy demand in Malaysia from year 2000 to 2015

Sources: Energy Commission, Malaysian Energy Information Hub (MEIH).

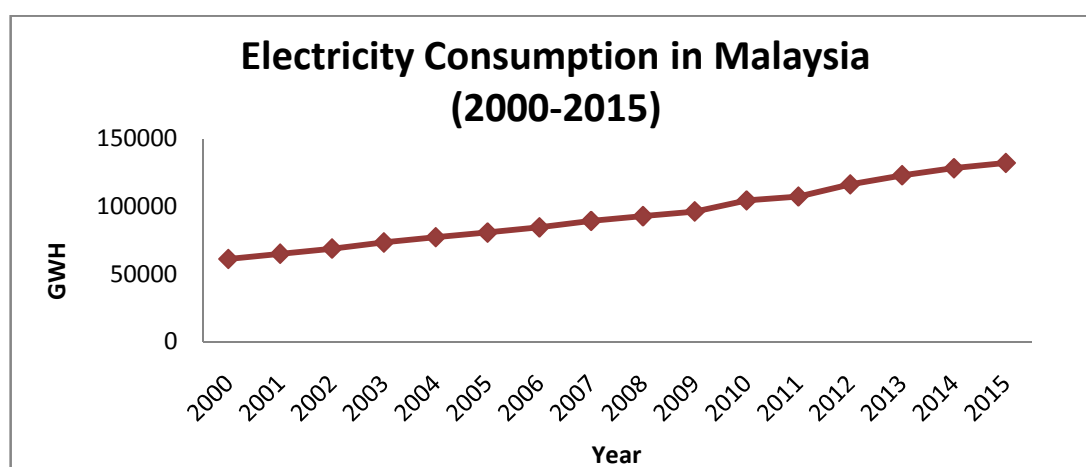


Figure 1.2: The electricity consumption in Malaysia from year 2000 to 2015

Sources: National Energy Balance, 2015, pg 18.

With the increase of energy demand, there comes change in energy consumption which is positively correlated with economy and population (Mekhilef *et al.*, 2011). It has been figured out that for every 1% rise in gross domestic product (GDP), there will be an increase around 1.5% of electricity consumption in Malaysia (Saidur, 2009; Oh, Pang and Chua, 2010). Furthermore, the final electricity intensity in year 2000 which is 0.117gwh/ gdp at 2005 prices (RM Million) has raised to

0.127gwh/ gdp at 2005 prices (RM Million) in year 2014. In addition, Bhattacharya (2003) reported an increase of 27% in energy consumption for developing country in Asia Pacific region from year 1990 to year 2000 which is higher than the overall increase rate for the world's energy consumption (which is 11%). That is why the nation may face energy deficiency, pollution and other energy related impact due to increase energy demand and consumptions by human beings.

Typically, energy consumption requires the combustion of fossil fuel to generate electricity. The nation, therefore, may face energy scarcity issue due to excessive use of energy. As a result, increase in energy demand with the addition of energy scarcity, in which fossil fuel is the basic source, is alarming the energy security of the country. According to the Malaysia Energy Statistic Handbook (2016), natural gas and oil are the dominant fossil sources which contribute to a total of 47.40% fuel mix in electricity generation. The remaining are coal (41%), hydro (10.70%) and others (0.90%). If we categorize coal as a source of fossil fuel, Malaysia is highly depended on the fossil fuel which accounts on total 88.40% of fuel mix. Table 1.1 shows the energy mix in Malaysia from year 1980 until year 2015.

Table 1.1: Energy mix in Malaysia

| Source | 1980 (%) | 1990 (%) | 2000 (%) | 2005 (%) | 2010 (%) | 2015 (%) |
|--------------------|----------|----------|----------|----------|----------|----------|
| Oil/ Diesel | 87.9 | 71.4 | 4.2 | 2.2 | 0.2 | 1.1 |
| Natural Gas | 7.5 | 15.7 | 77.0 | 70.2 | 55.9 | 46.3 |
| Hydro | 4.1 | 5.3 | 10.0 | 5.5 | 5.6 | 10.7 |
| Coal | 0.5 | 7.6 | 8.8 | 21.8 | 36.5 | 41.0 |
| Others | - | - | - | 0.3 | 1.8 | 0.9 |

Source: BioGen (2003); 9th Malaysia Plan (2006–2010), Table 19-5; Malaysia Energy Statistic Handbook (2016),pg 32.

The power industry in Malaysia is facing sustainability issue due to increased energy demand and its consumption rate (Ong, Mahlia, and Masjuki, 2011). "The philosophy of sustainability is rooted in how human manage and maintain resources

like electricity and water for future use by all cultures without compromising ecological diversity" (Holmes, T. G., 2007. p. 154). This shows that the country needs more exposure and implementation regarding the concept of sustainability. Sustainability concept applied in Malaysia will ensure energy security, continuous reliable energy supply and energy resources diversification (Mohamed and Lee, 2006). In a nutshell, Malaysia is in high need to sustain energy in various aspects to solve the problem of increased energy demand and the depletion of energy resources.

Facilities management can play a vital role in solving the issue of sustainability. According to The British Institute of Facilities Management (BIFM), it is the duty of facility management to provide, maintain and develop multiple services within an organization to support and improve the effectiveness of its business and the workplace. An effective facility management ensure a safe and efficient working environment for the employees on a day-to day basis. For instance, the availability of lift and proper air conditioning system while maintaining energy efficiency in the building at the same time. Meanwhile, according to the BIFM (2016) survey report reducing energy consumption has been considered by most of the companies as the key issue in the next 10 years. Apart from cost saving along with organizational behaviour change, energy conservation efforts such as reduce energy use, waste management and water conservation are essential to be delivered by the facilities management.

Energy is ubiquitous and it involves in consumers' daily life, action and decision (Sütterlin, Brunner and Siegrist, 2011). Energy conservation can be conducted through technology fixed approach or through behavioural approach (Wong, 1997). Technology fixed approach or structural method utilize tools, instruments, apparatus such as sensor lighting and centralized air conditioning system to conserve energy. However, Al-Mofleh *et al.* (2009) are in the opinion that the amalgamation of instruments is essential to achieve electrical energy conservation in Malaysia. The instruments include firstly, the use of efficient electrical tools, secondly, the application of passive energy technology such as solar heating and insulation, and finally the implementation of supportive tools such as public awareness, energy information and database. The first two instruments can be categorised as technology approach whereas the third instruments is a behavioural

approach. No behaviour changes of the users are required in technology fixed approach which means that energy wastage is the result of over depending on the instruments. In addition, over depending on technology or automation system may diminish pro-environmental behaviour (Murtagh *et al.*, 2015). To complement the weakness of technology fixed approach, human aspects of energy conservation should be taken into consideration.

No tools or instruments in achieving energy conservation are needed in Behavioural approach or non-structural approach. It depends on changes in human behaviour through motivation, awareness and skill development. Moreover, Sütterlin, Brunner and Siegrist (2011) stated that energy saving behaviour can be expressed through curtailment which is a repetitive energy saving behaviour in the course of change in everyday lifestyle by adopting new energy use habits (Marechal, 2009). In addition, Fishbein and Ajzen (2010) stated that “repeatedly performed behaviour has directed many to argue that they become “habits” which are characterized by a degree of automaticity and unconsciousness”. New human behaviour change when performed repeatedly, becomes a habit which is good if it is applicable to energy conservation compared to structural approach.

It is necessary for people to understand that behavioural approach is useful in energy management and is an alternate method to save energy. Energy conservation affects employees and vice versa. Besides, focusing on technology fixed approach, human behaviour factors in saving energy should be taken notice of. By monitoring people’s behaviour, there is a great chance to improve energy efficiency. Hansen (2002) mention that 80 percent energy saved in an effective energy management program is because of the people who are the main factor in energy efficiency. Furthermore, Gaballa (1996) revealed that “one of the successful criteria to generate saving is to focus primarily on behavioural changes” in the survey of successful school energy conservation programs in Tuscon.

As an effort to address the issue of energy wastage, the government of Malaysia had directed all government office buildings to reduce their energy usage by 10% (Chua and Oh, 2011). One of the strategies is to instruct government building to set their air conditioning temperature to 24 Degree Celsius. As discussed

earlier, energy consumption in office building is accounted for 70-300 kwh, which is 10-20 times higher than of the residential buildings (Yang, Lam and Tsang, 2008). Therefore, there is an abatement potential of energy for these office buildings. Even though some of the government office buildings use technology fixed approach such as centralized air-conditioning system, energy wastage still occurs, not to mention that many existing government buildings lacks energy efficient design. Hence, the best way to meet the rising demand for energy is not to supply more or solely depend on the technology fixed method (Choong, 2008). Behavioural approach seems to results effectively and helpful in energy conservation (Wedge, 2003).

Although the greatest currently available equipment could reduce energy consumption by 30% (Bertoldi, Ricci and Almeida, 2001) but neglecting consumer behaviour seems to be a mistake if we only focus on energy efficiency improvement on technology fixed method (Herring, 2006). Building users' awareness and behaviour play a crucial role in reducing the usage of energy for long term purpose and considered as a low hanging fruit method, for no large cost is involved. According to Camp (2005), raising awareness and improving energy-use behaviour are a large part of the solution for energy wastage. Therefore, humans who are the main cause of energy wastage can solve it by increasing their awareness regarding energy related issues and improving their energy usage behaviour.

There is no doubt that human's behaviour has to be implicated in the warming global climate (Newsome and Alavosius, 2011) because human behaviour is critical and it is strongly related to the environment. Human beings are the one responsible for protecting their environment and to put a stop to global warming. Although people should be aware and concerned about their actions to be taken for conserving energy, it is not easy as fostering conservation behaviour is very challenging. Kollmuss & Agyeman (2002) studied on several theoretical frameworks that have been developed to explain the gap between environmental knowledge, awareness, and demonstrate pro-environmental behaviour. Even though people have the awareness and intention to save energy, there is still a gap between their intention and action to perform energy conservation behaviour.

1.3 Problem Statement

Our country is facing the increase in energy demand and electricity consumption which will lead to the depletion of energy resources. On the 31st of March 2006, the Former Prime Minister of Malaysia, Dato Seri Abdullah bin Haji Ahmad Badawi has strengthened that:

...The public has to realise the value and scarcity of such resources, an energy conservation culture must be inculcated...Such resources need to be prudently and carefully utilised...

(Government of Malaysia, 2006b: 31)

The address of the Former Prime Minister shows that there is urgent need for creating energy awareness and improving energy use behaviour in the society so that the consumers will become aware of energy scarcity and will finally develop energy conservation behaviour.

Over the years, low energy conservation progress is caused by user's behaviour of refusal or unwillingness to change (Nandi and Basu, 2008). In order to achieve energy efficiency, the society should be concerned regarding the strategies and monitor their behaviour in consuming energy, because achieving a sustainable future relies on changing individual behaviour (McKenzie-Mohr, 2000). However, energy conservation behaviour is multifaceted and complex (McMakin, Malone and Lundgren, 2002), and it is difficult to elucidate because different people have different characteristics, thus perform different behaviour. Although there are some technologies in aiding energy conservation, failure to use and control them may lead to unsuccessful mission since people are the ones who operate the technology (Masoso and Grobler, 2010). The human behaviour plays the vital role in energy conservation.

Early studies revealed that "lack of energy awareness and energy-use behaviour" are the main reasons of energy inefficiency. Yik and Lee (2002) affirmed that lack of knowledge and motivation among users in energy-use behaviour are basic hurdles to improve energy efficiency of buildings. Attari *et al.*

(2010) is of the opinion that most people have low or little awareness on energy wastage and its impacts. Energy use awareness and energy-use behaviour have been discussed and considered as the main elements of energy efficiency and previous researchers even suggested that energy efficiency is possible only through improving behavioural changes (Loozen and Moosdijk, 2001, Matutinovic, 2008, Ouyang *et.al.*, 2009), but there is a great challenge that keeps facilities manager and energy manager out from fostering it.

As mentioned by Masoso and Grobler (2010), the building sectors has been recognized as the largest energy consumer because it accounts for a significant percentage of a nations' energy consumptions. In Malaysia, there are three main sectors that consumes majority of the electricity (see Figure 1.3). Based on the figure, commercial and public services was accounted for 32% as the second largest sector to consume electricity in Malaysia. In addition, there was a raising trend for the final electricity consumption in commercial and public services from year 2000 to year 2015 (Figure 1.4). With the passage of time, energy use in public buildings is growing further and the more we consume, the sooner our resources will be drained out. Therefore, it is vital for public buildings to play a key role in manifestation for energy-efficient improvement.

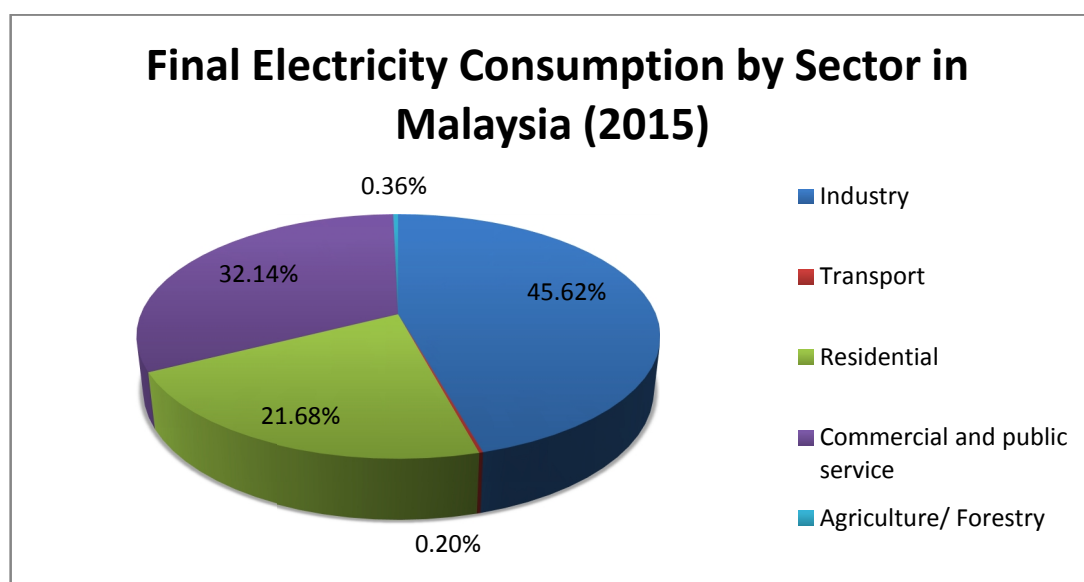


Figure 1.3: Final electricity consumption by sector for year 2015

Source: International Energy Agency (IEA)

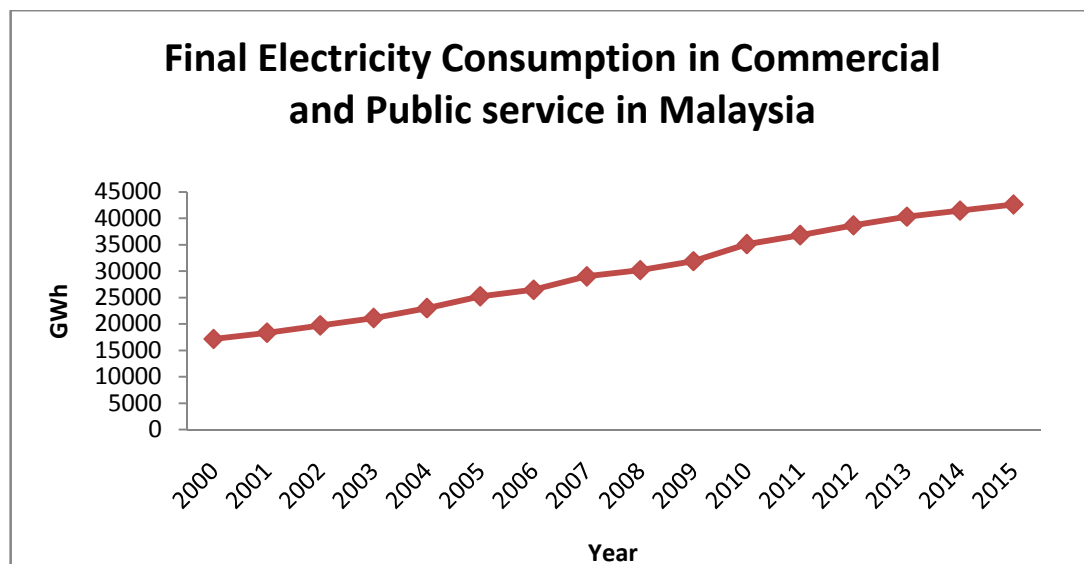


Figure 1.4: Final electricity consumption in commercial and public service

Source: International Energy Agency (IEA)

Government office buildings are significantly less energy efficient (Tahir, Nawi, Rajemi, 2015) and present great potential for energy savings as compared to other types of building. Practicing energy conservation can benefit various areas such as the environment, economy as well as the society. From the environment perspective, better energy efficiency will decelerate the overall emissions of greenhouse gas, prevent climate change and assure a better environment. So far the economy is concerned, energy conservation reduces energy bill, lessen the burden of government office buildings paying unnecessary energy cost and delay the country's movement to energy imported status. According to the Malaysia Energy Efficiency Action Plan Report by the Ministry of Energy, Green Technologies and Water (2014), the government should reduce their energy bill through leadership by example. Social benefits include sustainable society development, resolvable energy conflict between countries and decreased nuclear proliferation and nuclear power plant.

Most importantly is that energy consumption in public buildings will constantly increase in the future. Majority government buildings are not designed with energy efficiency features. For example, some of the Malaysian public buildings depend heavily on electrical lighting and are not designed for daylight utilization (Nikpour, Kandar and Mosavi, 2013; Kandar *et al.*, 2011) by using glass window with low shading coefficient and low visible transmittance so that very little