

STUDY OF ENERGY EFFICIENCY OPPORTUNITIES IN UTHM

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PERPUSTAKAAN TUN HUSSEIN ONN AMINAH

To my loving wife Wan Noredayu, my son Mohd Asyraf Zamir, my daughter Nur Afriena Zulaikha, my young daughter Nur Adriana Zulaikha , my parents, and..... ..

“THANK YOU for your support”



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In the name of Allah, The Most Gracious and The Most Merciful.

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Abstract

Sustainable energy usage has been recognized as one of the important measure to increase the competitiveness of the nation globally. Many strong emphases were given in the Ninth Malaysia Plan (RMK9) to improve energy efficient especially to government buildings. With this in view, a project to investigate the potential of energy saving in selected building in Universiti Tun Hussein Onn Malaysia (UTHM) was carried out. In this project, a case study involving electric energy consumption of the academic staff office building was conducted. The scope of the study include to identify energy consumption in a selected building, to study energy saving opportunities, to analyse cost investment in term of economic and to identify users attitude with respect to energy usage. The *MS1525:2001, Malaysian Standard -Code of practice on energy efficiency and use of renewable energy for non-residential buildings* was used as reference. Several energy efficient measures were considered and their merits and priority were compared. Improving human behavior can reduce energy consumption by 6% while technical measure can reduce energy consumption by 44%. Two economic analysis evaluation methods were applied; they are the payback period method and net present value method.

Abstrak

Penggunaan tenaga mampan telah dikenalpasti sebagai satu langkah penting bagi meningkatkan daya saing negara secara global. Banyak penekanan dalam aspek meningkatkan kecekapan penggunaan tenaga terutamanya di dalam bangunan kerajaan telah diberikan di dalam Rancangan Malaysia Ke 9 (RMK9). Menyedari hakikat ini satu projek untuk mengkaji potensi penjimatan tenaga pada bangunan terpilih di Universiti Tun Hussein Onn Malaysia (UTHM) telah dilakukan. Dalam projek ini, kajian kes melibatkan penggunaan tenaga elektrik di bangunan bilik-bilik penyarah UTHM telah dijalankan. Liputan kajian ini termasuklah mengenalpasti penggunaan tenaga di dalam bangunan terpilih, mengkaji peluang penjimatan tenaga dan menganalisa kos pelaburan. Disamping itu sikap pengguna berkaitan dengan penggunaan tenaga telah juga diselidik. Dalam kajian ini, *MS1525:2001, Malaysian Standard -Code of practice on energy efficiency and use of renewable energy for non-residential buildings* digunapakai sebagai rujukan. Beberapa langkah meningkatkan penjimatan tenaga telah dipertimbangkan dengan mana merit dan keutamaannya telah dibandingkan. Sikap keprehatinan terhadap penjimatan tenaga boleh mengurangkan penggunaan tenaga sebanyak 6% dan tindakan teknikal boleh mengurangkan penggunaan tenaga sebanyak 44%. Dua kaedah penilaian analisa ekonomi digunakan; ia adalah kaedah *payback period* dan *net present value*.

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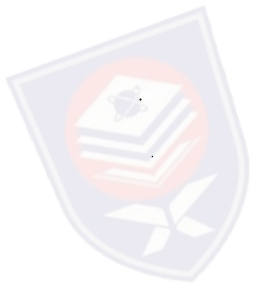
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CHAPTER I

INTRODUCTION

1.1 BACKGROUND

Rapid development of human civilization demands huge usage of energy resources. This leads to the sharp depletion of energy resources of the non-renewable type. The ever rising fuel cost is felt by almost countries worldwide. Efficient usage of energy is one approach that is being studied and implemented. The optimization not only reduces the sum of energy usage but also help to protect the environment by reducing the harmful emissions such as carbon dioxide. It is the fact that carbon dioxide is the major contributor of the greenhouse effect.

In the 21st century, energy, in the form of electricity, is use intensively in commercial, industrial and human society. Building sector is the major responsible for this energy utilization, which is accounted for 50% of total usage globally. In the United States, buildings consume a significant portion of energy. Buildings consume nearly half of all the United States energy for heating, cooling and power. It is estimated that nearly 30% of this consumption could be saved by energy conservation and/or sustainable building design and operations.

In the United Kingdom, more than 60% of energy used is to condition the indoor environment. While in South Africa, approximately 20% of all available municipal electrical energy used in commercial and office buildings [1]. In Malaysia, the figure is 48% [20].

1.2 PROBLEM STATEMENT

As Malaysia moves towards the status of a developed nation in 2020, our energy requirement will become more intensive. The building sector is among the major energy consumers in the country. Building sector consume 13% of the total energy and 48% of the total electricity energy. The Government has therefore laid equal emphasis on building sector in its strategies and programmed to promote energy efficiency [21].

Rapid growth of Unniversity Tun Huseein Onn Malaysia (UTHM) leads to an increase of electrical energy usage. It is expected that UTHM will expand six times greater that the current condition. Hence, it is crucial to study on the efficiency of the electrical energy usage.

Figure 1.1 shown present building energy index (BEI) in Malayisa. Energy index is the amount of electric energy consume per year per meter square, where electric energy in kwh unit. Unit of building energy index is $\text{kwh/m}^2/\text{yr}$.

According to MS1525 standard, recommended building energy index, BEI is 135 kWh/m²/yr. However, almost all of the buildings in Malaysia do not meet this standard. Refer to Figure 1.1 below, only three buildings achieved BEI recommended standard. Do UTHM buildings achieve this recommended standard? If not, what are the measures to achieve this?

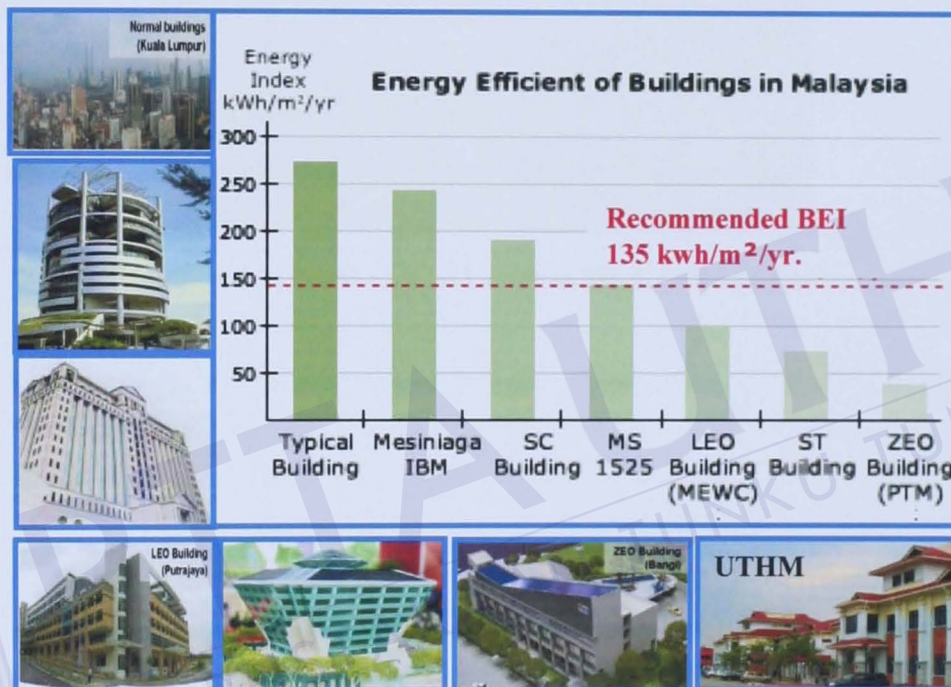


Figure 1.1: Energy efficient of building in Malaysia.

1.3 OBJECTIVE

The objective of this project is to investigate the potential of energy saving in selected buildings in Universiti Tun Hussein Onn Malaysia.



Figure 1.2: Front view of Lecturer Block C15 and C16.

1.4 SCOPE

The scope of this project is to study energy efficiency in Universiti Tun Hussein Onn Malaysia. In this project, the case study will focus on the electric energy consumption in lecturer office buildings designated as Block C15, C16 and C17.

The scopes of the study include:

- to identify the energy consumption.
- to study energy saving opportunities.
- to analyse economic benefits of energy efficient measures.
- to investigate users behavior with respect to energy issue.

1.5 SIGNIFICANT OF THE PROJECT

In Ninth Malaysian Plan (RMK9), sustainable energy usage has been recognized as one of the important measure in order to increase the competitiveness of the nation globally. Referring to Ninths Malaysia Plan which was presented by the Prime Minister, many strong emphases were given to improve energy efficient especially to government building [8]. They are listed as below.

➤ *In ensuring efficient utilization of energy resources and minimization of wastage, the focus will be on energy efficiency initiatives, particularly in the industrial, transport and commercial sectors as well as in government buildings... page 393.*

➤ *To promote the efficient use of energy, focus was given to the design and installation of energy efficient features in government buildings such as in the Ministry of Energy, Water and Communications...page 401.*

➤ *Intensifying energy efficiency initiatives in the industrial, transport and commercial sectors as well as in government buildings...page 402.*

➤ *The implementation of energy efficiency (EE) programmes will focus on energy saving features in the industrial and commercial sectors. In this regard, EE features such as efficient lighting and air conditioning systems as well as establishing a comprehensive energy management system will be encouraged...page 408.*

➤ *To promote greater EE in Government buildings, good energy practices such as optimal lighting and air-conditioning will be adopted. Energy audits will be conducted in Government buildings to identify additional measures that can be implemented to further improve EE...page 408.*

This project is our respond with regards to energy efficient in building as emphasised in the RMK9 plan. A strong emphasis was given by the government to improve energy efficient especially for government buildings.

This project is in support of government policy toward good energy practice. Further more, this project will prepare UTHM for the planned energy audits.

Today trend shows that electrical energy is the lifeblood of our style of living. It is difficult to survive without electric energy, air conditioning, lighting, television, computer, heater, fan and others. This situation becomes worse for the developed and the developing countries. As all fossil fuels such as coal, oil and gas are depleting and will disappear in the future. It is predicted that, based on the current electrical consumption, gas and oil will only be available for the next 40 to 60 years, and coal will only be available for another 200. Therefore, it is necessary to increase the efficiency of electric energy usage in order to lengthen these resources availability.

A more pressing problem at present is that the burning of coal, oil, and gas is producing a number of by-products that are harmful to the environment. The accumulation of carbon dioxide, the most important greenhouse gas, over the last few decades is believed to be responsible for increasing the Earth's surface temperature. The majority of scientists specializing in this area believe that if we continue our present trend, in long term our climate may change dangerously.

This project is aim to reduce electrical energy consumption in selected buildings designated as at Block C15, C16 and C17 at UTHM.

CHAPTER II

LITERATURE REVIEW AND THEORY

2.1 LITERATURE REVIEW

Below are reviews of several building energy conservation and building energy audit researches that had be carried out by a number of researchers.

Iqbal I and. Al-Homoud M. S (2007), investigated the impact of alternative energy conservation measures on energy requirements in office buildings in hot humid climates. The study conducted on a five-story office building located in Dammam, Saudi Arabia. The energy conservation measures evaluated using the energy simulation software of Visual DOE 4.0. The combined effect of all energy conservation measures can result in annual energy savings of as much as 36%.

Lollini, Barozzi, Fasano, Meroni and Zinzi (2006) promote the implementation of new measures, instruments and calculation methodology to improve the buildings energy performances. The thermal performance and quality of the Italian residential buildings is generally poor, depending on the

age of the building stock and the lack of application of the existing energy regulations. Theirs was demonstrating the global benefits of good insulated building envelopes. The study demonstrates that significant economic advantages come out from high performance building envelope. The study also shows that environmental extra loads due to a bigger use of the insulating material is paid back in few years, with consistent social benefits, if the life cycle of the building is taken into account.

Adel Mourtada (1996) studies on the possible cost and energy effects of the proposed Ivorian Energy Building Code. Energy and economic analysis via computer simulations of typical large and small office buildings indicates that the code requirements may reduce energy use by 27% in large office buildings and by 33% in small office buildings compared with current practices. It also showed that code requirements increase the incremental net present value for large office buildings and small office buildings.

Tommerup H and S. Svendsen J.R (2007) published the results of applying energy-saving measures on houses. The paper also presents results from measurements of the overall energy use, indoor climate and air tightness. The paper pointed out that it is possible to build typical single-family houses with an energy consumption that meets the demands without problems concerning building technology or economy. The paper concludes that the single houses are easily keeping the future energy demands.

Lee. C.S. (1998) conducted economic analysis of conventional versus airflow dyeing machineries in textile industry. Five economic analysis evaluation methods were applied in his research which are the net present value, equivalent uniform annual method, internal rate of return method, incremental rate of return and pay back period method.

D.W. Winiarski, D.B. Belzer, K.A. Cort and E.E. Richman (2003) did an assessment of the energy savings and economic impact for New Mexico by adopting the 2000 International Energy Conservation Code (2000 IECC) which in turn, refer to the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Standard 90a-1980 for the commercial building portion of the energy code. The analysis focused on three building types including a retail, office, and school building. They proved that adopting the 2000 IECC standard in New Mexico would provide positive net economic benefits to the state.

Vincenc Butala and Peter Novak (1999) conducted energy consumption audit in 24 school buildings in Slovenia. The result of audit found that heat losses of the school buildings are 89% higher than the recommended values.

Alex H.W. Lee (2000) studies on the electrical energy savings for lighting retrofits using short- and long-term monitoring. He conducted lighting energy audits to identify lighting efficiency for an office building, an industrial plant and a city hospital. The result estimated an energy savings within 30%.

S.M. Sadegh Zadeh (2007) developed a 25-year plan for energy management in the Iranian building sub sector. The purpose of this plan is to optimization energy flow from the point where energy generated and delivered to end user consumer.

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