

THE EFFECTIVENESS IMPLEMENTATION OF ENERGY EFFICIENCY IN
GOVERNMENT OFFICE BUILDING: STUDY CASE AT WISMA NEGERI
MELAKA.

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DECLARATION

“I hereby declare that the work of this exercise is mine except for the quotations and summarize that have been duly acknowledge”

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Date :

DEDICATION

This research is dedicated to my lovely parents and family who have been my source of my inspiration. I am so proud to have a family that supporting me from behind since first day I am producing this thesis. Not forget to my friends who continue supporting me when I need them in order to complete this study.

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ABSTRACT

The energy efficiency in office building become an important issue which are develop to reduce the energy consumption of the building and meet the increasingly regulating regarding energy performance. The increasing of energy consumption will increase the cost of electricity and decrease the energy performance of the office building. The aim are to determine the system implement in Wisma Negeri Melaka Office Building, measure the effectiveness of implementing energy efficiency system and determine the percentage change of energy consumption before and after implementation energy efficiency system in the office building. To meet the objective, the method will be used in this research paper is by using secondary data collection. The data will obtain from Perbadanan Teknologi Hijau Melaka and Denish Energy Management which the company manage the energy efficiency program in Melaka. The data will be analyzed using sample paired t-test analysis and comparative analysis and will be explain using descriptive method. The result of the analysis have revealed the advantage to energy consumption and electrical use by implementing energy efficiency system in office building. This research examines the Effectiveness Implementation of Energy Efficiency in Government Office Building, study case at Wisma Negeri Melaka Office Building.

Keywords : Energy Efficiency System, Green Office Building, Wisma Negeri Melaka, Paired Sample t-test, Energy Consumption, Electrical Used.

ABSTRAK

Kecekapan tenaga di bangunan pejabat menjadi isu penting yang dapat dikembangkan untuk mengurangkan penggunaan tenaga bangunan dan memenuhi pengawalseliaan yang semakin meningkat mengenai prestasi tenaga. Peningkatan penggunaan tenaga akan meningkatkan kos elektrik dan mengurangkan prestasi tenaga bangunan pejabat. Matlamatnya adalah untuk menentukan pelaksanaan sistem di Bangunan Pejabat Wisma Negeri Melaka, mengukur keberkesanan pelaksanaan sistem kecekapan tenaga dan menentukan peratusan perubahan penggunaan tenaga sebelum dan selepas sistem kecekapan tenaga pelaksanaan di bangunan pejabat. Untuk memenuhi matlamat, kaedah yang akan digunakan dalam kertas penyelidikan ini adalah dengan menggunakan pengumpulan data sekunder. Data akan diperolehi dari Perbadanan Teknologi Hijau Melaka dan Denish Energy Management yang syarikat itu menguruskan program kecekapan tenaga di Melaka. Data akan dianalisis dengan menggunakan analisis t-sampel sampel berpasangan dan analisis perbandingan dan akan dijelaskan menggunakan kaedah deskriptif. Hasil analisis telah menunjukkan kelebihan kepada penggunaan tenaga dan penggunaan elektrik dengan melaksanakan sistem kecekapan tenaga di bangunan pejabat. Kajian ini meneliti Pelaksanaan Efektif Kecekapan Tenaga di Bangunan Pejabat Kerajaan, kes kajian di Bangunan Pejabat Wisma Negeri Melaka.

Kata kunci: Sistem Kecekapan Tenaga, Bangunan Pejabat Hijau, Wisma Negeri Melaka, Analisis t-sample berpasangan, Penggunaan Tenaga, Penggunaan Elektrik.

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LIST OF ABBREVIATIONS

AHU	=	Air Handling Unit
CO ₂	=	Carbon Dioxide
COP	=	Coefficient of Performance
DEM	=	Danish Energy Management
EPBD	=	European Energy Performance of Building Directive
EPC	=	Energy Performance Certificate
GHG	=	Greenhouse Gas
HVAC	=	Heating Ventilation and Air Conditioning
LED	=	Light Emitting Diode
PTHM	=	Perbadanan Teknologi Hijau Melaka
VSD	=	Variable Speed Drive
WCPU	=	Water Cooler Package Unit

LIST OF SYMBOLS

%	=	Percent
<	=	Less-than
>	=	Greater-than
=	=	Equals

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays, the energy efficiency become an important issues. Energy efficiency means using less energy to provide same service. The phrase of 'energy efficiency' is often used as a shorthand to describe any kind of energy-saving measure. Through technically, it should be distinguished from energy conservation as a broader term which can also include forgoing a service rather than changing the efficiency with which it is provided. Increasing energy efficiency often costs money up-front but in many cases this capital outlay will be paid back in the form of reduced energy cost within short time period.

1.2 Background of Study

According to Winkler et al. (2002), there has been a major advance in research into the energy policy that show how energy can be saving and be the most cost-effective path for development which particularly in relation to on-going operating cost. Energy efficiency are being developed to meet the policy to reduce the environmental impacts and to meet increasingly more strict regulations regarding energy performance.

Sustainable Development Goals or SDG are known as the Global Goals which are universal call to action to end poverty, protect the planet and ensure all people will enjoy peace and prosperity. Based on SDG 11 under Sustainable Cities and Communities, it also discussing on energy efficiency project development. From this, showing that energy efficiency are one of the important issues that we need to pay attention. The building sector in Malaysia are consist predominantly of commercial, government and residential building. The estimation of electricity use in building sector amounted to about 7,750 GWh during 2008. The GHG emission will continue contribute significantly to country through the present growth in annual energy consumption in building unless efforts are done by improve energy efficiency. Besides, increasing in energy consumption experience brought by increase in new building construction and will cause increasing stock of electrical appliance either in new or existing building.

The scope of the saving and the techniques required are depend on the situation and location. This because there are many place or location which energy efficiency can be implement. The energy efficiency in building, appliance, transport and industry is one of the broad areas in the International Energy Agency through G8 Gleneagles Plan of Action (Soares, Dias Pereira, Ferreira, Conceição, & Pereira da Silva, 2015). For example in manufacturing industries which are energy-intensive industries such as iron, steel and cement manufacture have become more efficient over the time due to new equipment and better reuse. Vehicles have also become more energy efficient

over the decades based on the factors such as improved engines and lighter more aerodynamic design. Energy efficiency in building also have a different characteristic depends on the type of building such residence building, hotel, university, office building and etc.

In Australia, residential dwellings are responsible for 10 per cent of greenhouse gas emission and considerable effort is being direct effort to reduce emission level (Eves & Kippes, 2010). According to (Eves & Kippes, 2010) based on environmental law and soaring energy prices, all house need to exist to be more energy efficient and environmental suitable. The environmental suitable are relate to maximisation of energy efficiency for specific housing market weather conditions they experience. Based on Building Commission (2011) it state that the important of energy efficiency in building can built the environment by stating promoting energy efficiency in building can minimize harm on our environment (Hurst & Neville, 2012).

In 2004, Building Energy Consumption alone constitute 20.7 per cent national energy consumption and it will be increased to 1/3 by 2010 (Jiang and Yang, 2006; Liang et al., 2007). In China, hotel building is one type of large-scale public or commercial building and its main energy consuming system which are Heating, ventilation and air conditioning (HVAC), lighting, hot water provision and electricity such lift and cooking. (Peng Peng Xu, Edwin H.W. Chan, Queena K. Qian, 2012) have said that hotel building, in general with high energy consumption have a potential for energy efficiency improvement. In addition, (Peng Peng Xu et. El. 2012) also mention that the property ownership of most hotel building is single comparing to multi-ownership in residential and office building.

According to (European Commission, 2012) and energy efficiency can be considered as one of the most cost-effective ways for society to enhance security of energy supply and reduce emission of green-house gases and other pollutants. In achieving energy saving in university building take the following two measures which are technical solution and operational solution (Kwonsik Song, Sooyoung Kim,

Moonseo Park & Hyun-Soo Lee, 2017). In technical solution, according to (Romani Z, Draouni & Allard F., 2014) are refer to building envelope and purchasing high efficiency equipment such as heating, ventilating and air-conditioning (HVAC) system. University building are more focus in operational solution such control the strategies of electrical and mechanical equipment and the behavioural change toward energy saving (Kwonsik et. al. 2017).

In United Kingdom (UK) government has introduce a range of legislation to achieve energy conscious building. The new building must be synchronised with the European Energy Performance of Building directive (EPBD,n.d.) which requires all new building must be given energy star rating. It is for new building to meet a minimum standard of energy efficiency. Based on the case study of an office building in UK, it show the technology in energy efficiency in building contribute the energy conservation (Rusdy Hartungi & Liben Jian, 2012). According to (Rusdy Hartungi & Liben J., 2012) the sustainable feature of the building is further improve by applying various solution in mechanical and electrical system.

The office building equipped both natural and mechanical ventilation. Air handling unit (AHU) which located in the building help to supply air to the office via pressurise floor void and displacement grilles. In electrical design, the general lighting comprises of high frequency low energy fluorescent lamp. The low energy fluorescent lamp are use because it can improve energy efficiency and keep maintenance costs to a minimum. From the (CIBSE, 2005) it explain that used of general lighting which complies with CIBSE LG7 in open plan office. Metal halide and low voltage halogen luminaries suitable to use for decorative effect and accent lighting in reception areas.

According to (U.S. Department of Energy Building Technologies Office, 2016) to simulate energy performance of heating, cooling, ventilation, lighting plug and process loads and water consumption of building under prevue of United States Department of Energy Building Technologies Office. Simplified Building Energy Model (SBEM) use to predict monthly energy use and CO₂ emission of building using

variable such building geometry, construction, function and usage, HVAC system and lighting (BRE, 2016).

Based on the past studied, researcher found there are several implementation system taken by energy efficiency in office building such building design, cooling system, lighting system, function and usage and other common activities in the office building. In this context, research will be focus on several factor that stimulate the effectiveness of implementation of energy efficiency in office building. Research also will be at Wisma Negeri Melaka, office building. The data will gain Perbadanan Teknologi Hijau Melaka which provide by Danish Energy Management based on system implement, energy retrofit report and audit.

1.3 Problem Statement

The Energy efficiency in building plays a prominent role in the integrated urban development and environment planning. However, major impacts from Energy efficiency improvements can take decades to be fully realised. In addition, today the building sector is requested to define strategies and decide with energy retrofit actions to undertake in their existing building. Since building users are very often encouraged to save energy based on measured energy consumption, it is essential to know that the indicator used to assess energy efficiency is really guiding the building used towards sustainability.

The building sector contributes up to 30% of global annual greenhouse gas emissions and consumes up to 40% of all energy. Failure to encourage energy-efficiency and low carbon in new builds or retrofitting will lock countries into the disadvantage of poor performing buildings for decades. The energy usage is primarily electricity, which is used for lighting, cooling and equipment in the Wisma Negeri Melaka office building.

The bulk of the energy used for cooling in the building with a total of 71% of the electricity is consumed for lighting and the balanced 12% is taken up by other equipment such as lifts, office equipment etc. as stated by (Danish Energy Management). The increasing of energy consumption will increase the cost of electricity and decrease the energy performance of the building. Therefore, the knowledge of energy saving and energy efficiency needs to be known for every person in Wisma Negeri Melaka office to address those problems. Thus, the purpose of this study is to discover the initiatives that have been implemented which are related to energy efficiency and the effectiveness to the Wisma Negeri Melaka office building.

1.4 Research Question

According to (Saunders, 2016) defining research question are rather like generating a research idea and is not a straightforward matter. It also important that the question is sufficiently involved to generate consistent project as expected. The research question is the first active step for this research project and this research will cover the following question:

- 1) How Wisma Negeri Office building reduce their energy consumption?
- 2) Does effective on implementing a few system in the Wisma Negeri Office building?
- 3) What is the percentage change of energy consumption before and after the Energy Efficiency implementation for Wisma Negeri Office Building?

1.5 Research Objective

Research objective required to formulate a research aim as mentioned by (Saunders, 2016) and it actually a brief statement of the purpose of the research project. (Saunders, 2016) also state that the research question and research objective are the complementary ways of saying what research is about. The objectives of the study had been stated as below:

- 1) To determine the system has been implement in Wisma Negeri Melaka Office building.
- 2) To measure the effectiveness before and after the implementation of Energy Efficiency System in Wisma Negeri Melaka Office building.
- 3) To determine the percentage change of energy consumption before and after the Energy Efficiency implementation for Wisma Negeri Melaka Office Building.