

UNIVERSITI TEKNOLOGI MARA

**ENERGY AUDIT IN MALAYSIAN
PUBLIC UNIVERSITY: ASSESSING
THE ENERGY EFFICIENCY OF
UITM IN TAPAH CAMPUS**

**MUHAMMAD HILMI BIN
DZULKEFLI**

MSc

June 2020

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of Student : Muhammad Hilmi Bin Dzulkefli

Student I.D. No. : 2015584793

Programme : Master of Science (Green Architecture) – AP763

Faculty : Architecture, Planning and Surveying

Thesis Title : Energy Audit in Malaysian Public University:
Assessing the Energy Efficiency of UiTM in Tapah
Campus

Signature of Student :

Date : June 2020

ABSTRACT

The increase of energy consumption in Malaysian universities has raised national concerns because it increases government fiscal budget and at the same time influence the energy performance in the universities. Energy audit has become one of the essential elements in managing the energy consumption of universities. Through the energy audit, the energy performance of the buildings and its related facilities can be monitored and areas that have the potential for energy savings can be identified. At the moment, most of the research is focusing on universities in Malaysia that have total control over the energy audit processes through the conventional maintenance department. Little is known on the actual nature of the energy audit performance over Malaysian PFI universities. Under the 9th Malaysia Plan, the government had officiated the implementation of PFI projects in order to encourage better connection of the private sector in performing public services, which includes maintaining facilities in universities. Consequently, many PFI universities need energy audit to facilitate the energy performance and the standards of these implementations need to be justified. The purpose of this research is to focus on the energy audit processes conducted and to identify the factors that may contribute towards energy efficiency in the Malaysian PFI universities. In this research, a related information on energy audit such as specifications from electrical and mechanical systems and the relationship of these factors with the use of energy have been explored. It has been found that the significant processes in an energy audit can help to save energy consumption by comparing the energy implementation process through the investigation of energy consumption behaviour and the number of electrical systems, machinery and buildings activities that have an impact on energy consumption which allow energy-efficiency in a building. The Building Energy Index (BEI) has been used as an indicator and Energy Conservation Measures (ECM) has been used to obtain a solution and possible improvement of energy consumption during energy audit implementation. An energy data analysis approach has been obtained in order to identify the energy consumption trends in the university with the aid of selected energy audit documentation. It has been found that the selected PFI university in this research has achieved 135 kWh/m²/year of BEI after eight (8) improvement strategies in ECMs have been implemented that may consider significant towards energy performance efficiency. These eight (8) strategies involved four (4) No-Cost Measures, two (2) Medium-Cost Measures and two (2) High-Cost Measures. The methodology is limited to implementation of energy improvement on-site based on the energy reading collected using energy tools and the result has been achieved by looking through the best practice of energy audit of the case study in UiTM of Tapah Campus. UiTM of Tapah Campus is selected since this university is the first university in Malaysia that has implemented a PFI procurement with higher energy users. The result of this research can be used as a guideline for other PFI universities that consume high energy in order to help improving the energy consumption through a feasible energy audit process.

ACKNOWLEDGEMENT

First and foremost, I would like to express my highest gratitude to my supervisor Sr Dr Nur Azfahani Bt Ahmad for her continuous support, her patience, motivation, enthusiasm, and immense knowledge during my Master studies. Also, thanks to my co-supervisor Sr Dr Haryati Bt Mohd Isa for her encouragement, moral support, kind and understanding spirit in carrying out this research. My sincere thanks also dedicated to all Master in Green Architecture (AP763) lecturers for their guidance and advice.

I would like to thank to all UiTM of Tapah Campus management staffs and facility management staffs for all their help and information given during the process of my research, including my superior and staffs in Unitapah Sdn. Bhd. Besides that, million thanks to my classmates who helped me a lot by giving ideas while completing this project.

Finally, special thanks to my family who has been so tolerant and support me all these years. Thanks for their encouragement, love, and emotional support that they had given to me especially my beloved wife Nurul Ain Binti Hashim.

May this research and knowledge embracing this journey able to give benefits for future generations. Amin.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS	xvii
CHAPTER ONE INTRODUCTION	1
1.1 Chapter Overview	1
1.2 Background of Study	1
1.3 The Fundamental Study: Energy Audit Towards Energy Efficiency and Energy Conservation for Malaysian Universities	6
1.4 Problem Statement	8
1.5 Scope of Research	11
1.6 Research Question	13
1.7 Research Objective	13
1.8 Limitation of Study	14
1.9 Significant of Study	14
1.9.1 Energy Manager	14
1.9.2 Facilities Management Professional	15
1.9.3 Energy Auditor (Internal / External)	15
1.9.4 Top Management of the Universities	15
1.10 Chapter Outline	15
CHAPTER TWO LITERATURE REVIEW	17
2.1 Chapter Overview	17
2.2 Introduction	17