

SMART ENERGY MANAGEMENT SYSTEM FOR COMMON AREA IN
MULTI-TENANT BUILDING

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ABSTRACT

In recent years, energy management and efficiency in building became important concern in our country. Various technology and systems in energy management and efficiency aspect have been established in order to fulfill the needs for efficient energy and towards lower carbon footprint. However, energy management in multi-tenant building like apartment and other high-rise building seen less effective in energy management. Currently, most of this building management conduct energy management manually without any efficient control system in order to monitor and control energy consumption for optimal efficiency. Energy consumption by tenants is directly impact to overall building consumption but the building management cannot see the pattern of the tenant's consumption. As a result, the energy consumption and efficiency cannot be managed by the building management efficiently. Thus, this research will study about the potential of smart energy management system, system design and its implementation in multi-tenant building as on effort to control and increase energy efficiency as well as its potential economic impact. Finding, result and solutions based on the developed model of the smart energy management system are also being discussed as to establish a clear picture on potential economic impact from the application of smart energy management system into multi-tenant building.

ABSTRAK

Berapa tahun kebelakangan ini, pengurusan tenaga dan kecekapan dalam bangunan menjadi perhatian penting di negara kita. Pelbagai teknologi dan sistem dalam aspek pengurusan kecekapan tenaga telah diwujudkan bagi memenuhi keperluan tenaga yang cekap dan ke arah pengurangan karbon. Walau bagaimanapun, pengurusan tenaga dalam bangunan berbilang penyewa seperti pangsapuri dan bangunan tinggi lain dilihat kurang berkesan dalam pengurusan tenaga. Pada masa ini, kebanyakan pengurusan bangunan ini menjalankan pengurusan tenaga secara manual tanpa sebarang sistem kawalan yang cekap untuk memantau dan mengawal penggunaan tenaga untuk kecekapan yang optimum. Penggunaan tenaga oleh penyewa memberi impak secara langsung kepada penggunaan keseluruhan bangunan tetapi pengurusan bangunan tidak dapat melihat corak penggunaan penyewa. Akibatnya, penggunaan tenaga dan kecekapan tidak dapat diuruskan oleh pengurusan bangunan dengan cekap. Justeru, penyelidikan ini akan mengkaji tentang potensi sistem pengurusan tenaga pintar, reka bentuk sistem dan pelaksanaannya di bangunan berbilang penyewa sebagai usaha untuk mengawal dan meningkatkan kecekapan tenaga serta potensi impak ekonominya. Penemuan, keputusan dan penyelesaian berdasarkan model yang dibangunkan bagi sistem pengurusan tenaga pintar juga turut dibincangkan bagi mewujudkan gambaran yang jelas tentang potensi kesan terhadap ekonomi daripada penerapan sistem pengurusan tenaga pintar ke dalam bangunan berbilang penyewa.

TABLE OF CONTENTS

TITLE	PAGE
DECLARATION	II
ABSTRACT	III
ABSTRAK	IV
TABLE OF CONTENTS	V
LIST OF TABLES	VII
LIST OF FIGURES	VIII
LIST OF ABBREVIATIONS	IX
CHAPTER 1 INTRODUCTION	1
1.1. Research Background	1
1.2. Problem Statement	2
1.3. Objectives of The Study	3
1.4. Scopes of The Study	3
1.5. Significance of The Study	3
1.6. Report Outline	4
CHAPTER 2 LITERATURE REVIEW	6
2.1. Malaysia Energy Policies	6
2.2. Energy Consumption in Multi-Tenant Building	8
2.3. Smart Energy Management System	10
2.4. Research Gap	13
CHAPTER 3 METHODOLOGY	14
3.1. General Methodology	14
3.2. Data Collection	15
3.3. Data Analysis	16
3.4. Evaluation of existing method	17
3.5. Designed of Smart Energy Management System Framework	20

3.6. Simulation of Smart Energy Management System	22
3.6.1. Load Optimization Algorithm	23
3.6.2. Problem Formulation	24
3.7. Analysis Result and Comparison	26
CHAPTER 4 RESULT AND DISCUSSION	27
4.1 Optimization Result	27
4.2 Energy Efficiency Index	32
4.3 Economic Analysis	33
4.3 Summary	34
CHAPTER 5 CONCLUSION AND RECOMMENDATION	35
5.1 Conclusion	35
5.2 Recommendation	36
REFERENCES	37

LIST OF TABLES

TABLE NO.	TITLE	PAGE
Table 3.1	Detail of premise	16
Table 3.2	Range of the various technologies used in IoT systems	21
Table 4.1	Economic analysis result	34

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
Figure 2.1	Malaysia's commitment to Paris Agreement 2015	7
Figure 2.2	IREMS Framework	11
Figure 2.3	Smart Home Energy Management System diagram	12
Figure 3.1	General Methodology Process.	15
Figure 3.2	Premise location	16
Figure 3.3	Overall consumption trend	17
Figure 3.4	Landlord consumption trend	18
Figure 3.5	Overall energy efficiency index	18
Figure 3.6	Landlord energy efficiency index	19
Figure 3.7	Designed framework of smart energy management system	20
Figure 3.8	General Algebraic Modelling System (GAMS) software	22
Figure 3.9	Load Optimization Algorithm	24
Figure 4.1	Friday consumption trend	27
Figure 4.2	Saturday consumption trend	28
Figure 4.3	Sunday consumption trend	28
Figure 4.4	Monday consumption trend	29
Figure 4.5	Tuesday consumption trend	29
Figure 4.6	Wednesday consumption trend	30
Figure 4.7	Thursday consumption trend	30
Figure 4.8	Weekly consumption trend	31
Figure 4.9	Monthly consumption trend	32
Figure 4.10	Comparison of energy efficiency index	33

LIST OF ABBREVIATIONS

DSM	-	Demand Side Management
GHG	-	Green House Gaseous
HVAC	-	Heating, Ventilation, and Air Conditioning
IOT	-	Internet of Thing
IREMS	-	Intelligent Residential Energy Management System
MDIC	-	Meter Data Intelligence Centre
MDL	-	Maximum Demand Limit
NIALM	-	Non-Intrusive Appliance Load Monitoring
NILM	-	Non-Intrusive Load Monitoring
PMO	-	Prime Minister Office
RMR	-	Remote Meter Reading
SHEMS	-	Smart Home Energy Management System
TNB	-	Tenaga Nasional Berhad

CHAPTER 1

INTRODUCTION

1.1. Research Background

In recent years, energy management and efficiency become an important concern globally. This concern lead to a lot of effort from many countries in mitigation of climate change effect. Malaysia is one of countries which have serious concern about managing energy efficiency in order to enhance the energy sustainability and reduce greenhouse gaseous (GHG) emission. The government's concern regarding this issue is proven through Malaysia Energy Policy 1979 and National Energy Efficiency Action Plan which are emphasize the importance of energy efficiency towards productive use of energy in order to contribute to energy sustainability. Through 12th Malaysia Plan, government will regulate the use of energy by high-intensity consumers in the industrial and commercial sectors through the formulation of an act related to energy efficiency and conservation.

In line with the government's efforts on energy efficiency and sustainability, many parties have become aware of the importance of energy efficiency. As a result of this, various efforts are made to improve the energy efficiency of their buildings. One of the efforts to enhance energy efficiency is by implementing energy management system. Various technology and systems in energy management and efficiency aspect have been established in order fulfill the needs for efficient energy and towards greener environment. However, energy management in multi-tenant building like apartment and other high-rise building seen less effective in energy management.

Based on report from Department of Statistics Malaysia, about 77.57% of residential unit in Kuala Lumpur is high rise building type. This number represent that most of the residential energy consumption in Kuala Lumpur comes from high rise building type. High rise building type consist of multi-tenant dwelling. For energy use

in this building type consist of tenant consumption and common property consumption. Even though energy consumption by tenants is directly impact to overall building's consumption but the building management cannot see the pattern of the tenant's consumption. As a result, the energy consumption and its efficiency cannot be managed by the building management efficiently.

Thus, it is important to conduct this research in order to implement a smart energy management system in multi-tenant building as an effort to control and increase energy efficiency as well as its potential economic impact on this building type.

1.2. Problem Statement

Existing multi-tenant buildings are not equipped with a smart energy management system in order to optimize overall building energy efficiency for optimal usage.

As per current practice, the energy management has been carried out manually. The actual pattern of the tenant usage cannot be identified and controlled. However, the consumption of the tenant directly impacts on the maximum demand of the building. The owner of the building will be charged for this maximum demand. This energy consumptions have some implications in electricity consumption and bill charges.

Thus, it is imperative to have a smart energy management system for this type of building in order to improve building energy efficiency and efficiently control the consumption of the building.

1.3. Objectives of The Study

The objectives of this research are:

1. To study technology and methodology of Building Management system & control, and features of Smart Energy Management System in multi-tenant building.
2. To design and implement Smart Energy Management System to the multi-tenant building for consumption monitoring and control.
3. To establish potential economic benefits from application of Smart Energy Management System into multi-tenant building.

1.4. Scopes of The Study

In order to achieve the research objectives, the following scopes of this research have been considered:

1. Studying the Building Energy Management System for implementing into multi – tenant building.
2. Developing framework of Smart Energy Management System for multi-tenant building to monitor and control energy consumption

1.5. Significance of The Study

The significances of the research are to contribute towards application of smart energy management system in multi-tenant building. The implementation of smart energy management in this type of building will help the building management to see the actual behavior and pattern of all type of consumption including tenants. This application is important in order to help the building management to identify and

manage inefficient sector. Further action can be taken in order to achieve energy saving based on actual data.

Besides, application of smart energy management system in multi-tenant building also will contribute towards efficient energy and maximum demand management. This application also will contribute to reduction of energy consumption as well operational cost reduction.

1.6. Report Outline

This research report consists of 5 chapters which content of each chapter is explained as below.

a. Chapter 1: Introduction

The first chapter explains about the background of this research which justifying the execution of this research. Furthermore, the problem statement, objectives of the study, scopes of the study as well as significance of the study is explained in this chapter

b. Chapter 2: Literature Review

The second chapter reviews about some reports and studies on Malaysia energy policies, energy consumption in multi-tenant building and smart energy policy. From this review, research gap is identified and explained which become a source of motivation for the research execution.

c. Chapter 3: Methodology

The third chapter explains about the methodology of this research. There are six strategies has been developed by considering a sequence of steps:

(1) energy data collection, (2) data analysis, (3) evaluation of existing method (4) design of smart energy management system (5) simulation of smart energy management system and (6) result analysis and comparison. All steps in this methodology have been described in detail. In this chapter, the designed framework of smart energy management system, simulation method, load optimization algorithm and problem formulation also been explained in detail.

d. Chapter 4: Result and Discussion

The fourth chapter discuss about the result from the simulation of the designed smart energy system framework. The discussion includes several aspects such as optimization result, energy efficiency index as well as economic analysis.

e. Chapter 5: Conclusion and Recommendation

The fifth chapter which is the last chapter of this research report summarizes the entire report and provide some recommendation for further study in this energy management area.

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