

**APPLICATION OF DEMAND SIDE MANAGEMENT (DSM) AS  
STRATEGIC OPTION TO REDUCE ENERGY CONSUMPTION AND COST  
FOR COMMERCIAL BUILDING**

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*Specially dedicated to my dearest  
Father and Mother  
Jamal Bin Long and Hosmani Binti Ahmad  
and my dear Brother Muhamad Faiz Bin Jamal*

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## **ABSTRACT**

Demand Side Management (DSM) is an integral part of planning, implementing and monitoring of those utility activities designed to influence consumers in ways that will produce desired changes in quantity, pattern and the utility load shape. In DSM three concepts can be clearly identified: Energy Efficiency, Energy Conservation and Demand Response. Energy Efficiency refers to permanent installation of energy efficient technologies. New technologies of lightings represent energy efficient technologies which is a part of DSM program. This thesis focuses on the usage of lighting in commercial building. Lighting consumes approximately 15% of the energy usage in residential buildings and 30% in commercial buildings. The lighting industry has made substantial improvements in virtually all aspects of the total lighting system from new and improved lightings, ballasts, and luminaries to state-of-the-art energy control and management systems. Examples of lightings technology are: T8, T5, Light Emitting Diode (LED), Incandescent Lamp and Compact Fluorescent Lamp (CFL). Each type of lighting offers different energy savings and cost. This thesis compares different lightings in terms of cost and payback period. Simulations are done using Matlab software. It is discovered that the best lighting option depends on usage hour and payback period.

## ABSTRAK

“Demand Side Management” adalah merupakan sebahagian daripada perancangan, pelaksanaan dan pemantauan aktiviti utility yang bertujuan mempengaruhi pengguna melalui cara yang dapat menghasilkan perubahan pada kuantiti, corak dan bentuk beban utility. Dalam DSM tiga konsep dapat dikenalpasti: “Energy Efficiency”, “Energy Conservation” dan “Demand Response”. “Energy Efficiency” merujuk kepada pemasangan tetap teknologi kecekapan tenaga. Lampu yang berteknologi baru mewakili teknologi kecekapan tenaga yang juga sebahagian daripada program DSM. Tesis ini menumpukan kepada penggunaan lampu dalam bangunan komersil. Lampu menggunakan hampir 15% daripada penggunaan tenaga elektrik di kediaman tempat tinggal dan 30% di bangunan komersil. Industri lampu telah membuat penambahbaikan pada semua aspek sistem pencahayaan lampu daripada lampu yang telah diperbaharui, balast dan pencahayaan kepada penumpuan pengawalan tenaga dan sistem pengurusan. Contoh-contoh teknologi lampu ialah: T8, T5, “Light Emitting Diode” (LED), “Incandescent Lamp” dan “Compact Fluorescent Lamp” (CFL). Setiap lampu menawarkan kos dan penjimatan tenaga yang berbeza. Tesis ini membandingkan jenis-jenis lampu yang berbeza bergantung kepada masa bayaran balik dan kos. Simulasi dibuat dengan menggunakan perisian Matlab. Pilihan lampu yang terbaik dapat dikenalpasti bergantung kepada masa bayaran balik dan jangkamasa penggunaan lampu tersebut.

## TABLE OF CONTENTS

<b>CHAPTER</b>	<b>TITLE</b>	<b>PAGE</b>
	<b>TITLE PAGE</b>	i
	<b>DECLARATION</b>	ii
	<b>DEDICATION</b>	iii
	<b>ACKNOWLEDGEMENT</b>	iv
	<b>ABSTRACT</b>	v
	<b>ABSTRAK</b>	vi
	<b>TABLE OF CONTENTS</b>	vii
	<b>LIST OF TABLES</b>	x
	<b>LIST OF FIGURES</b>	xi
	<b>LIST OF SYMBOLS</b>	xii
	<b>LIST OF ABBREVIATIONS</b>	xiii
	<b>LIST OF APPENDICES</b>	xiv
<b>I</b>	<b>INTRODUCTION</b>	
	1.1 Background of research	1
	1.2 Objectives	2
	1.3 Scopes of project	2
	1.4 Problem statement	3
<b>II</b>	<b>LITERATURE REVIEW</b>	
	2.1 Introduction	4
	2.2 Energy Demand in Malaysia	4
	2.3 Demand Side Management (DSM)	8
	2.3.1 Concepts of DSM Programs	8
	2.3.2 Objectives of DSM Programs	9

	2.3.3 DSM in Commercial Building	13
	2.3.4 Advantages of DSM Program	13
2.4	Lightings as Part of DSM Program	14
	2.4.1 T8 Fluorescent Lamps	14
	2.4.2 T5 Fluorescent Lamps	15
	2.4.3 LED Fluorescent Lamps	15
	2.4.4 Incandescent Lamps	16
	2.4.5 Compact Fluorescent Lamps	16
2.5	Solar PV as Part of DSM Program	16
	2.5.1 Solar Major Components	17
	2.5.2 Calculations of Solar	18
2.6	Lists of papers reviewed	19
<b>III</b>	<b>METHODOLOGY</b>	
	3.1 Introduction	23
	3.2 Block diagram of the Project	25
	3.3 Methods for DSM Program	26
	3.4 TNB Tariff for Commercial Building	27
	3.5 Mathematical Modeling	28
	3.6 Objectives Function	29
	3.7 Simple Comparison	29
	3.8 Optimization	33
<b>IV</b>	<b>RESULTS AND DISCUSSION</b>	
	4.1 Introduction	35
	4.2 Comparing T8 with Other Lamps	36
	4.3 Retrofitting T8	37
	4.4 Comparing IL with Other Lamps	39
	4.5 Retrofitting IL	41
<b>V</b>	<b>CONCLUSION AND RECOMMENDATION</b>	
	5.1 Conclusion	43
	5.2 Recommendation	44

<b>REFERENCES</b>	45
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<b>APPENDIX A - C</b>	47 - 49
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**LIST OF TABLES**

<b>TABLE NO</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Cost of Electricity/kWh	18
3.1	Lamp and Lighting Specifications	28
3.2	Saving Cost of T5 and LED	30
3.3	Saving Cost of CFL and LED	31
4.1	Comparisons of T8	36
4.2	Options of DSM Lighting Technology in Retrofitting T8	37
4.3	Comparisons of Incandescent Lamp	39
4.4	Options of DSM Lighting Technology in Retrofitting IL	41

## LIST OF FIGURES

<b>FIGURE NO</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Energy Demand by Source 2008	5
2.2	Energy Demand by Sector of 2000 and 2008	6
2.3	Installed Generation Capacity and Maximum Demands in Peninsular Malaysia in the Year 2009	7
2.4	Peak Clipping	10
2.5	Valley Filling	10
2.6	Load Shifting	11
2.7	Strategic Conservation	11
2.8	Strategic Load Growth	12
2.9	Flexible Load Shape	12
3.1	Methodology Flow Chart	24
3.2	Project Overview Diagram	25
3.3	TNB Tariff for Commercial Building	27
3.4	Graph of Saving Cost for T5 and LED	31
3.5	Graph of Saving Cost for CFL and LED	32
3.6	Optimization Graph	34
4.1	Graph Comparisons of T8	37
4.2	Graph of Retrofitting of T8	39
4.3	Graph Comparisons of IL	40
4.4	Graph Retrofitting of IL	42

**LIST OF SYMBOLS**

%	- Percentage
$\sum_{all\ i} Capital\ Cost_i + Energy\ Cost_i$	- Sum of minimization of total cost

**LIST OF ABBREVIATIONS**

DSM	- Demand Side Management
MATLAB	- Mathematic Laboratory
TNB	- Tenaga Nasional Berhad
MW	- Mega Watt
AMI	- Advance Metering Infrastructure
kHz	- Kilo Hertz
LED	- Light Emitting Diode
IL	- Incandescent Lamp
CFL	- Compact Fluorescent Lamp
DR	- Demand Response
HVAC	- High Voltage Alternating Current
W	- Watt
PV	- Photovoltaic
kWh	- Kilowatt Hour
FIT	- Feed In Tariff
HID	- High Intensity Discharge

**LIST OF APPENDICES**

<b>APPENDIX</b>	<b>TITLE</b>	<b>PAGE</b>
A	Gantt Chart for Semester 1	49
B	Gantt Chart for Semester 2	50
C	Matlab Programming	49

## **CHAPTER I**

### **INTRODUCTION**

#### **1.1 Background of Research**

Cost and energy consumption in Malaysia has made a significant growth over the past decade aligned with vast of technology in human modernization and civilization. It also an essential input to social progress and the development of economy in all over the world. The demand of energy increased upon increment of industrial development in our country. Growth in energy demand will also keep on expanding adequate with growth of population. However, usage and production of energy has also come with environmental problem related to usage of energy, supply and cost.

These problems have been faced for all over the world countries nowadays. Environmental impacts such as green house effect, sea level change and global climate prospects are threats to energy consumption in future. Saving energy will be main criteria to decrease greenhouse gasses emission. All of the sources and invention that had take place was for the convenient of the people. When it has been used out of control, normally it will give bad effect in any circumstances.

Inefficient use of electrical lighting in residential and commercial buildings often causes wastage and losses. This wastage can be reduced by taking appropriate action like introducing Demand Side Management (DSM) options to consumer. By applying the methods of DSM, it can identify the possible areas of wastage like inefficient and excess use of lights. By taking appropriate measures energy can be

used efficiently in lighting. Effort should be taken by governments and organizations to minimize environmental damage and encourage the consumer to use electricity in efficient and wisely. By application of Demand Side Management (DSM), it will be a strategic option to reduce energy consumption and cost for commercial building.

## **1.2 Objectives**

In the progress of this project, there are several objectives that should be accomplished.

- i. To study the application of DSM particularly based on energy efficient technology in reducing energy consumption.
- ii. To create an avenue for consumers to select the best DSM options available for them to adopt.
- iii. To analyze effectiveness of DSM by using the payback period analysis.

## **1.3 Scope of Project**

The scope of this project will focus on the demand side management of electricity user mainly on lighting for commercial building. Foremost, this is one of the largest consumer sectors of energy consumption and cost. In detail aspect however, it will accentuate on non-residential and commercial building.

This project will begin by studying the technology of lamps that is more efficient but low in energy consumption per kilowatt-hour. This technology of lamps is approached by using mathematical modeling in order to obtain payback period. MATLAB programming software is used in optimization and obtains the results.

## 1.4 Problem Statement

An impressive economic growth in Malaysia has been created which led to increment of energy consumption recently. It refers to non-residential and commercial building. This advancement consuming electricity generated almost half of the usage. DSM programs are not necessarily mean advance technology or major process changes. Many changes require little investment. Most DSM programs achieve only partial success. The factors which restrain the consumers to move towards energy conservation are:-

i. Lack of Information

One of the major constraints in the implementation of DSM programs is information gap. Consumers are generally unaware the opportunities of improving energy efficiency which can reduce energy consumption.

ii. Cost of Energy Efficient Equipment

Most of the consumers are not willing to purchase high efficiency equipment due to high initial cost. Incentives such as lower taxes and duties contribute in making energy efficient equipments affordable.

iii. Tariff

In many developing countries the tariff for some categories of consumers is very low, even lower than cost of electricity generation. This kind of tariff structures needs to be avoided.



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