# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# DEVELOPMENT OF INTELLIGENT SWITCHING POWER STORAGE FOR DOMESTIC USAGE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

by

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# ABSTRAK

Sistem Penyimpanan Tenaga (ESS) adalah sistem yang menyimpan tenaga elektrik kemudian akan digunakan pada bila diperlukan. Di sesetengah negara, tarif elektrik domestik dikenakan caj untuk waktu puncak dan luar puncak. Sehingga, apabila masa puncak kenaikan tarif akan lebih tinggi daripada masa luar puncak. Seterusnya, apabila keadaan pemadaman kuasa berlaku, ia akan mengganggu pengguna dalam keadaan beban dalam talian. Kekurangan sistem ESS untuk pengguna domestik yang secara automatik mengawal pengecasan dan pengaliran secara automatik bekalan kuasa antara storan kuasa dan pembekal kuasa. Objektif projek ini adalah untuk menganalisis keupayaan ESS dari segi kuasa menyimpan, mengurus, dan menggunakan semula untuk beban penggunaan kuasa rendah dalam penggunaan domestik. Seterusnya, untuk mengawal keadaan bertukar dari bekalan TNB ke Bekalan Penyimpanan Kuasa Pintar apabila masa puncak, luar masa puncak dan gangguan elektrik. Sistem ini termasuk beberapa jenis litar elektronik yang merupakan penyearah, relay, pemasa, Arduino Uno dan meter elektrik sebagai pengukur dalam sistem ini. Sebagai hasilnya, beban dalam talian tidak terganggu oleh pemadaman kuasa dan bekalan kuasa rumah secara automatik bertukar antara penyimpanan kuasa ke bekalan TNB pada sistem OPTR. Akhirnya, kesimpulan untuk projek ini menunjukkan bagaimana sistem penukaran dan pengurusan storan tenaga untuk pengguna domestik kediaman digunakan dalam sistem OPTR dan apabila gangguan kuasa berlaku.



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## ABSTRACT

Energy Storage System (ESS) is a system that captures electrical energy then will be use at when needed. In a certain country, the domestic electrical tariff being charge for off-peak and on-peak tariff rate. So that, when the on-peak time the tariff will higher rather than the off-peak time. Next, when a power outage situation happens it will interrupt the user in online load situation. Lack of ESS system for domestic user which is automatically control charging and automatically flow of the power supply between power storage and power provider. Objective of this project is to analyse the ability of the ESS in terms of store power, manage, and reuse for low power consumption load in domestic usage. Next, to control the switching condition from TNB supply to the Intelligent Switching Power Storage Supply when peak time, off-peak time and power outage. The system will include a few types of electronics circuit which is a rectifier, relay, timer, Arduino Uno and electrical meter as the gauge in this system. As results, online load not interrupted by power outage and the house power supply automatically switch between power storage and TNB supply base on OPTR system. Lastly, the conclusion for this project to shows how the switching system and managing the storage of energy for the residential domestic user to use in OPTR system and when a power outage happens.




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## DEDICATION

To my beloved parents *Mohd Alip Bin Mohd Said* and *Roslinah Binti Mohammad Top*. Not forgotten my siblings *Mohd Zakuan, Mohd Abdullah, Siti Salwa, Mohd Akbalrizal, and Muhammad Sulaiman.*



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# LIST OF SYMBOLS

| | | |
|---|---|---|
| **V** | - | Voltage |
| **I** | - | Current |
| **W** | - | Watt |
| **NC** | - | Normally Close |
| **NO** | - | Normally Open |
| **AH** | - | Ampere Hour |
| **Re** | - | Reynold number |
| **V** | - | Velocity |
| **R** | - | Relay |
| **A** | - | Ampere |
| **H** | - | Hour |



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# LIST OF ABBREVIATIONS

| | |
|---|---|
| **ESS** | Energy Storage System |
| **TNB** | Tenaga Nasional Berhad |
| **NC** | Normally Close |
| **NO** | Normally Open |
| **OPTR** | Off Peak Tariff Rate |
| **AH** | Ampere Hour |
| **ROI** | Return Of Investment |
| **R&D** | Research and Development |
| **R** | Relay |
| **RTC** | Real Time Clock |



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# CHAPTER 1

# INTRODUCTION

## 1.0 Background

Energy Storage System (ESS) is a technology for capturing energy produced that to be use when needed. Accumulator and battery is element known as storage device to store electrical energy. ESS can makes electrical energy more convenient or economically storable forms in a system. Mostly, nowadays technology provide long-period of storage. However, have some of provider make just short-period of storage system. Rechargeable batteries which is the common of energy storage system, which is generally known converting chemical energy to electrical energy. That usually being use for gadget and transportation. Photovoltaics is common of the renewable energy to generate energy at home and it growing fast due to needs of consumer. Exceed 40% self-sufficiency in a household equipped with photovoltaics. Multiple manufacturers produce rechargeable energy storage battery systems that generally hold excess energy from the generation of domestic solar / wind. Today, because of their similar costs but much better performance, Li-ion battery is preferable to use for home energy storage. Home-generated electricity can be sold to the grid for purely financial purposes in areas where net metering is available through a grid-tie inverter without the use of batteries for storage.



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## 1.1 Problem Statement

The problem statement for this project are when the domestic electrical tariff being charge in off-peak and on peak time (OPTR) type. So that, when in the on-peak time the tariff will higher rather than the off-peak time. It will burden consumer that use high power consumption on peak time. Next, when a power outage situation happens it will interrupt the user in online load situation. Lack of ESS system for domestic user which is automatically control charging and automatically flow of the power supply between power storage and power provider.

## 1.2 Objective

The objective for this research project are:

i. To control the switching condition from TNB power supply to the Intelligent Switching Power Storage Supply when on-peak and off-peak time by use real time programming system.

ii. To develop an uninterrupted power supply for domestic user. So that, if load being used it should be switch and give the online load with backup power supply.

iii. To analyse the ability of the ESS in terms of store power, manage, and reuse for low power consumption load in domestic usage by control the charging process and flow of the electrical energy stored automatically.



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## 1.3 Scope of work

The scope for this project:

i. This project will focusing on ESS for the residential domestic user which is consists of intelligent switching and power storage that will be represent in hardware application.

ii. The system will include few types of electronics circuit which is rectifier, voltage divider, buck-boost converter, and electrical meter as gauge in this system.

iii. Automatically switching process between TNB power supply and power storage.

iv. Cover up the power interrupted situation when happen while using some targeted load.



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# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Introduction

The literature review outline in the starting of a research project which is to review the acute point of this project. This literature review being organize to gain information from other researchers which is have some same point of view in term of ESS. This chapter will elaborate more in term of energy storage, switching system, grid system, and advantage of this kind of system. It consist of two part which is background study and related previous project.

## 2.1 Background Study

Background study is a compilation of information from journal, thesis, and internet that related to this system. So that can have sufficient information based on the analysis purpose arguments or problem to fine solution.

### 2.1.1 Electrical Energy

According to (Jucker, Leupp and Sjökvist, 2008) electrical energy is an unable to see without suitable mechanism. It can considered as identical consumer benefit for a long time. Today, it accounts for 12 percent of humanity's total power energy



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