INDUSTRIAL BASED PROJECT - SOLAR POWERED SYSTEM FOR GREEN BUILDING

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I declare that this report entitle "Industrial Based Project- Solar Powered System for Green Building" is the result of my own research except as cited in references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date : 28th JUNE 2012

" I hereby declare that I have read through this report entitle "Industrial Based Project- Solar Powered System for Green Building" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power) with Honors".

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ABSTRACT

Solar power system is a renewable energy that widely used for the green building all over the world because it more reliable and stable. There are many design of solar system. The system usually designed by the designer based on a few factor, such as, capital, space, sustain period and load. The purpose of this project is to design a solar system that considered those entire factors and can be implemented in the green building. From the design in the Green Building, a scaled down system that fit with the owned resource is design. The solar system is design to power the outdoor area which consists of two led down light that brings a total load of 20W. The system also is designed to be last for three days without the presence of sunlight. From the system's load and requirement, the system specification to be used is determined. The system is consisting of a solar panel, a charger controller, a 100Ah battery, two LED down light, a daylight switch, an automated power switch and an AC/DC converter. This project will give two points to the building's green building index so; the building can be certified as a Green Building.

ABSTRAK

Sistem tenaga solar ialah satu cabang tenaga yang boleh diperbaharui yang popular digunakan di dalam *Green Building* di serata dunia. Ia kerana ianya lebih stabil dan boleh dipercayai. Terdapat banyak jenis rekaan bagi sistem solar. Sesebuah sistem kebiasaanya direka berpandukan beberapa perkara iaitu, modal, ruang, tempoh bertahan, dan beban. Tujuan projek ini dijalankan adalah untuk mereka bentuk satu sistem solar yang mengambil kira kesemua aspek tersebut dan boleh diaplikasikan di dalam *Green Building*. Berdasarkan reka bentuk pada *Green Building* tersebut, satu sistem yang dikecilkan yang boleh dilaksanakan dengan barangan yang sedia ada akan direka bentuk. Sistem solar ini direka untuk membekalkan tenaga kepada sistem luar yang terdiri daripada dua lambu simbah LED yang mempunyai jumlah beban sebanyak 20W. Sistem ini direka untuk bertahan selama tiga hari tanpa kehadiran cahaya matahari. Spesifikasi sistem ditetapkan berdasarkan beban dan keperluan sistem. Sistem ini terdiri daripada, sebuah panel solar, sebuah *Charger controller,* sebuah Bateri berkapasiti 100Ah, dua lampu simbah LED, sebuah suis peka cahaya, suis kuasa automatik, dan pengubah AU/AT. Projek ini akan memberikan dua mata kepada *Green Building Index* banggunan dan membolehkan banggunan tersebut diiktiraf sebagai sebuah banggunan hijau.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysian government nowadays committed in encouraging private sector and residency sector to implementing green technology in their building. Green Building Index is a certification to the building that implementing green technology in their construction process and their daily business[1]. In This project, a solar powered system that gives point to the green building index is design. The system will give point to the green building with a minimum cost to the owner.

This chapter will be discussing on the problem statement of the project, the objective of the project and the scope of the project. This chapter shows the project background and the objective of that to be achieved.

1.2 Problem statement

Renewable Energy such as Photo Voltaic (PV) Solar system will give a big point for a building to achieve Green Building Index certificate. A problem with PV solar system is the costing to implement the system. Owner of the building does not plan to invest much on the solar system. To fit in with the customer's budget and still give at least 2 point for the Green Building Index, the project has to use a minimum number of solar equipment, at the same time

try to gain maximum output to powered designated electrical appliances and use electrical appliance that have high energy efficiency[1].

1.3 Objective

The Objective of the project are :

I. To develop a solar system that meet the green building index requirement at least 2 points.
II. To develop a scaled down solar system that can still gain the main objective.
III. To develop a solar system that can sustain for 5 or 3 days.
IV. To study compatibility of a solar system to the green building.

1.4 Scope

The project is based on Green Building project done by a consultant company, Menara Teknik Sdn Bhd. The data collected from Menara Teknik and site visit to the based project site is used to design a scaled down project that can be fit to a smaller usage such as resident houses. The solar system is designated to gain point 2 points for Innovation in design and the Energy Efficiency for the Green Building Index certification[1]. The performance is discussed in term of reliability energy efficiency and the economic factor of the implementation of the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Demand of green building is increase nowadays as increasing of environmental awareness among the society, and more corporate companies wish to embrace Corporate Social Responsibility (CSR). Solar energy used is a big aspect for a green building as its characteristic can save a lot of energy especially Photo Voltaic (PV) system. There are a few advantages of PV system that seen to bring benefits to the people such as it's a renewable energy, environmental friendly, reliable, produce no noise and less maintenance[2]. Despite all the advantages, PV system also has some limitation. The main disadvantage of solar energy is the great initial cost of the equipment to convert the solar energy to electricity. Solar energy also requires a large area in order to it works efficiently.

2.2 Green Building

Green building also called sustainable building is a certification or standard of a building that designed, built, renovated, and operated in ecological-friendly and resource-efficient manner. Green building are designed to fulfill certain objective which are, improving employee productivity, using electricity, water, and others resources efficiently and keeping up the environment at once. In Malaysia, green building certificate were given by Greenbuildingindex Sdn Bhd, a company which were subsidiary of Institute Of Architect of Malaysia (PAM) and Association of Consulting Engineer Malaysia (ACEM). There were six criteria that need to be fulfill in order to be certified which are, energy efficiency, indoor

environmental quality, sustainable site planning and management, material and resource, water efficiency, and innovation. There were six tools been used to differ appropriate points for each criterion which are Industrial New Construction (INC), Industrial Existing Building (IEB), Township, Non-Residential New Construction (NRNC), Residential New Construction (RNC) and Non-Residential Existing Building (NREB)[1].

2.2.1 Green building certification.

This project is based on a green building own by ASR Padu Sdn Bhd. It will be certified under Non Residential New Construction (NRNC) tool. In the NRNC tool, in order to gain points for renewable energy criteria requires at least 5kW output of the PV (photo volataic sy system and it requires large amount of investment. Hence, the solar system is designated to gain score under the innovation criteria which only requires solar system only as a co-generation system. The PV solar system will give 1 points for the co-generation system[1].

2.3 PV Solar System

PV solar system produced very clean energy and suitable to install into building. Despite the price that a bit higher than another source of renewable energy, its suitability to install on a building makes PV solar systems were very popular for Green Building worldwide. PV solar system for the project consist four major parts which is PV module, Charger Controller, Batteries, DC load and a AC-DC power converter as the backup supply for the DC load. The PV module produced voltage and current that will charge the batteries[3]. The batteries stored the power produced by the PV module for the DC load uses in daylight or nighttime. The Charging and Discharging condition of the batteries are controlled by the charger controller.

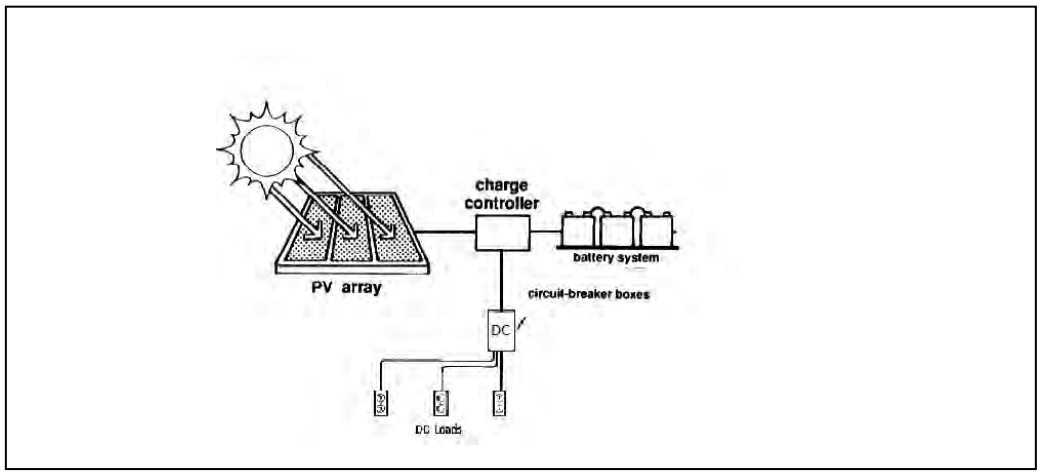

Figure 2.1: Basic PV Solar system

2.3.1 PV module

PV module is the part that converts the energy from the sun to electrical energy by converting the photons from the sunlight to electron (electrical charge). PV modules were consisting of a number of solar cells. Solar cell are made of semiconductor (usually silicon) [4]. PV module produced electricity when received sunlight by using the photons from the sunlight to produced electric current. This situation was cause from the characteristic of semiconductors. When the sunlight (photons) hit the solar cell, the photons push the electron to the other side of the semiconductor[4]. This phenomenon will create current flow if there any conductors attached to the positive and negative side of the semiconductors. By the conductor its will be the whole system of the PV solar system. The photocurrent (current generate by solar cell) will flow to the battery and will be control by the charger controller. The phenomenon is what makes PV system a sustainable source of electricity.

There is three type of common solar panel which is mono crystalline silicon solar cells, polycrystalline silicon solar cells and amorphous silicon solar cells. Mono crystalline type of solar cell would be used because of its efficiency. Table below shows the different between the three types of the solar cell.

Table 2.1: Comparison between 3 type Of Solar Cell

Mono crystalline	Polycrystalline	amorphous
Made in mono crystalline cell	*Made with Polycrystalline cell*	Not really crystals cell
Contain pure silicon	*the large block of many crystal*	A thin layer of silicon deposited on a base material such as metal or glass to create the solar panel
Complicated crystal growth process	Less efficient	Much less efficient
most efficient method		

The PV module is commercially sold in a range of power output between 10W to 300MW and producing a Direct Current (DC). The power output is calculated by the common power equation. The output varies within the presence and the density of the sunlight.

2.3.2 Charger Controller

The charger controller is designed to regulate the charging and discharging process of batteries. Solar cell is not an active device in low light conditions such as at night or shady weather. It generates low power in shady condition and no power in the dark. Hence, PV module's voltage and current will fluctuated during the time. Over voltage could damage the battery and reduce the battery life span. While if the battery charged in low voltage condition (below 80% of nominal voltage), the charging process be stunted and the battery cannot be fully charged. The charger controller controls solar array voltage into desired voltage in order to perform maximum power point tracking or battery charge control[3]. The charger controller also control the power output of the batteries. It ensures that the batteries will be cut out from the load at a certain Depth of Discharge. Depth of discharge is the percentage of the power that permits to be discharged from battery's full load capacity. For example, a 100Ah battery which has 70% depth of discharge can only withdraw 70Ah of current by the load. The main function of a charger controller is to avoid battery from overcharged and over discharged[5].

The charger controller will be connected in series with the PV module, the load and the battery also will be connected to the charger controller. Basically, charger controller can be described as the heart of a PV solar system.

There is two type of charge controller which is series and shunt-regulations. Series type of charger controller will be used for this project. The different between shunt regulations is it only suitable for a small current PV system[5]. Because of the regulation method is to short circuit the PV module, a blocking diode is required in series to the battery in order to keep the battery from being short circuited.

The series type of charger control will be used for the project. This project will draw a high current for charging the battery due to the power output of the PV module. The series type of charger control can withstand high current because of it operating technique that use switching method as the controlling method[5].

2.3.3 Batteries

The main function of the Batteries is to store excessive energy that been produce by the PV module during daylight. At night or in a low light condition, the battery will be the power source to the system. Without the battery, the system cannot operate during night time or low light condition. The system is unreliable if it can maintain the supply through any condition.

There were a few important criteria need to be considered in deciding the battery for a certain PV solar system. Battery capacity is an important criterion to be considered in selecting batteries for a solar system. the batteries need to store the excessive energy that been produced by the PV system, the greater the capacity of a battery, the longer that the system can operate without sunlight absence[6]. The capacity of a battery is being measured by Wh or Ah which means Watt hour and Amp hour. The capacity unit shows how many watt hour or amp hour that can be stored by the batteries.

The other criterion that can be considered is State of Charge (SOC). State of charge is the ratio of the present charge capacity to the nominal capacity (maximum capacity). The state

of charge of the batteries was used as a decision variable for the control of the overcharge and discharge[5]-[6].

The other important criterions that need to be considered are the Depth of Discharged of the battery. The Depth of Discharged is the capacities of power that can be withdraw from the battery. The depth of discharged usually written by percentage which shows the percentage of the power that can be withdraw from the nominal power charged to the batteries[6].

2.3.4 DC Load

The DC load is consisting of a set of LED down light. The DC load will be in 12V system. 12V DC system is been used because of the batteries rated voltage. The DC load is more energy efficient then AC load[7].

In order the system more efficient, a day light sensor is installed to system. The daylight sensor will detect daylight and turn off the down light without requires any person to turn off the light.

2.3.5 AC-DC converter

The main function of the AC-DC converter in the project is to be the backup power supply for the DC Load in case of the run out of the battery stored power. The battery stored the power produce by the PV module. In a rainy season, the sunlight density is a bit low due to the cloudy weather. There were some possibilities that the PV module not produced any power for a long time. After a while, the battery will run out of power. The battery could not be the power supply anymore. To create a reliable system, the system needs to have a constant supply. Hence, backup power supplies are needed.

The AC-DC converter will convert the AC power supply from the grid to a 12V DC power system that will be used by the DC load. The AC-DC converter only be used in case of the battery is out of power and the PV is not generating any power at the moment.

2.4 Conclusion

This project is about designing and remodeling of a PV solar system used in green building. In order to gain point in Green Building Index, the system need to fulfill criterion that Green Building Index required. The system must be consisting of a co-generation method and innovation. The PV solar system is going to be the co-generation system of the green building. The innovation of the project would be the power supply backup system of the DC load.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Methodology of this project will represent the design and development process that have been used to achieve the goal of this project. . This section will show the systematic flow of procedure that need to plan properly to satisfy the objective of project within the timeline given. There will be four major steps to be done in order to accomplish this project, collecting data from the based project, analysis and comparison, then designing a possible system and last is developing the project.

The very first step to start the project is by collecting the data and specification of the project. Then, a research about the Green Building Index and PV solar system were searched and studied. The Next step is to design the preliminary analysis which is important to get the crystal clear concept of the project. After that, the data collection from the literature review. The data collected is used in the next step which is preliminary analysis. In preliminary analysis step, the data that have been collected in previous step is analyzed based on the preliminary analysis design. Based on the preliminary analysis, a design and project that fulfills the requirement of a green building is developed. Lastly, the project flows followed by the analysis and discussion of the project.

3.2 Project Flow Chart

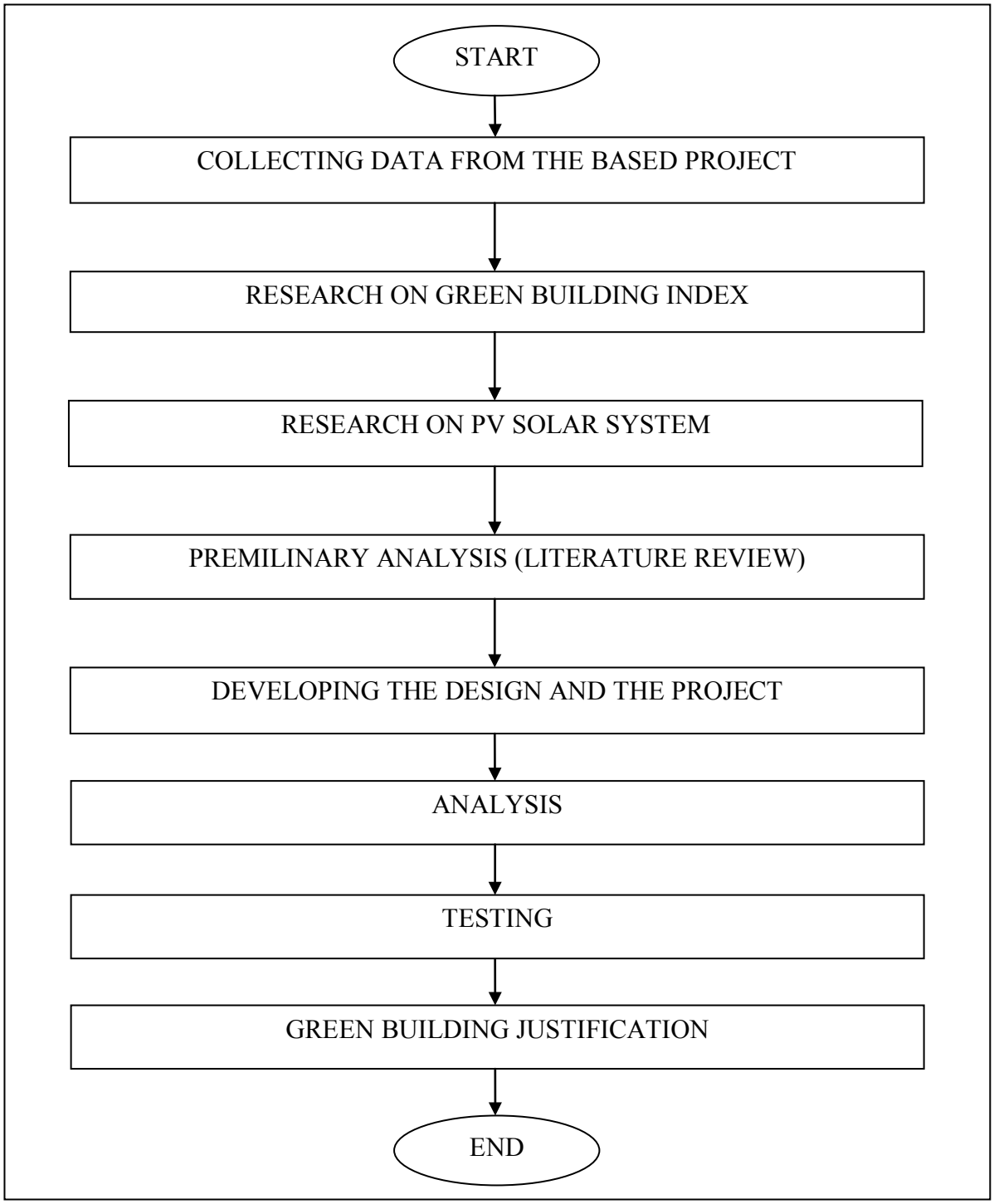

Figure 3.1: Project flow chart

3.2.1 Collecting data from the based project

Collecting data from the based project is an important part of this project. The data from the based project going to be used for the basic guideline in design the project. All criteria need by the based project should be follow.

The criteria that have to be followed by the based project is such as the estimated system's load, load specification, GBI point targeted and system requirement.

Below is the data that obtained from the based project from Menara Teknik Sdn Bhd,

3.2.1.1 **Based Project Specification**

Table 3.1 : Based Project's Solar System Specification

Total System Load	3111.19Wh/day
PV Array Size	845.43Wp
No of solar Module	10 solar module
Total No of Batteries	13 battery
Charger Controller	1

Table 3.2: Based Project's Load Specification

LOAD	Voltage System	Watts	Quantity	Runtime	Wh/day
DC Load	12	10	10	12	1296
	12	6.0	0	0	1
	12	10.8	14	12	1814
Total Load					3111