THE STUDY ON SARAWAK REMOTE AREA SOLAR ENERGY APPLICATION PROBLEMS

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BORANG PENYERAHAN TESIS

Judul: THE STUDY ON SARAWAK REMOTE AREA SOLAR ENERGY APPLICATION PROBLEMS

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This project report attached here to, entitled "**The Study on Sarawak Remote Area Solar Energy Application Problems**" prepared and submitted by Affendy Bin Kolot as a partial fulfilment of the requirement for the degree of Bachelor of Engineering with Honours in Mechanical and Manufacturing system is hereby read and approved by:

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ABSTRACT

This study is conducted on the Samusan National Park, Tanjung Datu National Park and Talang-Talang Besar Island. The focus of this study is to identify the problems associated with application of solar energy for remote area electrification. The problem that been identified were the incorrect system design, insufficient number of expertise, weather condition and low user knowledge. The problem with weather condition will always occur but the other problem can be reduced or prevented. Before the solar energy system installation, it will be best to provide the training and knowledge to the user so the system failure potential will be reduced. In the future, the solar energy system designer will use the finding from this study, in order to designing the proper system.

ABSTRAK

Kajian ini telah dilakukan pada sistem perbekalan tenaga di Taman Negara Samusan, Taman Negara Tanjung Datu dan Pulau Talang-Talang Besar. Fokus kajian ini adalah untuk mengenalpasti masalah yang timbul daripada aplikasi tenaga matahari bagi tujuan perbekalan tenaga elektrik di kawasan yang terpencil. Masalah yang telah dikenalpasti adalah rekaan sistem pembekalan tenaga yang tidak sesuai, kekurangan pakar, keadaan cuaca dan pengetahuan pengguna yang rendah. Masalah daripada keadaan ini tidak dapat dielakkan tetapi masalah yang lain dapat dikurangkan ataupun dielakkan. Sebelum sesuatu sistem hendak dipasang, latihan dan pengetahuan tentang sistem tersebut haruslah diberikan terlebih dahulu supaya risiko kerosakan pada sistem tersebut dapat dikurangkan. Pada masa yang akan datang, pereka sistem tenaga matahari akan menggunakan maklumat yang telah diperoleh daripada kajian ini untuk merekacipta sistem yang betul dan sesuai.

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NOMENCLATURE

a	Azimuth angle [°]
C	energy storage capacity [Wh]
C_{DOD}	energy storage capacity depth of discharge [%]
C_{use}	useable energy storage capacity [Wh]
E	power of electric appliance [kW]
Ec	estimated energy collected [kWh/day]
Hs	hours of sun duration with 1 kW/m2
h	hours angle of sun [°]
i	receiving surface angle [°]
L	energy load [kWh]
Lt	total energy load per day [kWh/day]
l	latitude of location [°]
n	number of days starting from 1st January
Pe	photovoltaic array angle efficiency
R	battery capacity [Ah]
TWp	total watt peak of photovoltaic array [kW]
t	electric appliance usage duration [h]
Vb	battery voltage [V]
X	solar radiation [kWh/m2]
Xb	battery quantity
Y	solar radiation [MJ/m2]

Greek Letter

δ	Sun declination angle
χ	Surface-sun incident angle

CHAPTER 1

INTRODUCTION

1.1 Introduction

The energy demand on the non-renewable energy especially oil increases but that energy source is limited and it is going to be exhausted in future. Most developing countries tried to replace this source of energy with alternative energy source, the renewable energy of course. There are lot of renewable energy source such as tidal, wind, hydroelectric, solar energy and etc and this renewable energy needs more research to obtain high efficiency and performance.

According to Hislop (1992), most developing countries started give greatest attention on renewable energy technologies development since 1970s as a response to the oil supply shortage and high price. When the oil prices back to lower price, the choice to use renewable energy is not just to replace the oil but also to provide energy with low pollution and to solve the energy problem for rural area.

1.2 Renewable energy source

There are various renewable energy sources such as solar, wind, biomass, hydroelectric, geothermal, tidal, wave and energy from marine currents. All of that energy source availability has a great potential in the future use but today's application, wind, solar,

biomass and hydroelectric are most popular. Basically, the renewable energy is from three different primary sources, which is the isotopic dissociation in the core of the earth, the movement of the planets and thermonuclear conversion in the sun. Figure 1.1 shows the three main source of renewable energy. In Malaysia, hydroelectric already been applied for electric energy production. There are main problem in using renewable energy for transportation where there are no effective energy storage device or equipment to store the energy.

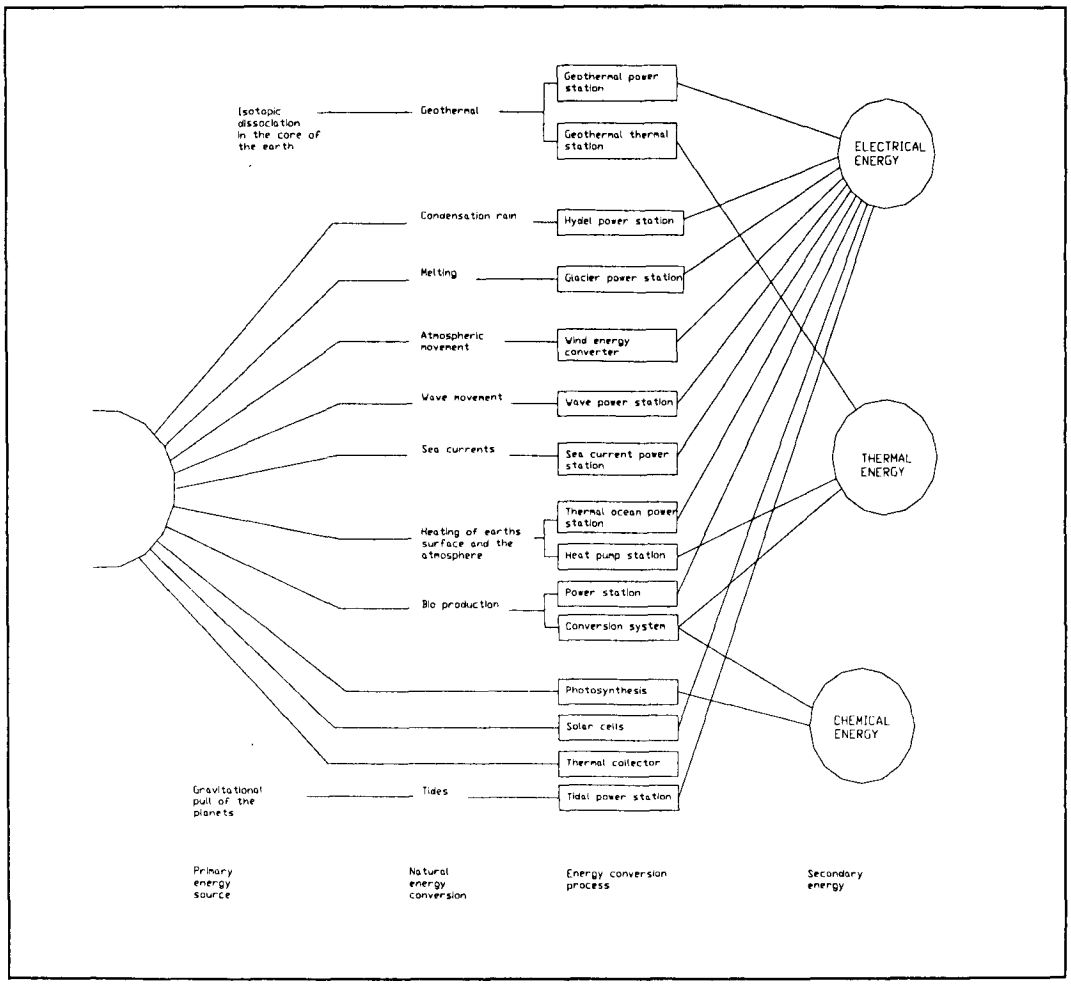

Figure 1.1 The Three-Main Source of Renewable Energy (Bansal, 1990)

1.3 Introduction to solar energy

Solar energy from sun is the major energy source for many years. It can be collected directly from the sun and everywhere on earth surfaces. This energy source is non-constant energy where it depending on the weather condition and different locations have different amount of solar radiation each year. Figure 1.2 shows different location in earth received different amount of solar radiation.

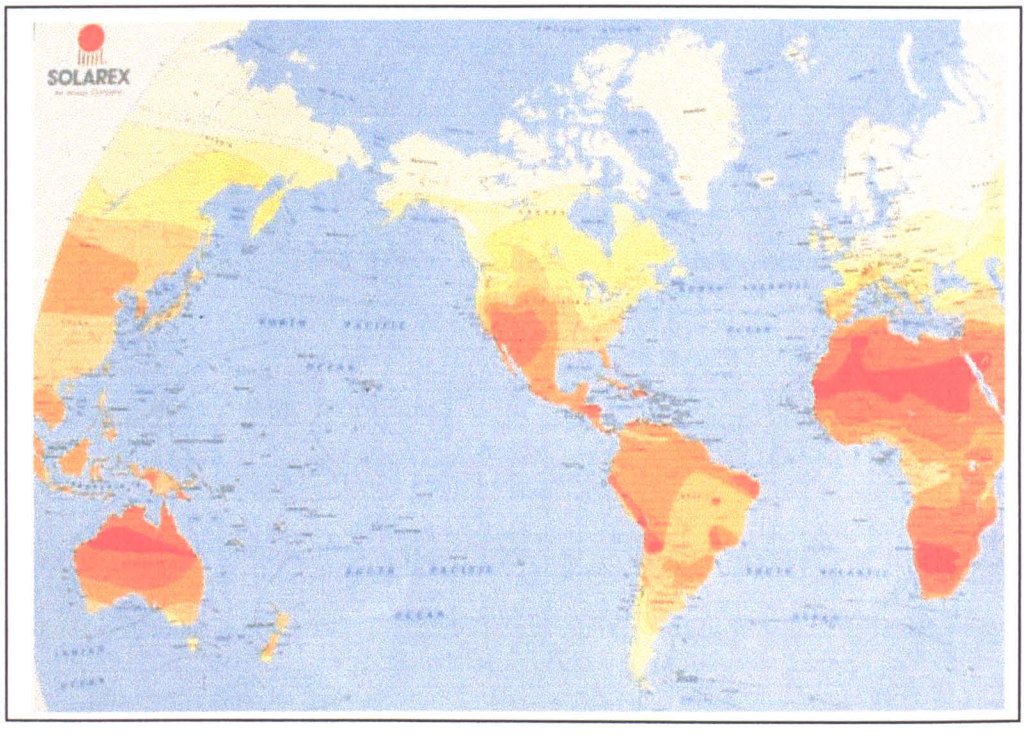

Figure 1.2 World annual solar radiation (Solar Electric Inc.2001)

The main application in using solar energy is for heating and provides electric energy but there are other application such as for cooling and transportation. The usage of this energy source with different application will achieve different level of success (Brown,

1988). According to Borlow (1993), the strength of sunlight is measured in Watts per metre square area. Total power absorbed on a horizontal surface reach maximum of a $1000W/m^2$ at sea level.

Solar energy technology is improved quickly and the potential for these energy sources to provide electric energy increase with the increasing in solar module efficiency. According to Weinberg (1991), since the potential depend to the technology itself, the photovoltaic industries could help solar energy to reach it's full potential.

In future, this source of energy can promise great potential where a lot of researches will continually improving that solar technology but still, resource management also important in maintaining the performance of those solar energy system and resources.

1.4 History of photovoltaic technology

The discovering of a photovoltaic effect from the n-p doped silicon was the first stage in the development of photovoltaic technology. In the photovoltaic cell, the sufficient energy of light that falls on the cells will produce excess of electron in the n-region and a deficiency in the p-region. Figure 1.3 shows the photovoltaic effect in photovoltaic cell. When this n-p region connected together with a conductor and load, it will produce power. According to Hislop (1992), French scientist, Becquerel was the first person that observing this phenomena. After the Becquerel discovery on the photovoltaic effect, other research been done to find the most active material that showing photovoltaic

effect. According to Laughton (1990), the Bell Telephone Laboratories discovered the silicon cell with efficiency 10 times then the traditional light-sensitive materials used in earlier devices in 1954. More and more research been done so the photovoltaic cell can be used to convert light to electric energy in practical. According to Kelly (1992), in the early 1970s, the photovoltaic cell has been in practical application. According to Stone (1993), the demonstration of higher performance, lower cost and better reliability in today's photovoltaic cell is leading many different end users to assess the value of these potential for their particular applications.

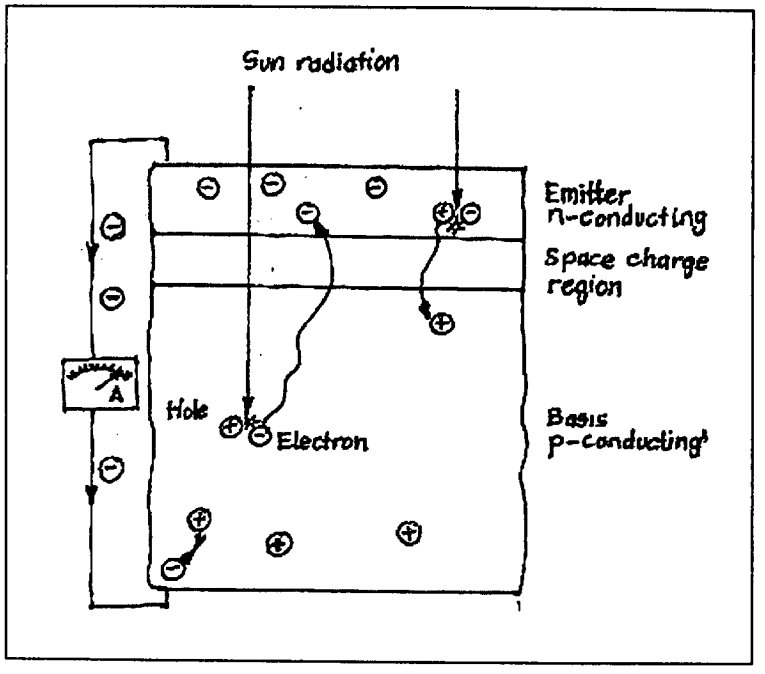

Figure 1.3 The Photovoltaic Effect In The Basic Photovoltaic Cell
(Bansal, 1990)

1.5 The challenges of solar energy

The availability of solar energy at the earth's surface varies in several different ways and on different time scales where the amount of solar radiation in India is different in Malaysia at noon. According to Bahm (2001), the greatest challenge to the designer of solar energy systems is first to forecast the availability of that solar energy at some time in the future, and then to provide system to capture the energy, and store it when necessary, so that it will be available when needed.

The actual output of the sun varies slightly due to the occurrence of sunspots, and possibly some other factor, but this variation is so small compared to the foregoing effects that it is ignored by most of solar systems designers.

According to Bahm (2001), the second great challenge is to make a device to capture the solar energy in the form of radiation, and to convert it to a useful form of energy

The amount of energy falling on a flat level surface one-meter square for one day is roughly 5 kilowatts hours and averages in 24 hours per a day is about 0.2 kWh/m2. The challenge occurs when this power output is compared to other modern energy sources where this is not very concentrated. The usage of 100-Watt light bulb at its surface has an intensity of about 12 kW/m2. How about the power that 500-Watt electric stove uses. Surely we are going to need and about 25 kW/m2. This shows a lot of solar cells and land requirement is needed just to power that electric stove. Thus solar energy systems need to

have collectors over a relatively large area compared to other energy sources that we are familiar with.

According to Bahm (2001), the third great challenge is economic. The concepts of collection and storage of solar energy are very simple, but those collectors and that storage unit price must compete economically in a world, which already has fairly inexpensive energy sources. This is the problem with solar energy where the cost in most of the case is not affordable.

The forth challenge will be in transportation where according to Brown (1998), the solar energy will be less efficient for transportation. Most of the transportation such as cars is using fuel and more comfortable compare to solar car, which is small in size and slow in speed. The technique in refilling the energy will also be the most important problem in solar car.

1.6 The objective of this project

Solar energy can be collected everywhere on earth surface and this source of energy have great potential to be applied in Malaysia. The government, private's organization and foreigner from other countries already applying this technology to remote area.

The main objective of this study was to identify problem from the application of solar energy for the remote area in Sarawak.

CHAPTER 2

LITERATURE REVIEW

This chapter will cover the technical knowledge of some component of solar energy system. Hybrid solar system and stand-alone solar system will also be explained.

2.1 Photovoltaics (PV) system technology

The photovolatics power system technologies involve the photovolatics modules as the main component and other devices that can greatly increasing the system performance. The simplest photovoltaics power system consist photovolatics modules and batteries but for large power application it is enhanced by the controller and inverter. This photovoltaic system was known as stand alone solar energy system where the system only depending on the amount of solar irradiation. In Asia, the weather always changes where there is time with low level of solar energy source but higher level of other energy source such as wind energy. According to Hislop (1992), these stand-alone systems have higher potential to be applied at location with high and constant amount of solar radiation per year.

There are lots of improvements to the system in the order to solve the problem for solar energy application in Asian. The latest system was hybrid system which it combine the solar energy with other renewable energy source such as wind. These new systems have