UNIVERSITI TEKNIKAL MALAYSIA MELAKA

POTENTIAL STUDY AND A DEVELOPMENT OF HYBRID SOLAR PICO HYDRO POWER HARVESTING FOR URBAN AND RURAL AREA

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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I hereby, declared this report entitled “Potential Study and a Development of Hybrid Solar Pico Hydro Power Harvesting for Urban and Rural Area” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

……

(En Muhamad Faizal Bin Yaakub)

ABSTRAK

Projek ini adalah bertujuan mengkaji potensi dan perkembangan hibrid solar hidro pico dalam penghasilan kuasa untuk kawasan bandar dan luar bandar. Bekalan dari sumber fosil yang semakin berkurangan dan akan kehabisan. Isu penting yang perlu diselesaikan adalah permintaan elektrik yang semakin meningkat dan tiada akses elektrik kerana tiada sambungan grid elektrik. Bahan utama yang digunakan dalam projek ini adalah penjana dan sel solar untuk menghasilkan elektrik, injap bola untuk mengawal arus air dari tangki, paip berdiameter 15mm x 1mm, tangki untuk mengumpul air, pengawal hydro dan solar untuk mengecas bateri dan bateri untuk menyimpan tenaga elektrik yang dijana. Tenaga elektrik dijana melalui dua kaedah iaitu dengan menggunakan penjana yang menggunakan sumber air dan sel solar yang menggunakan sumber cahaya matahari. Voltan, arus dan kuasa direkodkan dan analisis dijalankan. Hasil dari projek ini adalah untuk menghasilkan system hybrid solar hydro untuk menjana kuasa elektrik yang menggunakan gabungan dua sumber tenaga yang boleh diperbaharui dan ia menjana antara 5W keluaran kuasa. Oleh itu reka bentuk membolehkan prototaip menjana output dalam dua mod walaupun terdapat ketidakseimbangan dalam jumlah cahaya matahari atau jumlah hujan, penjanaan kuasa sentiasa ada.

ABSTRACT

This project presents a potential study and a development of hybrid solar-pico hydro power harvesting for the urban and rural area. Supply from fossil resources is depleting and will run out. The important issue needs to be solved are the electricity demand is rising and no electricity access because of no extension of the electricity grid. The main materials that used in this project are generator and a solar cell that generates an electricity. The ball valve is chosen to control the flow of water from the tank, 15mm x 1mm diameter of the pipe, tank to gather the water, hydro and solar hybrid controller to charge the battery and battery to store the generated electricity. The electricity is generated by two ways which are by using the generator that uses the water and solar cell that use the sunlight. The voltage, current, and power are recorded and the analysis is conducted. The results of this project are to produce the hybrid solar hydro system to generate electric power by using a combination of two renewable sources and it generates 5W output power. Therefore the design allows for prototype generate the output in two modes even though there is an imbalance in the amount of sunlight or amount of rainfall, generation of power is always there.

DEDICATION

To my beloved parents Mohd Zali Bin Ayob and Zaleha Binti Che Pa for supporting and encouraging me to believe in myself. A full appreciation to my Supervisor Muhamad Faizal Bin Yaakub for his advice, his patience, for helping me through this project. To lecturers, teachers and friends to achieve this level.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

P	-	Power (Watt)
m	-	Flow rate (L/s)
h	-	Gross head (m)
g	-	Gravitational (9.81 N/kg)
NEM	-	Northeast Season
SWM	-	Southwest Season
MA	-	March April Inter-monsoon Season
SO	-	September October Inter-monsoon Season

CHAPTER 1

INTRODUCTION

1.0 Introduction

In this chapter will explain the introduction of the project consist of project overview, problem statement, objectives, and scope of the project.

1.1 Project Overview

The project aims to study the possibility of using hybrid solar hydropower system for low-cost electricity production which can satisfy the energy load requirements in urban and rural areas. The system is determined based on these problems which are the supply from fossil resources is depleting and will run out if it not used prudently. The electricity demand and the extension of grid electricity networks also considered as the most important issue need to be solved. The prototype of hybrid solar will be used to convert the renewable energy resources for generating an electrical power. The amount of the rainfall and amount of sunlight is collected and the system is designed based on data collection. This prototypecombines the pico hydro and solar power generator to produce an electricity. The system controller ispowered by Arduino based technology both hardware and software. The maximum electricity produced is 5 Watt to supply a streetlight.

1.2 Problem Statement

Malaysia's energy sector isdominatedby anon-renewable energy source which is fossil fuel.Coal is the energy source of the country by a total of 40%. However, fuel is limited. Soon the fuel will run out. Even now liquefied natural gas and coal are 100% imported from other countries (TNB 2015). The domestic tariff using from 301 until 600 kWh per month cost 51.60 cents compared to June 2011 only cost 40 cents per kWh starting from January 2014 (Kettha 2016). The demand for electricity is gradually increased because of these problems. The previous record has broken in peak demand of 16,901 MW registered on June 6, 2014, because of the higher electricity demand (TNB 2016). Therefore, to solve this problem, the renewable energy is used to preserve the country's natural resources for our future generations.

Besides, global energy demand rises so quickly that it is expected to growth from 14.591010MW in 2007 to 21.891010 MW in 2035 (i.e., an increase of 49 %) (Hasanuzzaman et al. 2012). Hence, due to the lack of electricity in rural areas that increase poverty in emerging countries, international researchers intend to fulfill this demand. Nearly 1.3 9 109 people live without electricity, which is 18% of theglobal population according to international energy agencies (IEA), (International Energy Agency 2013).

In 2006, there weresubstantial numbers of areas in Malaysia that had no access to 24-hours electricity. Extension of grid electricity networks becomes wasteful because of the geographical conditions of these areas and the low electrical energy density demand of the population. Therefore, emphasizesthe need to improve living condition in the rural areas. The solar energy resources in the region are used

for providing analternative power supply for these areas (Mahmud & Blanchard 2016).

1.3 Project Objectives

1. To investigate renewable energy resources for generating electrical power that is sustainable, environmentally and feasible to rural areas.
2. To design and develop ahybrid solar-pico hydro prototype with generation ability.
3. To test and validate the maximum output power can be produced.

1.4 Project Scope

The scope of this project is about the design and development a prototype of power generation based on rainfall and amount of energy from the sun. This project will focus on field data collection and field study in the urban and rural areas in Malacca.

The scope of this project is it only focuses Malacca only. Therefore, to expand the application of the project to other state or country, the rainfall rates and theamount of sunlight is required. This project focus on the maximum of amount electricity produced which is 5Watt.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, the background theory regarding the project is discussed. This chapter also highlighted past studies related to the subject of the project.

2.1 Renewable Energy

Renewable energy is the energy that is derived from natural processes that are replaced at a faster rate than they are consumed. This consist of sunlight, geothermal heat, the wind, tides, water, and countless forms of biomass. This energy is unlimited and constantly renewed. The renewable energy is inexhaustible resources which are also called as green sources that can replace consumption of fossil fuel. They are harmless energy to the environment, instead can be used in our daily life and for our future. Besides, some of therenewable energy already used today. The type of renewable energy consists of hydropower, biomass, geothermal, solar, the wind and so on.

2.1.1 Biomass energy

Biomass is a sustainable power source not only because the energy in it comes from the sun, but also because the biomass can grow back in a relatively short period of time compared to the hundreds of millions of years needed for fossil fuels to form.Through photosynthesis, chlorophyll in the plant captures sun's energy by converting carbon dioxide from air and water from the soil into complex carbohydrates comprising carbon, hydrogen, and oxygen. When these carbohydrates are burned, they turn back into carbon dioxide and water and release the energy they captured from the sun. Biomass is also thereusable energy that uses as fuel combustion. It sourced from organic material such as industrial waste, agricultural waste, wood, and bark. The advantage of biomass is biomass more cost-effective because energy utilized from biomass is inexpensive compared to coal and oil.According to (Mathias Aarre Mæhlum 2012) usually they are about 1/3 less than fossil fuels that do the same work. This means you can spend 1/3 less each year for your home heating and after 10 or 15 years that adds big savings. According to (Kaltschmitt M 2003) energy from biomass presently commit 10–12% of gross worldwide energy.

Most biomass is used for direct energy-powered purposes to produce heat and / or power, but a variety of additional possibilities are provided to provide simple and / or electrically-electric electricity as well as transport fuels from organic matter. The most important conversion routes available now or in the nearfuture will be discussed according to the framework shown in Figure 2.1.

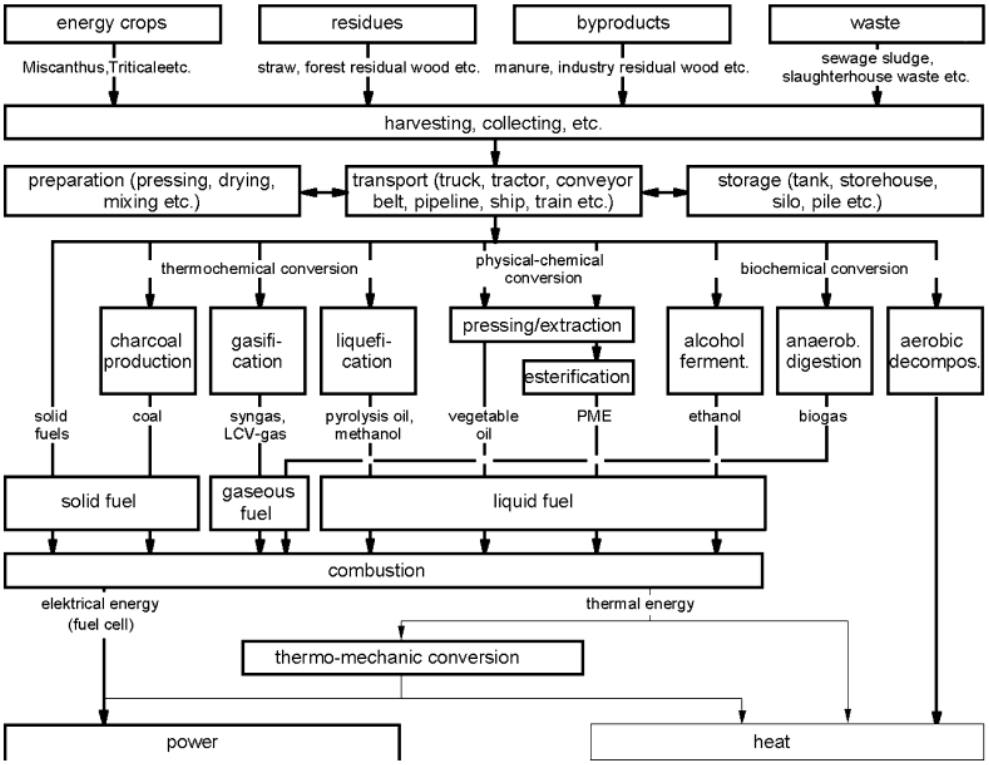

Figure 2.1:Possibilities to provide heat and/or power as well as fuels from biomass. (From Kaltschmitt, M. et al. 2000).

Bangladesh has a strong potential for gasification-based energy. This is because Bangladesh has more biomass assets accessible in the country which is rice husk, crop, residue, wood, jute stick, animal waste, municipal waste and so on (Ab Md. Abdul Wadud et al 2013).

2.1.2 Geothermal Energy

The heat from the Earth is called geothermal energy. It's unpolluted and sustainable. The sources of geothermal energy from shallow ground to hot water and hot stones are found several miles below the Earth's surface, and further down to the high temperature of melting stones called magma. To generate electricity, the steam and hot water produced inside the earth surface is used. This renewable energy is reliable resources which can reduce the use of fossil fuel for power generation. According to (Ab Md. Abdul Wadud et al 2013), 25 countries worldwide have generated about 10,715 megawatts (MW) of geothermal energy. The largest producer of geothermal energy is Kenya which now creates over eight times more geothermal electric power (202 megawatts, or MW) than does the world's leading energy consumer, China generates 24 MW of geothermal electricity. Kenya is rich in potential geothermal energy (Geothermal Energy Association's 2013).

According to (Mathias Aarre Maehlum 2013), the dry steam, flash steam, and binary cycle are several different main types of geothermal plants

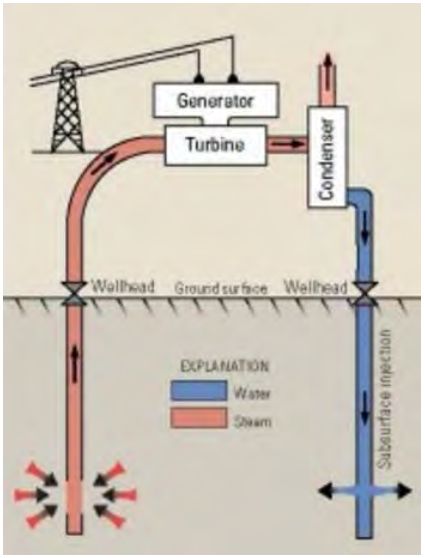

Figure 2.2: Geothermal Dry Steam Power Plants (Mathias Aarre Maehlum 2013)