TECHNO-ECONOMIC EVALUATION OF PHOTOVOLTAIC AND WIND ENERGY IN MALAYSIA

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Dedication to my beloved father, Harun Bin Abdul Latih, my wife, Faridah Ghazaliand my sonswhom support me, physically, mentally and emotionally, throughout my Master's study.
For my siblings and friends, appreciate your encouragement and help.
To all my lecturers, you are my inspiration for today and future time, Insha'Allah.

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ABSTRACT

The thesis presents the techno-economicevaluation of Photovoltaic and wind energy which provided electricity from green resources of solar irradiance and wind speed characteristic from Perlis, a state located in the northern Malaysia was taken for the hybrid system performance analysis. The potential of PV and wind power generation with the consideration of all the energy cost, total net present cost, and total electricity sold to utility with FiT and payback period of the system are calculated in Visual Basic and Microsoft Excel simulations to give the optimum cost and bring guidance to consumer before the investment for PV-Wind Hybrid Energy system has been made.

ABSTRAK

Tesismembentangkanpenilaiantekno-ekonomi Photovoltaic dantenagaangin yang menyediakanbekalanelektrikdaripadasumber-sumberhijausinaran solar dankelajuanciriangindari Perlis, sebuahnegeri yang terletak di utara Malaysia telahdiambiluntuksistemanalisisprestasihibrid.Potensi PV danpenjanaankuasaangindenganmengambilkirasemuakostenaga, jumlahkoskinibersih, danjumlahelektrik yang dijualkepadautilitidenganFiTdantempohbayaranbaliksistemdikiradalam Visual Basic dan Microsoft Excel simulasiuntukmemberikos optimum danmembawapetunjukkepadapenggunasebelumpelaburanuntuk PV-anginsistemtenagahibridtelahdibuat.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

CO2		Carbon dioxide
PV		Photovoltaic
WES		Wind Energy System
FiT		Feed in Tariff
PWHES	-	PV-Wind Hybrid Energy system
PWM	-	Pulse Width Modulation

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Recently, environmental becomea big issuein the world. The release ofgases, especiallyCO_2pollutinganddepletingthe ozone layer isa key factortothisissue. It's happen because of an attitude of people thatdoes notrealize the importance ofthe environment with released of the smoke vehicle engine and manufacturing process especially in develop country. Power generationis notexemptfromproblemsgas emissions (CO_2) andother gasesinto the atmospherein which eachgenerationusingcoals, gases, steams and others contributetoenvironmental pollution.

As energy demands around the world increase, the need for a renewable energy source that will not harm the environment is increased. Some projections indicate that the global energy demand will almost triple by 2050[1]. Renewable energy sources currently supply somewhere between 15% and 20% of total world energy demand. Photovoltaic, PV, and wind energy system, WES, are the most promising as a future energy technology. A 30% contribution to world energy supply from renewable energy sources by year 2020 as proposed

in Ref. [1] would reduce the energy related to CO^2 emission by 25 %.The advantages of electricity generation from green resources are:-

→ Green resources, do not emit smoke or create pollution such as wind and solar.

→ No charge for sunshine and the free of wind blows around.

→ Zero cost of solar and wind energy

→ Generation of energy from green resources is environmental friendly compared to fossil fuel emission (CO_2) associated with generation of electricity.

→ Enhance diversity in energy supply markets and strengthen energy security make a major contribution to reduce global atmospheric emissions.

→ Create significant new employment chances in energy infrastructure, manufacturing and installation.

→ Contribute to the securing of long term, cost effective environmentallysustainable energy supplies.

→ Lowmaintenance and operating cost.

→ Offer high reliability

In recent years, Photovoltaic–Wind Hybrid energy system is getting popular due to oil price increases and unstable in the global market. Furthermore with green peace movement, and the consciousness of mankind has heightened up regarding green energy, photovoltaic maybe one of the solution for better as well cleaner energy as it is naturally harness from the Sun energy. PVtechnologyis very popular indevelopedurbanenvironment-conscious carebutitis not very popularin rural areas. This is becausethe initial cost ofgeneration andthe efficiency of ageneration systemwhich is quiteburden to theconsumer [1]. Due to that problem, to answer

the cry for alternative energy has made the PV system again popular among the researchers. For developing countries, the rural areas where the grid connection is extremely expensive, PV Systems have been implied to give hope to these areas, while for the urban life, the PV Water Heater is common and can be found on the roof of the houses. While wind turbine been installed near to sea which is placed in several state of Malaysia.

In 2004, the photovoltaic industry production broke the 1GW barrier, worldwide some 1,200 MWp of photovoltaic modules and has become a 5.8 bill. € Business [1]. In the past 5 years, the yearly growth rate was anaverage of more than 40%, which makes photovoltaic one of the fastest growing industries at present [2]. The principal factors affecting the performance of PV systems are solar irradiance, ambient air temperature, electrical load characteristics, system configuration, and characteristics of the three major subsystems, namely, the array, batteries/grid, and power conditioning. Two types of grid-connected photovoltaic systems are considered in the Grid-Connected Photovoltaic System.

In Malaysia, wind energy conversion is a serious consideration. The potential for wind energy generation in Malaysia depends on the availability of the wind resource that varies with location. Understanding the site-specific nature of wind is a crucial step in planning a wind energy project. Detailed knowledge of wind on-site is needed to estimate the performance of a wind energy project. This first requires a general assessment of the wind energy potential nationwide.

Thisthesis project presents the technical evaluation of PV-wind hybrid energy systems in Malaysia. The evaluations is a developed version of existing similar methods, taking into account a further design parameter. New concepts, which combine the energy system and cost, are also introduced to be used in the techno-economic optimisation process. The sizing of a PV-wind hybrid system on a yearly basis requires a detailed analysis of the solar radiation and wind speed on a monthly basis. Many previous sizing methods have been developed based on the ‘worst month’ scenario for PV alone systems and PV-wind hybrid systems.

Any of renewable energy development will be getting its financial payback and profit through the Feed in Tariff Scheme (FiT), introduced by the Malaysian government. Through the FiT Scheme, up to RM1.46 per kWhr of solar energy will be paid in 2012 to participating individuals or companies. Funding allocation for the FiT Scheme is obtained by charging an extra 10% on existing electricity bills. For this project, RM1.46 will be paid for each kWhr of solar energy that is produced and feed into the national grid in year 2012 and RM1.34 in 2013. The FiT Scheme ties the project owner with Tenaga National Berhad (TNB) through a Renewable Energy Power Purchase Agreement (REPPA) for 21 years[2].

1.2 Problem Background

The sizing and optimisation of renewable energy systems (typically a hybrid PV-wind system) is more complex than that of single systems. This complexity is brought about by the use of at least two different resources together. The combination from both resources has to be considered in economic evaluations. Therefore, different sizing methods could then be applied to reach a techno-economically optimum renewable autonomous hybrid energy system. However, whichever sizing and optimisation techniques are used, they must ultimately search for an optimum combination of the following parameters: the level of autonomy, i.e. the fraction of time for which the specified load can be met, and the system cost (that, in turn, is the unit cost of the electricity produced from the system).

The aim of this study is to access the economic feasibility of the proposed PV-Wind power system that connected to the grid. The ultimate aim is to determine the optimum size of PV and wind turbine considering the cost of all components and pay-back period associated in the propose system. The evaluation will be performing based on weather data, economic viability of the system and system capital.

1.3 Problem Statement

The global increased of a fuel prices was an issue that cause the increment of the electrical tariff cost. This burden goes to consumer. Due to the problems, consumer needs the option to reduce the cost of electrical energy usage. There is a lot of hybrid energy system in the market which advertised their system. The consumer always requested a hybrid energy system that provides a reliable service for an extended period of time.

The major concern of the study is to provide an option to the consumer aPV-Wind Hybrid system that utilizes renewable energy sources and given an accurate selection of system componentswhich is PV module, Wind turbine rotor, Battery Cell and the Inverter that can economically satisfy the load demand.

1.4 Objective

The objective of this study is to determine the technical and economic feasibility of Photovoltaic and Wind energy in Malaysia. The more specific objective of this study was:

a) To propose a suitable strategy/method to optimize the size of PV-Wind energy system.

b) To evaluate the financial economic viability of the proposed system based on the weather conditions and the electricity tariff in Malaysia

c) To simulate the economic optimization of PV-Wind Energy system using Microsoft Excel and view the output using Visual Basics simulation packages

1.5 Project Scope

The methodology proposed are techno-economic approach to determine the system that guarantee the energy supply with a lowest investment. Its included the payback period and life cycle cost. The analysis will be carried out through hybrid optimization model for electric renewables (HOMER) as a guidance and mathematical models will be implemented in the Visual Basics and Microsoft Excel to perform the optimal configuration for the most prominent parameter of the PV-Wind size and the financial economic evaluation will be perform refer to system capital and electricity bill and weather condition in Malaysia

The economic evaluations of PV-Wind Hybrid system in a residential building are taken into consideration which has normal electrical appliances. The scope of this study as shown below:

a) The potential location/area of the building which will affect the generation of PV-Wind Hybrid system.

b) The technical analysis of the sizes of equipment referred to the load profile.

c) The economic analysis of the equipment, thus the capital cost, maintenance and operation cost (COE), total net cost (NPC) and the Payback period.

1.6 Significance of Project

Generation of electricity is vastly still dependent on fossil fuel such as natural gas, coal, fuel oil and diesel oil. The combustion of fossil fuel for electricity generation result in emission of greenhouse gases such as CO_2, ozone, nitrogen oxide (NO) etc, into atmosphere. CO_2 emissions are one of the main culprits to the problem of global warming whereas No emissions contribute to smog and acid rain problems.

Due to this issue the development of renewable energy rapidly growth. This project introduced the technical method to use the renewable resources and sized the hybrid system to minimize the cost of hybrid system as a function of PV size, wind turbine swept area and battery capacity.

1.7 Organization of Report

In general, this report mainly consistsof five main chapters; introduction, literature review, economic evaluations andsimulation using VISUAL BASIC/ SIMULINK software, simulation results analysis andconclusion.

Chapter onediscussedthe research project in collectively. This chapter explained the crucial aspect of the research work such as background studies, objectives, research scopes and methodology as well the thesis outline will also be discussed finally.

Chapter two completely dedicated to literature review about the PV-Wind Hybrid system. This chapter will be solely theoretical indetail discussing on the sizes of photovoltaic cell, Wind turbine, and the whole system about it. In this academic scribbling some of the weather condition, solar radiation and wind speed which contribute to the output power of the system. Thus, controlling techniques for both of the resources will be discussed as well. In this section the cost related to the system which is techno-economic evaluation will be discussed.

Chapter threeexplains how the sizing of the PV, Wind turbine, total power output of the system being implemented using the Visual Basic simulation. The load profile to be taken as a building which have average load. All the components used in building the models shall be included as well to add value in the academia world.

Chapter fourdiscussed in depth on the obtain simulation results. The result will be analyzed in terms of economic feasibility and also the payback period analysis. Conclusion and suggestion in improvising this research work shall be detailedout in Chapter five.

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