ASSESSMENT OF ONSHORE WIND ENERGY POTENTIAL IN PENINSULAR MALAYSIA

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Dedicated to

My wife and son

who has been a constantsource of support and encouragement during the challenges of graduateschool and life

&

Special dedication to

My beloved parents

who have always loved meunconditionally and whose good examples have taught me to work hard forthe things that I aspire to achieve

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ABSTRACT

Wind power and other sources of renewable energy are gaining attention as an alternative to replace demanding on traditional energy sources that scarce. However, wind energy still need to be developed and probably to commercialized as a huge renewal energy sources. The wind data with duration from year 2010 till 2014 was collected from Malaysian Meteorological Department (MMD) stations across Peninsular Malaysia, namely; Langkawi Island, Malacca, Mersing, Kuantan, Kota Terengganu and Kota Bahru. All selected area and wind data were analysed and simulated using Vector data by Geographic Information System(ArcGIS) and Wind Atlas Analysis and Application Program (WAsP) software. The resulted analysis from collected data shows a rated of wind speed and wind direction. The wind rose chart and Weibull distribution obtained was summarizing a wind power density. The overall results of this study show that the assessment and analysis of wind energy in Malaysia has potential to growth by developing small and medium scale of wind farms in order to generate a power sources which are clean, non-polluting and renewable.

ABSTRAK

Kuasa angin dan lain-lain sumber tenaga boleh diperbaharui yang semakin mendapat perhatian sebagai alternatif untuk menggantikan permintaan terhadap sumber tenaga tradisional yang semakin sukar didapati. Walau bagaimanapun, tenaga angin masih perlu dibangunkan dan seharusnya dikomersialkan sebagai sumber tenaga keterbaharuan. Data angin dengan tempoh dari tahun 2010 hingga 2014 telah dikumpul daripada stesen-stesen Jabatan Meteorologi Malaysia (JMM) di seluruh Semenanjung Malaysia, iaitu; Pulau Langkawi, Melaka, Mersing, Kuantan, Kota Terengganu dan Kota Bahru. Semua data kawasan dan angin yang dipilih dianalisis dan disimulasikan menggunakan perisian Data Vektor dengan Sistem Maklumat Geografi (ArcGIS) dan Angin Analisis Atlas dan Program Permohonan (WASP). Hasil analisis daripada data yang dikumpul menunjukkan penarafan kelajuan angin dan arah angin. Selain itu, carta ketinggian angin dan taburan Weibull diperolehi melalui ringkasan kepadatan kuasa angin. Keputusan keseluruhan kajian ini menunjukkan bahawa penilaian dan analisis tenaga angin di Malaysia mempunyai potensi untuk pertumbuhan dengan mengembangkan skala kecil dan sederhana ladang angin untuk menjana sumber tenaga yang bersih, bukan tercemar dan boleh diperbaharui.

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LIST OF SYMBOLS

C_p	-	Power Coefficient
m/s	-	Meter per second
^oN	-	Latitude
^oE	-	Longitude
v	-	Velocity of wind speed
Ø	-	Diameter of rotor
mph	-	Meter per hour
t	-	Time
V_i	-	Mean of monthly wind speeds
U_2	-	Final velocity
k	-	Shape parameter
c	-	Scale parameter
ρ	-	Density (kg/m^3)
m	-	Mass (kg)
P	-	Power (W)
A	-	Swept area (m^2)
x	-	Distance (m)
E	-	Kinetic Energy (J)
r	-	radius

LIST OF ABBREVIATIONS

ArcGIS	-	Vector data by Geographic Information System
WAsP	-	Wind Atlas Analysis and Application Program
DEM	-	Digital Elevation Modelling
DSM	-	Digital Surface Modelling
MMD	-	Malaysian Meteorology Department
GWh	-	Giga Watt per hour
WFD	-	Wind speed Frequency Distribution
WPD	-	Wind Power Density
WED	-	Wind Energy Density
AEP	-	Annual Energy Production
HAWT	-	Horizontal Axis Wind Turbine
VAWT	-	Vertical Axis Wind Turbine

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Wind is defined as an inducement or pressure gradient produced by air movement in the atmosphere. Wind is stronger and more frequent which able to move an object will producing kinetic energy and normally in wind energy, kinetic was generated by the movement or rotational of wind blade (mechanical systems) to electricity power.

However, it is crucial to have a wind energy assessment in Malaysia especially as a challenge in exploiting the energy concerned. In addition, the construction of wind farms or wind systems should be expanded and the dependence on existing resources can be reduce. Through recorded data by the Malaysian Meteorological Department (MMD), motion analysis, gust, speed and geography surface was reviewed through simulation. Similarly, spatial data modelling wind sustained winds of space is becoming more important for the analysis of spatio -temporal in the exploitation of wind energy. During the spatio-temporal analysis of wind power, the area or areas with high potential for wind energy can be easily distinguished.

Therefore, the aim of this study was to assess the potential for wind as well as wind power density space included in the scale of the study. This project is directed towards aiming to priorities the key parameters of wind energy potential in future as one of sustainable energy source which use to generate electricity in Malaysia

1.2 Research Objectives

The objective of this study are:

- To analyse the potential of wind energy and future development in Malaysia as renewable energy source
- To conduct energy analysis and wind energy speed using Vector data by Geographic Information System (ARCGis) and Wind Atlas Analysis and Application Program (WasP) softwares.
- To identify the potential of harnessing of wind energy for establish electricity production in Peninsular Malaysia.

1.3 Problem Statement

The electricity consumption in Malaysia is dramatically increased from year 1990 to year 2010 where the levels of electricity usage against daily usability affect the electricity tariffs and current prices of materials used. Besides, the crude oil and gas with continuously used as a source of energy in the entire life is not be ascertained and potential of the fossil energy may totally deplete. There are no contributions of wind energy for producing electricity in Malaysia due to not commercialize as eligible renewable sources in. Thus, a detailed study of wind energy is ongoing to determine the potential of wind energy for electricity generation in Malaysia

1.4 Scope of Research

This research deals mainly with design and simulation of wind energy in details. There are variable of parameters use such as type of wind turbines, wind turbine rate power system and wind data with several Malaysian Meteorology Department (MMD) stations. Firstly, selected map were created and simulated using

Vector data by Geographic Information System (ArcGIS) software to analysis it spatial and map contour before converting to vector mapping using Global Mapping application. Furthermore, wind simulation can be calculated by using Wind Atlas Analysis and Application Program (WAsP) software. Finally, the concept of ideal area to harnessing the produced electricity from wind turbine is the main focus.

In this paper the study only cover the 3 type of wind turbines, seven differents location of MMD stations with geographical surface and simulation results by analysing Annual Energy Production (AEP) produced from wind turbine selection.

1.5 Theoretical Framework

Figure 1.1 at next page is showing the framework of this research. The critical steps of study are creating a contour mapping and simulating Wind Atlas Analysis and Application Program (WAsP) to producing Annual Energy Production (AEP) results.

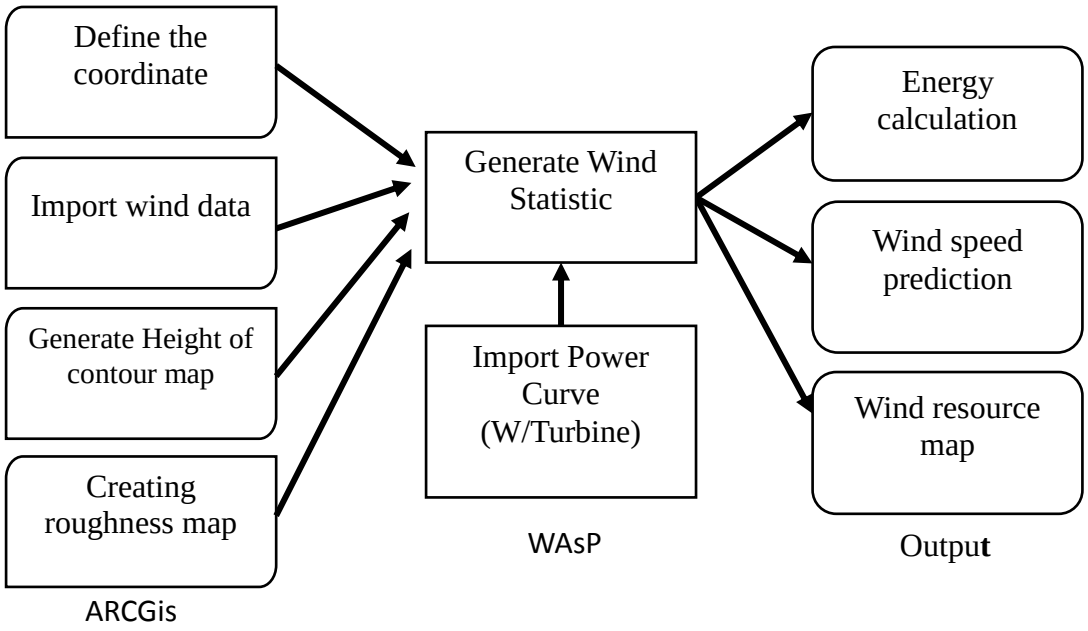

Figure 1.1 : Theoretical Framework

1.6 Thesis Outline

Chapter 1: Introduction

This chapter describes the research background of this. The objective of this project also been started in this chapter

Chapter 2: Literature Review

In this chapter, the item that will be discussed is the related works and literature review that will supported this study.

Chapter 3: Methodology

The most significant chapter that is chapter 3 detailing on the research methodology variables and mathematical modelling with equations involved in the modelling and simulation part. Data collection method and the accuracy of the result are been listed in that chapter.

Chapter 4: Result and Discussion

For this chapter, results from simulation done are listed out and discussion is carried out for the result obtained**.**

Chapter 5: Conclusion and Recommendation

In this last chapter it is dedicated for conclusion of the studyand recommendations on future improvements for different type of simulation and variable parameters such design and software applications needed in this study.

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