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SciVerse ScienceDirect
Energy Procedia 18 (2012) 1428 – 1433
Energy Procedia

# A Study on the Wind as Renewable Energy in Perlis, Northern Malaysia

I.Daut[a], *A.R.N. Razliana[b], Y.M. Irwan[c], Z. Farhana[d]

[a, b, c]*Electrical Energy and Industrial Electronic System Research Cluster,*
*School of Electrical Systems Engineering,*
*Universiti Malaysia Perlis (UniMAP), 01000 Kangar Perlis, Malaysia.*

**Abstract**

This paper represented analysis of wind speed and study of vertical axis wind turbine. There are two type vertical axis wind turbine that had been discussed on this paper that are Darrieus type and Savonius type wind turbine. The wind speed data is recorded using Davis Vantage Pro2 Weather station. A few calculations has been done to get output power from the wind to shows the possibilities and potentialities of wind energy whether it can be develop in Perlis.



*Keywords: Wind speed,Vertical axis wind turbine,*

## 1. Introduction

Wind power is a renewable energy source that has developed rapidly since the end of the 1970s. Wind turbines produce clean energy, don’t need any fuel transport that can hazardous to the environment. The sun, the wind and running water are all renewable energy sources, in contrast to coal, oil and gas, which depend on fossil fuels from mines or oil and gas fields. Modern wind turbines are efficient, reliable and produce power at reasonable cost. This has been achieved by an energy policy that has created a market for renewable energy and by research development. The technology in the wind turbines has developed in several ways. The control systems have become cheaper and more advanced, new profiles for the rotor blades can extract more power from the wind, and new power electronic equipment makes it possible to use variable speed and to optimize the capacity of the turbines [1]. In this few decades wind power has

 doi:10.1016/j.egypro.2012.05.159

developed from alternative energy source to a new fast-growing industry which no longer needs subsidies and manufactures wind turbines that produce power at competitive cost.

This paper will show principle of work of vertical axis turbines and the potential of wind energy in Perlis. The main data applied in the equations is collected and recorded using Davis Vantage Pro2 Weather Station. This weather station is successfully installed at Electrical Energy and Industrial Electronic (EEIES) Research Cluster located at Kangar, Perlis. The main purpose of weather station installations is to improve the study in assessment of wind and solar energy especially in northern area of Peninsular Malaysia. Figure 1 shows a Davis Vantage Pro2 weather station data center in EEIS.


Fig 1. Davis Vantage Pro2 weather station center

## 2. Type of wind turbine

Harvesting small amounts of wind energy, on a large volume of scale provides a significant contribution toward global renewable energy [2]. The energy conversion process through commercially available small wind turbines includes blades that convert the wind energy into rotational mechanical energy on the shaft and an electric generator that is both simple in design and manufactured in small quantities by the wind turbine developer or retrofitted off-the-shelf general purpose machine [3].

There are several different design concepts for wind turbines. One basic classified is Horizontal Axis Wind Turbines (HAWT) and Vertical Axis Wind turbines (VAWT). Vertical axis wind turbines are a type of turbine where the main rotor shaft runs vertically. These turbines can rotate unidirectional even with bi-directional fluid flow. VAWT is mainly due to the advantages of this kind of machine over the horizontal axis type, such as their simple construction, the lack of necessity of over speed control, the acceptance of wind from any direction of the mechanical design limitations due to the control systems and the electric generators are set up statically on the ground [4]. Generally, there have been two distinct types of vertical axis wind turbine that is the Darrieus and savonius types. For the Darrieus, there are three common blades that are Squirrel Cage Darrieus, H-Darrieus and Egg Beater Darrieus.

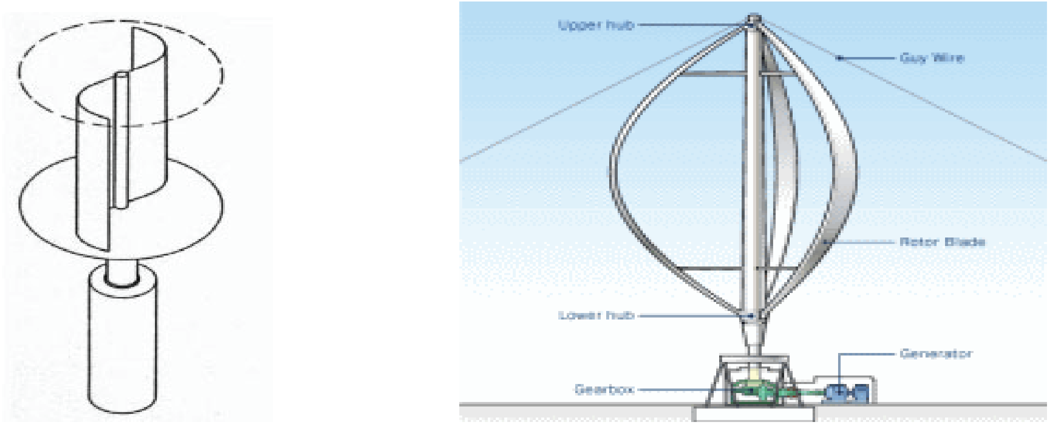


Fig 2. (a) Savonius wind turbine [5] ; (b) Darrieus wind turbine [5]

The machine is particularly suited to medium or low of wind speed which is inland area. The design of Egg Beater wind Darrieus wind turbine shown in figure 2 (b).

Both designs have almost identical component. To make it clear, Table 1 shown advantages and disadvantages over one another.

| | Darrieus wind turbine | Savonius wind turbine |
|---|---|---|
| **Advantage** | | |
| | - High speed with low torque machine | - Slow rotating with high torque machine |
| | - Generally manual push therefore some | - Shaft of the generator can be placed nearer to the ground |
| | - external power source to start turning | - Starts at low wind speed |
| | as the starting torque is very low | - Low- noise system |
| | - Generator can be placed on the ground | - Work with any wind direction |
| | - Easily integrated into buildings | |
| **Disadvantage** | | |
| | - Difficult to self starting | - Low efficiency |
| | - Need multiple guy wires to give it | |

Table 1. Darrieus wind tubine versus Savonius wind turbine

## 3. Calculation for wind turbine

Calculating the energy available in the wind relies on knowledge of basic geometry and the physics behind kinetic energy. If the air mass is *m* and it moves with an average velocity *V*, the kinetic energy (KE) of the wind is:

$$KE = \frac{1}{2} m V^2 \quad \text{Joules} \tag{1}$$

The mass of air hitting our wind turbine (which sweeps a known area) each second is given by the following equation:

$$\textit{Mass hitting in wind turbine} = V \times A \times p \ \ /\text{second} \tag{2}$$

Where V is velocity in meter per second, are in meter$^2$ . *p* is the density of air (which at sea level is 1.2256 kgm$^{-3}$). And therefore, the power in the wind hitting a wind turbine with a certain swept area is given by simply inserting the mass per second calculation into the standard kinetic energy equation given above resulting in the following vital equation:

$$\textit{Power density} = 0.5 \times p \times A \times V^3 \tag{3}$$

Where Power is given in Watts, the Swept area in square meters, the Air density in kilograms per cubic meter, and the Velocity in meters per second.

### *3.1. Weilbull distribution*

The movement of air mass in the atmosphere is perceived as a wind and has various causes. The first and most important of these is the heating of the earth by the sun. Wind energy utilization is, therefore an indirect form of solar energy utilization. The radiation from the sun is absorbed by the earth's surface and then returned to the atmosphere above and give impact on the wind speed [6]. Due to this, the best describe of wind speed can be modeled using the Weilbull distribution. The weibull distribution is a statistical model defined by two parameters, which can be altered to change the scale and the shape of the curve. It describes the probability of the occurrence of different wind speeds. The statistical will tell how often winds of different wind speed will be seen at a location with certain average wind speed. Figure 3 shows an example of how weilbull distribution varries with k.

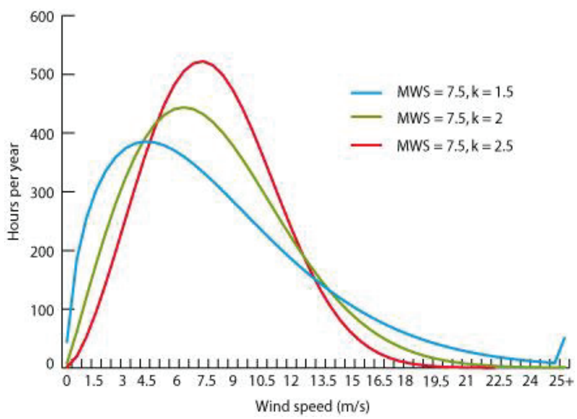


Fig 3. Weibull distribution

Larger values of ‘k’ result in a more regular bell-shaped curve and lead to a higher mode, while the mean wind speed is unchanged.

## 4. Potential of wind turbine in Perlis

According to Malaysian Meteorological Department, wind over this country is generally light, but there still some homogenous periodic changes, Malaysia face four seasons, namely the southwest monsoon, northeast monsoon, and two shorter periods of intermonsoon seasons [7]. But in Perlis, it more tend to tropical monsoon because it’s located near to Thailand. The daily average wind speed for the April 2011 has been choosing for this study as shown in figure 4. The maximum, minimum and mean wind speeds for a month are 3.2274 m/s, 0.1992 m/s and 1.7133 m/s.

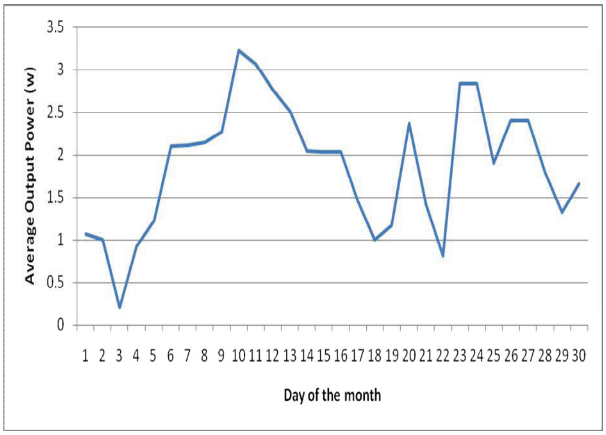


Fig 4. Daily wind speed for April 2011

The evaluation of the wind power and energy per unit area are importance information of wind power project assessment. Figure 5 show average output power density during year of 2009 at 21.7 m above ground level. The highest month average power density is 4.9237 W/m$^2$ occur on January and the lowest one is 0.1159 W/m$^2$ occur on july. The annual wind power density is 1.1549 W/m$^2$

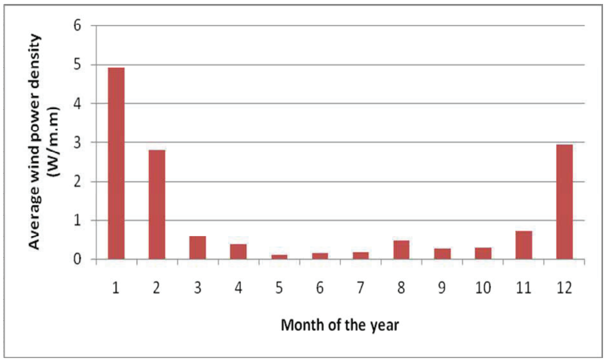


Fig 5. Monthly average wind power density

The calculation of output power in watt is using equation 3 respectively.

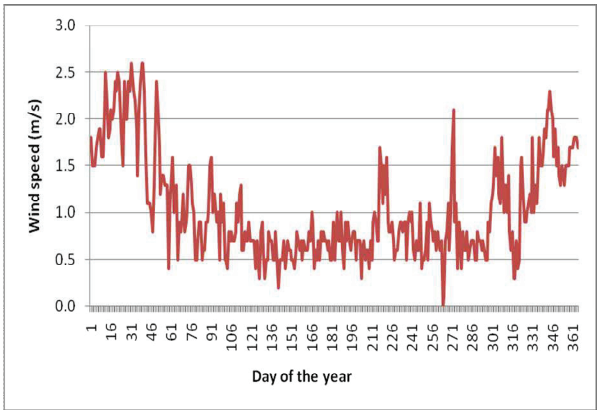


Fig 6. Daily wind speed for the year of 2009

The daily wind speed for a year of 2009 is shown in fig. 6. The maximum and average wind speed during this year is 2.600 m/s and 1.3001 m/s. From the fig 6, it is show that the best time harnessing wind energy is when the highest average wind speed occured. From fig 5 and 6 the maximum average wind power happened from November until March. Hence this is the perfect time to harrnessing this renewable energy in Perlis. Thus, the wind data analysis shows in fig 5 and 6 can provide information about the suitability of having wind turbine in perlis.

## 5. Conclusion

This paper concludes that, Perlis has potential in developing the wind energy system. The installation of Davis Vantage Pro2 weather station has improved the recording data of wind speed. Through the recording data a study of the vertical axis wind turbine shows that, this type of wind turbine most suitable to asses in Perlis as the wind speed in this state is low.

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