Evaluation Of Wind Energy Potential In Kermanshah Province

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Received: 20/06/2010 Accepted: 10/06/2012

Extended Abstract

Introduction

The rapid reduction of fossil fuels, global warming, green house effects, environmental pollution and falling of acid rains have increased the need of attention to renewable energies especially wind energy as a clear interminable and free energy source (Rahman at el, 2003). Therefore, in order to exploit the potential energy of wind, assessment in different areas should be considered. This study assessed the potential of wind energy at Kermanshah province. Wind energy potential based on statistics of three hours wind direction and speed of synoptic stations of province including Kermanshah, Eslamabade Gharb, Ravansar, Kangavar and Sarpolzahab, Was assessed from 1997 to 2006. For showing wind speed and direction of province stations, the Wrplot software was used as well us the Weibull mathematical model for befitting of data possibilities distribution.

Distribution of wind speed is a feature of wind that contains important data not only for environmental and structural design, but also as the potential for wind energy and wind energy conservation system. During the past two decades many researchers have spent much time to develop an appropriate statistical model for the distribution of wind speed. Application of two-parameter Weibull probability distribution is one of the best ways to describe the distribution of fluctuating wind speed and has been used to investigate wind power in many different countries (Li, 2005). Al-Nassar et al (2005) investigated the potential for wind energy production in

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Kuwait. Belu and Koracin (2009) studied wind characteristics and wind energy potential in Western Nevada. Similar research has been done in Iran. Salahi et al (2004) evaluated wind energy using the probability distribution function Weibull for Ardebil province. Jehangiri et al (2005) calculated the wind energy with two parameters Weibull distribution for… province.

As part of the US Department of Energy's Federal Wind Energy Program, developed a wind power classification scheme. Areas are classified on the basis of wind power, ranging from 1 (lowest) to 7 (highest). Each class represents a range of wind power density (W/m2) or a range of equivalent mean wind speeds (m/s) at specified heights above ground level. Typically, grid blocks designated as Class 4 or greater are considered to be suitable for most wind turbine applications. Class 3 areas are suitable for wind energy development using taller wind turbine towers. Class 2 areas are considered marginal for wind power development and Class 1 areas are unsuitable (Ilinca et al., 2003).

In this research using Weibull probability distribution function, Kermanshah province was zoning for developing wind power potential

Methodology

Weibull function is a case of Gama distribution. This distribution is usually used to plot the wind distributions for specific locations in the determined monthly and annual time period (Zhou et al., 2006). This distribution is defined as follows:

$$P(V)=\left(\frac{K}{C}\right)\left(\frac{V}{C}\right)^{K-1}\exp\left[-\left(\frac{V}{C}\right)^{K}\right] \quad (1)$$

In this formula, (K) is a dimensionless parameter known as the "form factor" and (C) is a parameter called "scale factor" that the unit is meters per second (Ahmad-shata and Hanitsch, 2006).

After calculating the components of Weibull function, wind power density at a height of 10 meters can be obtained from the following relation:

$$P_{ave}=\frac{1}{2}\rho.C^{3}.\Gamma(1+\frac{3}{K}) \quad (2)$$

Where Γ is Gama function, C and K are parameters of Weibull function and ρ is density of air. Density of air at standard conditions of temperature and pressure is equal to 1.225 kg per cubic meter.

Studies have shown that the height of most commercial wind turbines is about 30 to 80 meters from ground level (Jahangiri et al, 1384). Here 2 and 50 meter values were selected. To estimate the wind speed, 1/7 power low model was used according to the following equation:

$$\frac{v(z)}{v(z_0)}=\left[\frac{z}{z_0}\right]^{\frac{1}{7}} \quad (3)$$

In this Equation z is height of desirable wind speed, V(z) is the wind speed that must be

estimate, and z_0 and $V(z_0)$ are reference Height and wind speed, respectively (Annaser et al., 2005).

Results and Discussion

Weibull continuous probability values (Pw) in Kermanshah station is between 2 and 6, the Eslamabad Gharb between 3 and 8, Kangvar and Sarpol zehab between 4 and 9, and Ravansar between 5 and 10.

The amount of annual wind power density at heights of 10, 20 and 50 meters, is the lowest and highest value belong to Kermanshah and Ravansar station respectively. Sarpol zehab, Islamabad Gharb and Kangavar Wether stations have higher amount of wind power respectively after Kermanshah. The value of annual potential wind energy at four named stations at the level of 10 meter is 254, 223, 214, 146 and 82 watt on square meter, respectively.

Conclusion

In general, the results show that Ravansar, Kangavar and Sarpolzahab stations are suitable for using wind energy; EslamabadeGharb is suitable provided that high elevation wind turbines are used and Kermanshah station is known unsuitable for using wind energy.

Keywords: Wind Power Density, Weibull Distribution, Power Law, Kermanshah Province.