

## Solar Energy South Africa

# Relationship between wind power density and power generation



## Overview

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What are the statistical properties of wind power density function?

This study discusses the statistical properties of the wind power density function, particularly the mean power, standard deviation, skewness and kurtosis. The transformation method has been proposed for deriving a theoretical density function of wind power based on the wind speed pdf, such as the Gamma, Weibull and Inverse Gamma pdfs.

What is a wind power density model?

The wind power density model is useful for describing the distributions of wind energy at various wind speed values. As discussed above, wind power density is obtained by considering a suitable wind speed density function.

Why is mean wind power density better than mean wind speed?

tory (NREL) of the USA. Mean wind power density has advantages over mean wind speed for comparing sites with different probability distribution skewness, because of the cubic nonlinear dependence of wind power on wind speed (see Fig. 11 in reference).

How is wind power density determined?

The Wind Power Density (WPD) was determined by measuring wind speed at the analyzed location and considering the air density. Wind speed data collected from the meteorological station at a height of 10 m was extrapolated to the turbine hub height (80 m) using the power law to account for altitude variations in wind speed.

How important is the probability density function of wind speed?

Based on the wind power equations discussed above, it can be concluded that the probability density function of the wind speed is very important in determining and evaluating wind energy potential. In fact, the Weibull pdf is among the most popular statistical distributions in the field of wind energy

applications.

What is the energy ratio of a wind turbine?

Environmental conditions. Considering that energy is the product of its time-rate, that is, the power with the elapsed time, this energy ratio is equal the ratio of average power  $P$  to the nominal power of the system  $P_n$ . For a single wind turbine this nominal power is

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### Using Conditional Kernel Density Estimation for Wind Power Density

relationship between wind speed and wind power (S nchez 2006). It would seem wise to take this additional uncertainty into consideration when converting wind speed density forecasts to wind

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### Understanding wind farm power densities , Journal of ...

Luzzatto-Fegiz & Caulfield (Reference Luzzatto-Fegiz and Caulfield 2018) developed a two-interface entrainment model for fully developed wind farms to analyse the power output density of wind farms. Their main ...



### Incorporating air density into a Gaussian Process wind turbine power ...

Particular attention should be paid to the air density since it significantly affects wind power generation and its accuracy. For example, the BARANI company, [14], concludes that weather

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### Wind Power Generation Forecast Based on Multi ...

Accurate forecast results of medium and long-

term wind power quantity can provide an important basis for power distribution plans, energy storage allocation plans and medium and long-term power generation plans ...



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