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Assessment of Wind Energy Generation Potential for Ongwediva, Namibia and Application to JEDS Campus

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Abstract. Renewable energy technologies are considered clean sources of energy and optimal use of these resources minimizes environmental impacts and is sustainable based on current and future economic and societal needs. In Namibia, wind energy can be considered one of the available renewable energy sources. Despite the abundance of wind speed distribution over Namibia, there is a lack of properly analyzed and documented data that could reveal the capabilities of wind energy generation in Namibia. This research aims to assess the wind energy generation potential for Ongwediva and with specific application to the University of Namibia Engineering Campus to determine its suitability. Data for the Jose Eduardo dos Santos (JEDS) Campus was collected from the National Aeronautics and Space Administration (NASA) Data Access Viewer. The collected data was analyzed and modelled using the Weibull probability distribution function. Results from the model predict the wind speed distribution pattern and energy density which constitute the decision variables for the suitability of wind energy application at the selected site. The yearly averaged wind speeds for the study location varied between 3.456 and 3.698 m/s while the calculated yearly averaged wind power density ranged between 22 - 27 W/m^2 for a single turbine. The study concluded that the appropriate wind turbine for the range of wind speed and power density for Ongwediva was the Vestas V100 which could produce 1800 kW of electrical power which may provide CO_2 savings of 4,974 tons/year. This assessment provides data for advancing wind resource development and application in the Engineering campus or around Ongwediva town.

Introduction

Increase in the greenhouse effect and the subsequent increase in carbon dioxide levels in the atmosphere suggests there is an increasing need to reduce the use of fossil fuels for energy generation, particularly given the population's ever-rising energy demands [1]. On the account of the expanding population and awareness of sustainable development and environmental protection, making use of renewable energy sources has received a lot of attention in recent decades [2]. Wind energy is one of the best-known renewable energy sources, as it is clean, environmentally friendly, and relatively limitless and as such it is widely employed around the world.

Moreover, the generation of wind energy is more beneficial to the environment unlike fossil fuels that emit greenhouse gases [7]. Additionally, wind turbines, on a small scale, has minimal land requirements and can be easily integrated into the existing landscapes [3], reducing its environmental impact compared to other renewable energies [8].

However, adopting wind energy for electricity generation needs an understanding of its resource availability in specific locations, since wind power potentials are locational due to the variability of the wind characteristics [3]. This variation in the wind trends is what calls for a thorough assessment on the characteristics of the wind patterns for the chosen location [4], which is the JEDS Campus in Ongwediva. While wind energy offers a solution for clean and sustainable energy generation, accurately assessing its potential at targeted areas remains a challenge since existing data may be