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# Wind Potential Assessment of the El Dhaya Region- Sidi Belabbess

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## ABSTRACT

This work aims to assess the wind potential of the El Dhaya region located in the south of Sidi Belabbess North-West Algeria using three years of collected data (2020-2021-2022). The statistical analysis of the data confirms that the study region has significant wind potential with an average wind speed of 6.5m/s at 10m height, a power density of 383w/m² and Weibull parameters A= 6.9m/s K=1.65 from the South, and South-South-West (SSW) direction. Regarding the temporal analysis, it was found that the night times of the site are relatively calm and windier in June (8.13m/s) and November (10.3m/s). Then, three wind turbine technologies (Bonus 2MW, NEG-Micon 2000-500/72, Vestas V66 2MW) were simulated and compared using WindPro software to select the most suitable technology for the construction of 12MW wind farm Finally, after obtaining the desired energy production capacity, an economic analysis was carried out by the RETScreen software which confirmed the desired economic indices with an energy sales cost (COE) of $0.09/kWh.

**Keywords:** Wind potential, wind speed, power density, Weibull distribution, COE

## 1. Introduction

The kinetic energy of the wind is an inexhaustible but intermittent energy source. For any on-site wind installation, it is necessary to first have the characteristics of the study site. The wind potential of a site is defined as the energy that can be extracted over a given period from the operation of a specific wind turbine on a site [1]. Wind farm modeling is a complex process involving several aspects, such as data collection, on-site visits, modeling of wind speed and direction, as well as modeling of electrical energy production.
The process of sizing a wind farm typically involves multiple steps. It commences with a statistical analysis of measurements to ascertain the mean wind speed. Subsequently, the optimal configuration and suitable wind turbine technology are identified, as outlined by [2]. The present study concerns an Algerian area called El Dhaya region situated in the southwestern part of Sidi Belabbess region Fig (1). a city located in northwestern Algeria in the Tell Atlas Mountain range. The principal reason for choosing the site of El Dhaya is that the recent measurements recorded at the meteorological station of the Photovoltaic Power Plant show very interesting winds during several months of the year. This study focuses on the main following points:

- Determination of the relative wind potential of the study area using measured data (wind speed and direction) from 2020 to 2022
- Mapping the site (Drawing the Atlas map and the elevation map).
- Comparative analysis between Three main types of wind turbine technology and determination of the expected annual energy production (AEP) and capacity factor for each one of them
- Economical study and cost comparison using RETScreen software.



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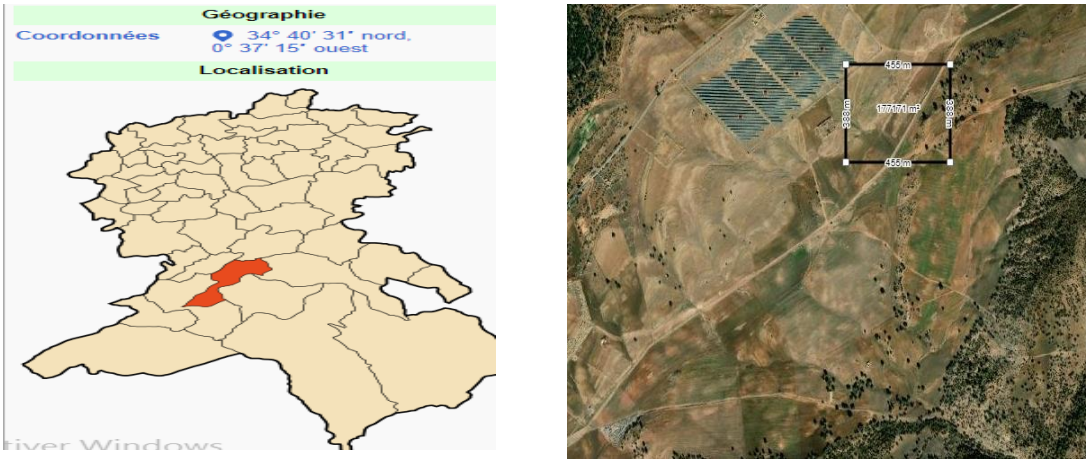


**Figure 1:** El Dhaya topographic carte

## 2. Experimental

To estimate the wind potential in the case study region of El Dhaya, we used the WindPro software for the simulation. The main function that the software uses to characterize the variation of wind speed and the available wind power density in the selected site is the Weibull probability because it is the most used in this field and its parameters were determined. It has been used to represent wind speed distributions for application in wind load studies over a specific period of time and can give a good fit to experimental data and provides a good approximation to many measured wind speed distributions., which has the function [3].

$$p(V) = \frac{k}{A}\left(\frac{V}{A}\right)^{k-1} exp\left[-\left(\frac{V}{A}\right)^{K}\right] \quad (1)$$

For calculating the mean wind speed , following expressions can be used:

$$\bar{v} = \frac{1}{n}[\sum_{i=1}^{n} v_i] \quad (2)$$

## 3. Results and Discussion

This section shows a detailed discussion of results presented in the form of wind roses, histograms, maps and tables. In the first part, the statistical analysis of the entire region is presented. Then, the second part shows theresults of the comparative study of three main types of wind turbines to find the optimum one for the selected site which includes the principal reason that this study was initiated.

## 4. Conclusions

In this study, we evaluated the wind resource in a newly discovered wind site located in northwestern Algeria in the Tell Atlas Mountain range called El Dhaya, which no previous study has dealt with. Also, this work has shown the importance of the WindPro tool which allowed us to evaluate the wind potential available in this area very easily in comparison to other tools such as the AIOLOS tool.

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