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Comparison of different wind farm layouts for a 25 MW project in the south west of Algeria

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Abstract. The object of this work is to evaluate and compute the power potential of the KABERTEN site and to make the rigorous choice among different placements of wind turbines in order to decrease the wake effect and improve the power efficiency. Three proposals of wind farm layouts where all the turbines are faced to the prevailing wind have been used in the simulations. The results for individual and global energy yield as well as wake loss have been obtained and plotted. The wind Atlas Application Program (WASP) software of the Danish RISO laboratory is used in the study as a simulation tool to evaluate potential of the chosen site and to determine the best wind farm layout for a 25 MW project.

Keywords

Wind energy Potential, wind farm layout, wake effect, turbines placement, WASP

1. Introduction

In order to make your wind energy project economically viable wind turbine placement is one of the most important factors to consider. The good selection of location for your wind turbine can in many cases mean the difference between economic success and failure to even return the investment. The location needs to have constantly high wind speeds to ensure the maximum efficiency but factors like the availability of transmission lines, value of energy to be produced, cost of land acquisition, land use considerations, and the environmental impact should also be considered. Many attempts have been made in optimizing wind turbines positioning. As rule of thumb, 10 ha/MW can be taken as the land requirement of wind farms, including infrastructure. The spacing of a cluster of machines in a wind farm depends on the morphology of the terrain, the wind direction and speed, and the turbine size. The optimal spacing is found in rows 8–12 rotor diameters apart in the windward direction, and 1.5–3 rotor diameters apart in the crosswind direction [1]-[2]. If the wind strikes a second turbine before the wind speed has been restored from striking an earlier turbine, the energy production from the second turbine will be decreased relative to the unshielded one. The amount of decrease is a function of the wind shear, the turbulence in the wind, the turbulence added by the turbines and the terrain. Spacing the turbines further apart will produce more power but at the expense of more land more roads and more electrical wire. The wind leaving the turbine must have lower energy content than the wind arriving in front of the turbine. A wind turbine will always cast a wind shade in the downwind direction. In fact, there will be a wake behind the turbine, i.e. a long trail of wind which is quite turbulent and slowed down, when compared to the wind arriving in front of the turbine. When choosing the perfect placement for wind turbine many wind farm designers use specialized wind energy software applications to determine the efficiency and economic benefits of given wind energy project. In our study the WASP software has been used to evaluate potential of the chosen site and to determine the best wind farm layout for a 25 MW project to be installed in the south west of Algeria precisely at KABERTENE in the province of ADRAR which is the windiest part of the country [3]-[4]. Three proposals of wind farm layouts where all the turbines are faced to the prevailing wind have been used in the simulations. The geological and meteorological data used in the simulation were given by the *National Office of Meteorology* (ONM).