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The wind power potential of the eastern Mediterranean region of Turkey

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Abstract

The wind energy potential in the eastern Mediterranean region has been investigated using hourly wind data taken from seven stations during 1992–2001 periods by the Turkish Meteorological Service. The present work suggests that in the east Mediterranean Sea coast of Turkey, wind energy sources are convenient for electricity generation. The mean power density was determined as 500 W/m^2 in many areas of this region at 25 m from the ground level. The most promising locations in terms of wind power generation are identified. The contours of constant wind speed and power potential could lead the private power developers to decide the locations of appropriate wind farms.

Keywords: Wind energy; Wind speed; Weibull distribution; Turkey

1. Introduction

The demand for energy, especially for electricity, is growing rapidly in Turkey as a result of social and economical development of the country. According to the predictions of the Turkish Ministry of Energy and Natural Resources, Turkey needs to increase its electric generation capacity to 60 GW by 2010 [1]. It is known that

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hydroelectric power plants produce 40% of electricity demand of Turkey and the remaining 60% of electricity is produced by thermal power plants mostly based on fossil fuels [2]. Turkey does not have large oil and natural gas reserves. Almost all types of oil and natural gas are imported from neighboring countries. These limited sources force Turkey to search for renewable energy sources. One of the best renewable energy sources for Turkey is wind energy. Due to a change in government policy concerning wind energy, potential wind energy sites are now being investigated. However, the potential sites of wind energy generation of the country have not been completely investigated in detail yet. Although several studies investigating the wind potential of the Aegean region of Turkey are available, these studies do not cover all sites where a substantial rate of wind power potential are available.

Karslı and Gecit [3] determined the wind power potential of the Nurdağı/Gaziantep district located in the south of Turkey using Weibull parameters of the wind speed distribution. Their results show that the district has a mean wind speed of 7.3 m/s at 10 m height and mean power density of 222 W/m^2. Tolun et al. [4] demonstrated the presence of high wind speeds and power in island Gökceada, located in the north-western region of Turkey. They observed that one-third of the island meets with wind speed greater than 6.0 m/s. Durak and Sen [5] investigated the wind power potential of Akhisar located in the west coast of Turkey. The annual wind energy output of Akhisar varies between 31.4 and 41.5 GWh. Aras [6] indicated that Turkey is a suitable country to build wind farms and that the Aegean region is the most appropriate region for wind electricity production. He concluded that the wind electricity production companies should be encouraged and supported by the government and that new financing mechanisms are needed to promote investment in wind energy. Incecik and Erdogmus [7] investigated the wind power potential on the western coast of Anatolia at eight stations. They concluded that Bozcaada Island is the best place for the application of wind energy among the stations being considered. Turksoy [8] also evaluated the potential of wind power on Bozcaada Island. He concluded that the average wind speed is 6.4 m/s and the mean energy density is 324 W/m^2 at the Bozcaada meteorological station. Bilgili et al. [9] stated that obstacles, which are situated around meteorological stations, have substantial effect on the wind speeds.

Exploitation of wind as an energy source to meet the world's electricity demand was demonstrated by Sesto and Casale [10]. They presented an introduction to the basic aspects of the exploitation of wind energy for electricity generation, as regards both the characteristics of the source and the features and state-of-the-art of today's wind energy conversion systems. They also presented an overview of worldwide applications of wind energy and of the various factors currently driving the wind turbine market. Consequently, a conclusion can be drawn from this work that there is a worldwide desire for the wind power generation to reduce the regional and worldwide environmental pollutions.

Celik [2] compared the monthly probability density distribution obtained from the Weibull and Rayleigh models to the measured distribution in order to compare their suitability. He used 1-year measured hourly time-series wind speed data of