WIND DATA ANALYSIS AND WIND ENERGY POTENTIAL IN ITALY

Ubaldo Ayr
Dipartimento di Scienze dell'Ingegneria Civile e dell'Architettura – Politecnico di Bari (Italy)

Directive 2009/28/EC of the European Parliament and Council promotes the use of renewable energy and establishes, for each Member State, a target of energy consumption from renewable sources coherent with a 20% share of energy from renewable sources in overall Community energy consumption by 2020. In recent years, a significant growth in the number of the wind turbines installed in the world has occurred. Most of the wind machines, about 40% of the overall installed power, are located in Europe, especially in Germany, Spain, UK, Italy and France, while the rest are mostly situated in the USA, China and India.

The wind turbines diffusion is due to the reduction of the cost per unit of energy produced, thanks to the progress in wind turbines design, which has produced greater efficiency, lower construction costs and higher wind turbine reliability. So wind energy has become an energy source exploitable at costs similar to those of fossil fuel power plants. However, a wind power plant can be profitable only if the location and the wind turbine are appropriately chosen.
To assess the profitability of a wind power plant in a given location, we need to foresee the amount of energy the wind turbine could generate in a year. This prediction is a difficult and complex operation, because it depends on both the wind turbine features and the statistical characteristics of the winds that blow in that location. In a given site, the wind speed is not constant and an average value alone cannot predict the amount of energy that a wind turbine could produce. To predict this amount of energy, it is necessary to assess the frequency distribution of wind speeds which best fits the experimental data, which must be available over a long enough period of time. Many analyses and investigations have concluded that the Weibull distribution is the best model to fit the real wind data.

This paper presents an accurate method for predicting the energy that a wind turbine can produce in a given location based on the Weibull distribution of the wind data. Furthermore, wind data collected in 97 Italian sites, quite homogenously placed throughout the country, are presented and elaborated from an energy viewpoint. The experimental data have been obtained from wind measurements during 30 years, which can be considered a significant period of time.
The wind data at each station are processed in order to calculate the annual mean speed and the available wind power density. Furthermore, the Weibull distribution parameters are determined in order to allow the calculation of the annual energy which can be provided by a wind turbine, once its Power Coefficient is known as a function of the wind speed. Finally, the most interesting sites for intensity and regularity of the wind are identified and the one characterized by the greatest value of the available power density is analysed in detail by describing the temporal distribution of the monthly and hourly available energy.

Prof. Eng. Ubaldo Ayr
Dipartimento di Scienze dell'Ingegneria Civile e dell'Architettura - Politecnico di Bari
Via Orabona, 4 - 70125 Bari (Italy)
Tel.: +39.080.5963403
E-mail: ubaldo.ayr@poliba.it