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Feasibility of wind power generation for the reduction of power costs in residential buildings

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Abstract. Introduction: The installation of wind power generators on buildings located in areas with regular winds may be a suitable investment in a renewable power source. Brazil has a high eolic potential, where the annual mean wind speed may reach over eight meters per second. This case study is aimed to assess the economic feasibility of the installation of small wind power plants in urban areas. Methods: This work evaluates a project for the installation of a vertical axis wind turbine in three buildings (15-, 22-, and 26-store) including the following stages: 1) Installation of a real-time power meter in the 15-store unit; 2) Demand analysis of the 26-store building's power consumption; 3) Winds survey along the coast of the State of Ceará; 4) Analysis of the wind turbines available in the market; 5) Simulation aimed to choose the system. Results: Vertical wind power generators offer better conditions of use in urban areas. The turnover time was established to be between four and six years in the three studied units. Conclusions: The installation of a wind power generator on buildings in regions with an adequate eolic regimen reaches a financial return of the investment before the end of the equipment's lifespan.

Key words

Wind power generator, wind energy, power consumption, renewable energy, power plants in urban areas.

1. Introduction

Brazil has a great wind power generation potential and Ceará is among the most promising of all its states. The installed capacity in Brazil by the end of 2007 was only 247 megawatts (MW), while Portugal had 2,150 MW. The estimation is that the Brazilian potential could go beyond 143 GW. In the UK, the *Sustainable Development Commission* [1], a commission that deals with environmentally sustainable projects, stated that most of the wind generation growth in Great Britain comes from small producers interested in reducing their power bills

and who are also concerned with the environment. In Ceará there is a great potential for the application of the English model in regions with winds exceeding five meters/second. This case study aims to show the economic feasibility of installing small wind turbines in urban areas for the private use of the generated electricity [2]. Several factors are essential in the choice of vertical axis turbines. Vertical-axis turbines are ideal for environments with high turbulence, have a low noise generation, high aerodynamic efficiency, are practically free of any vibration and have a low maintenance cost, while being safe in the event of a transient excess of winds.

2. Materials and Methods

This is a case study for the implementation of a vertical axis wind turbine on the roof of buildings in the city of Fortaleza.

A. Characterization of the sample

Simulations were conducted on two residential units: Unit I (15- store buildings), Unit II (23-store buildings) and Unit III (commercial 23-store building). The heights of the buildings were taken with a GPS (Global Positioning System).

B. Power demand profile analysis

A real-time, Embrasul RE 1000/TM power meter was installed at the entrance of the electric company's triphasic power meter in Unit I, recording current and voltage measurements at 30-second intervals throughout the day for one week. The demand of the Unit II was proportionally adjusted from that of the first building. The profile of the Unit III was requested from the electric