



# Life cycle assessment: A case study of two wind turbines used in Mexico



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## HIGHLIGHTS

- Two wind turbines were compared by LCA methodology in Mexican conditions.
- The overall assessment of the environmental impacts in all phases was achieved.
- LCA technique revealed that the nacelle and tower have most environmental impacts.
- Environmental impacts reduction in LC of turbines will enrich Mexican wind industry.

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## ABSTRACT

This paper presents the case study of two wind turbines installed in Mexico which are analyzed using the life cycle assessment (LCA) methodology. Environmental impacts of different fabrication materials and electricity consumption were studied for the main turbine components. The designs of both turbines were examined through the phases of manufacture, construction, and final disposal. Both turbines (turbine A and turbine B) were of 2.0 megawatts (MW). Results ascertain that the most intensive environmental impacts come from the nacelle and tower components of both turbines; and that within life cycle phases, turbine A influences the environment less than turbine B, specifically during manufacture and final disposal. This study is valuable for decision makers in the domain of technological product design and marketing; in order to determine which features of the wind turbines can be modified to mitigate environmental impacts, contributing to technological innovation in the domains of sustainability and renewable energies in Mexico.

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## 1. Introduction

The current worldwide growth in the usage of alternative sources of energy is a consequence of (i) the need to increased demands for energy, (ii) the rising prices of fossil fuels, and (iii) the need to reduce emissions of greenhouse gases (GHG). Electricity sector plays a leading role in the energy industry and poses significant environmental concerns. Therefore, the environmental impacts of the electricity generation are to be relevant criteria for the planning and decision-making in Mexico, and will provide important basis for the inclusion of sustainable sources of energy such as wind power generation [1].

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Throughout decades the Mexican energy policy has been oriented towards fossil fuels. At the end of 2012, total power generation in Mexico was 260,398 gigawatt-hours (GWh); it was primarily generated via technologies depending on the use of fossil fuels: 45.15% gas combined cycle, 20.71% conventional thermal, 6.81% coal-fired steam turbine plant, 6.23% dual technology, 2.39% gas turbine and nearly 0.5% from internal combustion turbines. Alternative power generation technologies included 12% hydropower, 3.37% nuclear power, 2.23% geothermal, and 0.67% wind power [1]. Fossil fuels have been identified as one of the most polluting sources of energy for electricity generation, affecting ecosystems and human health [2,3]. Worldwide the use of wind power has increased due to the growing demand for electricity, the increase in the prices of fossil fuels [4,5] and the necessity to reduce GHG.

The environmental impacts of energy sector has been recognized and analyzed by various research institutes and governmental