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# Environmental impacts of electricity production of micro wind turbines with vertical axis

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## 1 Abstract

2 The increasing focus on the installation of sustainable energy systems has resulted in a wide  
3 range of micro wind turbine systems being introduced in the market. Although the majority of  
4 the commercially installed wind turbines are the horizontal axis ones, vertical axis turbines are  
5 considered as a promising technology for the future. It is generally known that the  
6 environmental impacts generated in the operational stage of wind turbines are significantly  
7 lower than the ones, generated by the fossil fuels based systems. The use of the Life Cycle  
8 Assessment (LCA) enables to assess the environmental impacts of a product or a process,  
9 taking into consideration also raw material extraction, manufacturing, distribution, and  
10 disposal stages of life cycle. The contribution of these stages is often critical for the  
11 environmental impacts of the bioenergy systems. This study contributes to the existing  
12 knowledge by presenting the detailed LCA of electricity produced in micro wind turbines  
13 with the vertical axis. For the impact assessment, two methods were selected: the CML-IA  
14 and Thermo-Ecological Cost in the whole life cycle (TEC-LC). Firstly, the environmental  
15 impacts of electricity generated by wind turbines with 1 and 3 kW nominal power were  
16 evaluated and compared with each other and with the impacts of the grid electricity produced  
17 in the Italian energy mix. Next, the sensitivity of the impact results on the wind characteristics  
18 variability was investigated. Results showed that the 3 kW turbine has, in general, lower  
19 values of the environmental impact indicators per unit of produced energy than the 1 kW  
20 turbine from 27 % lower Global Warming Potential (GWP) to 75% lower Abiotic Depletion  
21 (ADP). The impacts per unit of produced energy in the analysed micro wind turbines are  
22 lower than the corresponding impacts for the grid electricity generated in the Italian energy  
23 mix for nine impact indicators out of twelve. It was also observed that wind distribution  
24 parameters strongly influence the environmental impacts of the electricity produced by the  
25 considered turbines, leading to values higher than those obtained for Italian energy mix for  
26 low wind average speed and, even more, for low variances of the average wind speed.  
27 **Keywords:** life cycle assessment, thermo-ecological cost, microturbine, vertical axis

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