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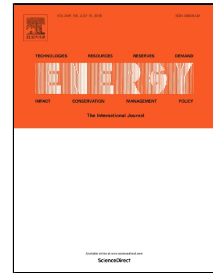
Environmental assessment of the wind turbine systems based on thermo-ecological cost

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10 11 12 Abstract

13 An increased wind capacity penetration reduces loading on conventional thermal units
14 causing higher fuel requirements due to the off-design operation. Regarding the
15 environmental analysis, such an adverse effect should be allocated to the operational phase of
16 wind turbines. In the present work, we apply Thermo-ecological Cost (TEC) to evaluate the
17 environmental performance of wind power systems operating in Poland and Italy. The
18 analysis focuses on the quantitative assessment of the effect of additional chemical energy
19 consumption due to part-load operation of the conventional power units in both analyzed
20 electricity systems. We present the results for two different dispatch strategies. The results
21 confirm high environmental effectiveness of wind power systems. However, the TEC
22 resulting from the compensation for wind generation variations has a significant contribution
23 to the overall LC-TEC index. In particular, without considering the effect of compensation,
24 the TEC for wind turbines are from 47 to 65 times lower than for coal-fired power plants and
25 35 to 48 times lower than for NGCC plants. Concerning the real load conditions, and
26 considering the effects resulting from the compensation for wind generation variations, the
27 TEC index for this phase contributes between 36% and 75% to the total TEC value.

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29 **Keywords:** life cycle assessment, thermo-ecological cost, wind energy, electricity production
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