An integrated multi-criteria decision making model for evaluating wind farm performance

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Abstract

The demands for alternative energy resources have been increasing exponentially in the 21st century due to continuous industrial development, depletion of fossil fuels and emerging environmental consciousness. Renewable energy sources, including wind energy, hydropower energy, geothermal energy, solar energy, biomass energy and ocean power, have received increasing attention as alternative means of meeting global energy demands. After Japan's Fukushima nuclear plant disaster in March 2011, more and more countries are having doubt about the safety of nuclear plants. As a result, safe and renewable energy sources are attracting even more attention these days. Wind energy production, with its relatively safer and positive environmental characteristics, has evolved in the past few decades from a marginal activity into a multi-billion dollar industry. In this research, a comprehensive evaluation model is constructed to select a suitable location for developing a wind farm. The model incorporates interpretive structural modeling (ISM), benefits, opportunities, costs and risks (BOCR) and fuzzy analytic network process (FANP). Experts in the field are invited to contribute their expertise in evaluating the importance of the factors and various aspects of the wind farm evaluation problem, and the most suitable wind farm can finally be generated from the model. A case study is carried out in Taiwan in evaluating the expected performance of several potential wind farms, and a recommendation is provided for selecting the most appropriate wind farm for construction.