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BROWNFIELDS TO RENEWABLES: A MCDA BASED METHODOLOGICAL FRAMEWORK FOR SITE EVALUATION

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Abstract

This paper introduces a methodological framework, comprising a comprehensive Multi-Criteria Decision Analysis (MCDA) and the Analytic Hierarchy Process (AHP), to evaluate the suitability of brownfield sites for renewable energy development. The proposed methodology offers a replicable approach for different regions seeking to optimize land use for renewable energy development, aligning with global climate commitments such as the Paris Agreement. This framework provides policymakers and investors with actionable insights for prioritizing RES projects, optimizing land use, and accelerating the transition toward sustainable energy systems. The methodology assesses different criteria across environmental, economic, legal, and social dimensions. Key evaluation criteria included proximity to grid connections, wind speed, solar irradiation, land type, and environmental risk. As a case study Republic of North Macedonia is analysed. In 2019, North Macedonia's government adopted a Strategy for Energy Development up to 2040, setting ambitious goals to shift electricity generation to over 80% renewables from the current 80% fossil fuels. This includes construction of photovoltaic (PVPP) and wind power plants (WPP) with capacities of 1400 MW and 750 MW, respectively. To support this transition, brownfield sites, especially mines with existing infrastructure and minimal environmental impact, are identified as attractive locations for renewable energy projects. Five brownfield sites in North Macedonia are analyzed in this paper. Results indicate that Suvodol is the most suitable site for PVPP development, with an estimated installed capacity of 480 MW, representing 34% of the national 2040 PV target. For WPP, Sasa ranks highest, with an average wind speed of 6.9 m/s.

Key words: AHP, MCDA, Brownfields, Energy transition, Renewable energy

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