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Multi-Criterial Analysis: Potential Regions and Height of Wind Turbines, Rio de Janeiro, Brazil

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Abstract : The process of choosing a region for the implementation of wind farms involves factors such as the wind regime, economic viability, land value, topography, and accessibility. This work presents results obtained by multi-criteria decision analysis, and it establishes a hierarchy, regarding the installation of wind farms, among geopolicy regions in the state of 'Rio de Janeiro', Brazil: 'Regiao Norte-RN', 'Regiao dos Lagos-RL' and 'Regiao Serrana-RS'. The wind regime map indicates only these three possible regions with an average annual wind speed of above of 6.0 m/s. The method applied was the Analytical Hierarchy Process-AHP, designed to prioritize and rank the three regions based on four criteria as follows: 1) potential of the site and average wind speeds of above 6.0 ms^{-1}, 2) average land value, 3) distribution and interconnection to electric network with the highest number of electricity stations, and 4) accessibility with proximity and quality of highways and flat topography. The values of energy generation were calculated for wind turbines 50, 75, and 100 meters high, considering the production of site (GWh/Km^2) and annual production (GWh). The weight of each criterion was attributed by six engineers and by analysis of Road Map, the Map of the Electric System, the Map of Wind Regime and the Annual Land Value Report. The results indicated that in 'RS', the demand was estimated at 2,000 GWh, so a wind farm can operate efficiently in 50 m turbines. This region is mainly mountainous with difficult access and lower land value. With respect to 'RL', the wind turbines have to be installed at a height of 75 m high to reach a demand of 6,300 GWh. This region is very flat, with easy access, and low land value. Finally, the 'NR' was evaluated as very flat and with expensive lands. In this case, wind turbines with 100 m can reach an annual production of 19,000 GWh. In this Region, the coast area was classified as of greater logistic, productivity and economic potential.

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