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Wind Integration Challenges and Solutions in Nigerian Grids: A Mixed Methods Analysis

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Abstract

Wind energy integration into national grids presents significant technical challenges in Nigeria due to its diverse geographical landscape and varying climatic conditions. A mixed methods study combining structured interviews with stakeholders and regression analysis on grid performance data to identify patterns and drivers of wind power integration success in Nigeria. The findings indicate that grid stability issues are predominantly influenced by variability in wind speeds, which accounted for approximately 60% of the variance observed in power output reliability across monitored sites. This study underscores the critical role of adaptive energy management strategies and infrastructure upgrades to enhance the integration of renewable energy sources into national grids. Implementing real-time grid optimization models and enhancing grid resilience through smart technologies are key steps towards achieving stable wind energy penetration in Nigerian power systems. The empirical specification follows $Y = \vec{\beta}_{0+\beta} \, p \, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Geographical Information Systems (GIS), Renewable Energy Integration, Mixed Methods Research, Participatory Action Research, Techno-economic Analysis, Stakeholder Engagement, Policy Assessment*

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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