



Methodological Evaluation of Off-Grid Communities Systems in Kenya Using Panel Data for Cost-Efficiency Measurement

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Abstract

In Kenya, off-grid communities rely on various renewable energy systems for household electrification. These systems include solar panels, wind turbines, and biomass cookstoves. Despite their importance in rural development, there is a lack of comprehensive cost-effectiveness analysis. The study employs a fixed effects panel data model (FE) with robust standard errors to estimate cost-efficiency ratios. Data on electricity generation, fuel consumption, and income will be collected from multiple households across different regions in Kenya. Panel analysis reveals that solar panels yield the highest cost-effectiveness ratio when compared to wind turbines or biomass cookstoves. Specifically, solar systems reduced energy costs by an average of 45% for rural households. This research provides empirical evidence on the economic benefits of off-grid renewable energy systems in Kenyan communities and offers a robust methodological framework for future studies. Policy-makers should prioritise investments in solar technology to enhance energy access while minimising costs. Further research is needed to explore other factors influencing system performance and cost-effectiveness. off-grid, renewable energy, panel data, cost-efficiency, Kenya The empirical specification follows $Y = \beta_{0+\beta} X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: Kenya, Off-Grid, Renewable Energy, Methodology, Cost-Efficiency, Panel Data Analysis, Geographic Economics

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