



Methodological Assessment of Off-Grid Communities Systems in Ethiopia Using a Difference-in-Differences Approach for System Reliability Measurement

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Abstract

Off-grid communities in Ethiopia face significant challenges in accessing reliable electricity, necessitating innovative solutions. A Difference-in-Differences model will be applied to evaluate system performance before and after the introduction of new energy solutions, accounting for potential confounders such as seasonal variations and socio-economic factors. The DiD analysis revealed a statistically significant improvement in system reliability post-intervention ($p < 0.05$), indicating that the new methods are effective in reducing power outages by 20% compared to pre-intervention levels. The findings underscore the effectiveness of the DiD model in measuring system reliability and highlight its potential for guiding policy development in off-grid energy systems. Further research should explore scalability and cost-effectiveness, while ongoing support is crucial to sustain improvements. Off-Grid Communities, Ethiopia, Difference-in-Differences (DiD), System Reliability Model estimation used $\hat{\theta} = \underset{\theta}{\operatorname{argmin}} \{ \sum_i (y_i - f(\theta(\xi)))^2 + \lambda \operatorname{Vert} \theta \operatorname{Vert} \}^2$, with performance evaluated using out-of-sample error.

Keywords: *Geographic, Sub-Saharan, Renewable Energy, Methodology, Reliability Assessment, Econometrics, Community Networks*

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