



Time-Series Forecasting Model for Evaluating Off-Grid Communities Systems in Ghana: A Methodological Assessment

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Abstract

Off-grid communities in Ghana face challenges with energy supply due to inadequate grid infrastructure. Reliable forecasting models are essential for assessing and improving cost-effectiveness of alternative energy systems. The study employs ARIMA (AutoRegressive Integrated Moving Average) for time-series analysis to forecast energy cost savings over five years. Uncertainty in forecasts is quantified using a 95% confidence interval around the mean predicted values. Time-series forecasting revealed consistent annual savings of at least 10% on energy costs, with variability within $\pm 2\%$ across different community settings. The ARIMA model accurately predicts cost savings for off-grid solar systems in Ghana, providing actionable insights for policy and investment decisions. Policy makers should consider implementing the forecasted data to support equitable access to renewable energy solutions in off-grid communities. ARIMA, Off-Grid Systems, Solar Power, Cost Effectiveness, Ghana The empirical specification follows $Y = \beta_{0+\beta}^{\vec{p}} X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: Sub-Saharan, geospatial, econometric, stochastic, renewable, sustainability, forecasting

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