



Methodological Scrutiny of Off-Grid Communities Systems in South Africa Using Quasi-Experimental Design Framework

Kgosi Mncube^{1,2}, Mpho Tsongo^{2,3}, Siphon Khumalo⁴

¹ Cape Peninsula University of Technology (CPUT)

² Mintek

³ Department of Research, Cape Peninsula University of Technology (CPUT)

⁴ Department of Interdisciplinary Studies, Mintek

Published: 26 April 2004 | **Received:** 10 February 2004 | **Accepted:** 02 April 2004

Correspondence: kmncube@hotmail.com

DOI: [10.5281/zenodo.18790415](https://doi.org/10.5281/zenodo.18790415)

Author notes

Kgosi Mncube is affiliated with Cape Peninsula University of Technology (CPUT) and focuses on Energy research in Africa.

Mpho Tsongo is affiliated with Mintek and focuses on Energy research in Africa.

Siphon Khumalo is affiliated with Department of Interdisciplinary Studies, Mintek and focuses on Energy research in Africa.

Abstract

The proliferation of off-grid communities in South Africa has necessitated a robust methodological framework to evaluate energy efficiency gains. A quasi-experimental design will be employed to compare pre- and post-intervention data from selected off-grid communities equipped with solar photovoltaic (PV) systems. The study will utilise a difference-in-differences approach with robust standard errors for statistical inference. This quasi-experimental design provides a rigorous methodological foundation for future studies aiming to enhance the sustainability of off-grid renewable energy systems in South Africa. The framework should be further validated through longitudinal data collection and expanded to include additional community settings and interventions. The empirical specification follows $Y = \beta_{0+\beta} X + \text{varepsilon}$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Sub-Saharan, African, Spatial, Heterogeneity, AnalyticHierarchyProcess, Quasi-Experimental*

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