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Methodological Evaluation and Efficiency Gains in Senegal's Power-Distribution Systems

A Multilevel Regression Analysis (2000–2026)

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ABSTRACT

Background: Power-distribution systems in many developing nations face chronic inefficiencies, leading to substantial technical and commercial losses. In the Senegalese context, ageing infrastructure and rapid demand growth have necessitated a rigorous, data-driven evaluation of equipment performance to inform strategic investment.

Purpose and objectives: This case study aims to methodologically evaluate the performance of key power-distribution equipment and quantify efficiency gains from recent infrastructure interventions. The primary objective is to establish a robust analytical framework for measuring and predicting system improvements.

Keywords: *Power-distribution networks, Technical losses, Sub-Saharan Africa, Multilevel modelling, Infrastructure evaluation, Efficiency gains, Regression analysis*

Article Highlights

- Modern amorphous core transformers show a statistically significant link to reduced technical losses.
- Central distribution zones demonstrated the most pronounced efficiency gains from interventions.
- The study establishes a validated multilevel framework for assessing distribution system performance.
- Analysis accounts for heteroskedasticity using robust standard errors in longitudinal data.

Methodological Note

The core multilevel model nests equipment-level observations within regional zones to account for hierarchical data structure.

This analysis provides a replicable framework for infrastructure evaluation in similar contexts.

ABSTRACT-ONLY PUBLICATION

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