

# Methodological Evaluation and Panel-Data Estimation for Yield Improvement in Rwanda's Power-Distribution Infrastructure, 2000–2026

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## ABSTRACT

**Background:** Power-distribution infrastructure in many developing nations faces persistent challenges with technical losses and reliability, constraining economic development. A rigorous, data-driven methodology for evaluating equipment performance and forecasting yield improvements is required for effective infrastructure investment.

**Purpose and objectives:** This study aims to develop and apply a panel-data econometric model to evaluate methodological approaches for assessing power-distribution equipment and to estimate the yield improvement trajectory of the national infrastructure.

**Keywords:** *Power distribution infrastructure, Technical losses, Panel-data estimation, Sub-Saharan Africa, Yield improvement, Grid reliability, Methodological evaluation*

### Article Highlights

- Panel-data model confirms systematic investment as principal driver of yield enhancement.
- Transformer upgrades and conductor replacement identified as key intervention points.
- Methodology provides robust framework for long-term infrastructure planning.
- Analysis projects yield trajectory for Rwanda's power distribution to 2026.

### Core Methodology

Fixed-effects panel model:  $Y_{it} = \alpha_i + \beta X_{it} + \delta_t + \varepsilon_{it}$ , with robust standard errors clustered at feeder level.

*This econometric analysis offers utilities a replicable framework for asset-performance tracking.*

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