

# A Quasi-Experimental Cost-Effectiveness Evaluation of Power-Distribution Equipment Systems in Ghana

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## ABSTRACT

**Background:** The selection of power-distribution equipment in developing economies is often based on initial capital cost, with limited rigorous analysis of long-term cost-effectiveness. This creates significant lifecycle cost uncertainties for utilities, impacting grid reliability and financial sustainability.

**Purpose and objectives:** This case study aimed to develop and apply a quasi-experimental methodology to evaluate the comparative cost-effectiveness of two prevalent medium-voltage distribution equipment systems in a West African context: conventional pole-mounted transformers versus compact substations.

**Keywords:** *Cost-effectiveness analysis, Quasi-experimental design, Power-distribution networks, Sub-Saharan Africa, Life-cycle costing, Electrical grid reliability, Developing economies*

### Article Highlights

- Quasi-experimental design matched sites by load, environment, and topology for robust comparison.
- Lifecycle analysis incorporated capital, maintenance, failure, and energy loss costs.
- Higher initial cost of compact substations offset by lower technical losses and maintenance.
- Methodology provides a practical framework for real-world utility economic evaluation.

### Methodological Insight

Employed a generalized linear model with robust standard errors to estimate cost differences while controlling for site-specific covariates.

*This study offers a replicable framework for infrastructure investment decisions in developing economies.*

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