Smart meters for firms in Ethiopia: Evidence from a randomised experiment

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- Ethiopian small and medium enterprises face severe electricity constraints: firms experience, on average, nearly 24 power outages per month, and 71% have no backup power source.
- Electricity theft, billing errors, and delayed payments undermine the Ethiopian Electricity Utility's (EEU) ability to invest in grid improvements – a cycle that smart meters could help break.
- An ongoing randomised controlled trial (RCT) across 1,583 firms in Addis Ababa and Sheger City will provide the first rigorous causal evidence on smart meter effects for businesses in a low-income country.
- Awareness of smart meters is low: only 33% of firms had heard of the technology at baseline, suggesting rollout should be paired with targeted information campaigns.
- Findings will directly inform EEU's planned installation of 125,000 smart meters for three-phase SME customers, with broader lessons for sub-Saharan Africa.

Reliable electricity is essential for firm productivity and economic growth. In Ethiopia, however, small and medium-sized enterprises (SMEs) face some of the most severe power supply constraints in sub-Saharan Africa. Poor billing systems, electricity theft, and limited grid monitoring prevent the Ethiopian Electricity Utility (EEU) from generating sufficient revenue to invest in infrastructure. The result is a vicious cycle: unreliable power forces firms to rely on costly diesel generators, while the utility lacks resources to improve service.

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Smart meters – which enable remote readings, automated billing, and remote disconnection – offer a promising solution. Yet rigorous evidence on their effects for firms in developing countries remains almost entirely absent (Demeke et al., 2026).

The policy problem: electricity unreliability undermines Ethiopian firms

Firms in Ethiopia depend heavily on electricity for their core operations. Our baseline survey of 1,583 three-phase business customers in Addis Ababa and Sheger City found that 98% rely on electricity as their primary energy source, using it predominantly for manufacturing and production. Yet supply is deeply unreliable. Firms experience an average of 23.7 outages per month – with a median of 16 – and most interruptions occur during core working hours. Three-quarters of reported outages happen between 6:00 AM and 3:00 PM, when disruption to production is most costly.

Electricity constraints at baseline: key numbers

23.7 – average monthly outages per firm (median: 16).

71% of firms have no backup power source, leaving them fully exposed to grid disruptions.

11.7% of total production costs are attributable to energy on average, with significant variation across firms.

Three-quarters of firms have no backup at all; among those that do, diesel generators are the near-universal fallback. Energy costs average 11.7% of total production costs, though a subset of firms faces substantially higher burdens.

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These patterns confirm that electricity insecurity is a binding constraint on productivity and a source of high private costs for Ethiopian SMEs.

The EEU faces a parallel set of challenges. Non-technical losses – electricity consumed but not billed due to theft, meter tampering, or reading errors – deplete the utility's revenue base. Delayed and non-payment of bills compounds the problem. Smart metering directly addresses both issues: automated billing reduces errors and theft, while remote management enables the utility to act quickly on non-payment (Burgess et al., 2022).

Our research: a rigorous randomised trial

This study evaluates the effects of smart meter installation through an RCT implemented in close partnership with the EEU. Following an in-person screening of 2,341 registered three-phase business customers, 1,583 eligible firms were enrolled and surveyed at baseline between August and November 2025. Firms were randomly assigned to receive smart meters in Phase 1 (786 treatment firms) or Phase 2 six months later (797 control firms). Randomisation was stratified by firm size, EEU administrative region, and pre-treatment electricity consumption. Balance tests confirm that the two groups are comparable across nearly all observed characteristics.

The study will measure effects on four domains: (i) electricity consumption, (ii) billed utility revenue, (iii) supply quality (voltage fluctuations and outages), and (iv) firm performance (sales, employment, investment, and fuel expenditure for backup generation). Secondary outcomes include the adoption of energy-efficient technologies and the incidence of informal payments. Heterogeneity analysis will examine whether manufacturing versus service firms, and firms of different sizes, respond differently to smart meter installation.

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Who are the firms in the study?

The sample is dominated by manufacturing firms (72%), with the remainder primarily in services. Nearly all (99%) are formally registered. Ownership structures are simple: 53% are sole proprietorships and 32% partnerships. Most are small to medium-sized, with an average of 11 employees, though firm size ranges from sole traders to enterprises with over 400 workers. The median firm recorded annual sales of approximately ETB 1.6 million (USD 10,000) in the most recent financial year – though the mean is much higher, reflecting a small number of large outliers.

Key baseline findings

Firms are acutely exposed to power disruptions.

With 71% of firms having no backup power and electricity use concentrated in core production activities, every outage translates directly into lost output. Most outages last between one and six hours – long enough to disrupt production cycles – and fewer than 30% of firms have a dedicated energy manager to respond to disruptions. This low institutional capacity within firms amplifies the damage from an already unreliable supply.

Awareness of smart meters is low, and expectations are uncertain.

Only 33% of firms had heard of smart meter technology at baseline, and among the aware, fewer than half knew about EEU's own rollout plans. Firms' expectations about the technology are mixed: roughly a quarter of informed firms expected reductions in energy consumption, 43% were uncertain, and 12% expected consumption to increase. These findings suggest that the benefits of smart meters are not yet well understood, even among potential adopters. Without active outreach, the technology's potential may not be fully realised.

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Policy recommendations

Based on the baseline findings, we offer five recommendations for the EEU and Ethiopian policymakers.

- Use the RCT to validate the smart meter rollout before scaling. The phased randomised design provides the most credible basis for assessing whether smart meters deliver the expected improvements in billing revenue, service quality, and firm performance. Endline evidence should inform decisions about national rollout.
- Pair installation with information campaigns. Low awareness means firms are unlikely to adapt their energy management practices without active outreach. Communication that explains billing changes, remote monitoring, and expected service improvements will be important for realising the technology's potential.
- Address governance weaknesses alongside technological upgrading. Smart meters reduce opportunities for informal payments and meter tampering, but institutional reforms – including staff incentives and oversight within EEU – are needed to complement the technology.
- Monitor energy efficiency co-benefits. The study will track power factor improvements and uptake of energy-labelled machinery (currently, only 10.5% of machines carry energy labels). If smart metering increases billing transparency, it may also create incentives for efficiency investment – an important co-benefit for Ethiopia's Climate Resilient Green Economy strategy.
- Share findings regionally. Ethiopia's experience with firm-level smart metering will be directly relevant to utilities across sub-Saharan Africa planning similar rollouts for SME and three-phase customers, where experimental evidence is scarce.

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Implementation challenges

- EEU institutional capacity. Smart meters installed in this study transmit data via 4G SIM cards. Sustaining this infrastructure requires reliable connectivity and trained utility staff to manage remote monitoring – capabilities that are still being developed.
- Firm compliance and behavioural adaptation. Firms may resist smart meters if they expect higher or more accurate bills. Managing expectations – particularly for firms currently benefiting from billing irregularities – will require careful communication.
- External validity. The sample is concentrated in Addis Ababa and Sheger City. Findings may not generalise to firms in smaller towns or rural areas with weaker grid infrastructure and different EEU service conditions.
- Multiple testing. With outcomes spanning four domains and planned heterogeneity analysis by sector and firm size, the endline analysis will apply sharpened q-values (Anderson, 2008) and outcome indices to reduce the risk of spurious findings.

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