LUMS | Chaudhry Nazar Muhammad Department of Economics

EVALUATING REFORMS IN ELECTRICITY DISTRIBUTION:

THE CASE OF KARACHI ELECTRIC (KE), PAKISTAN

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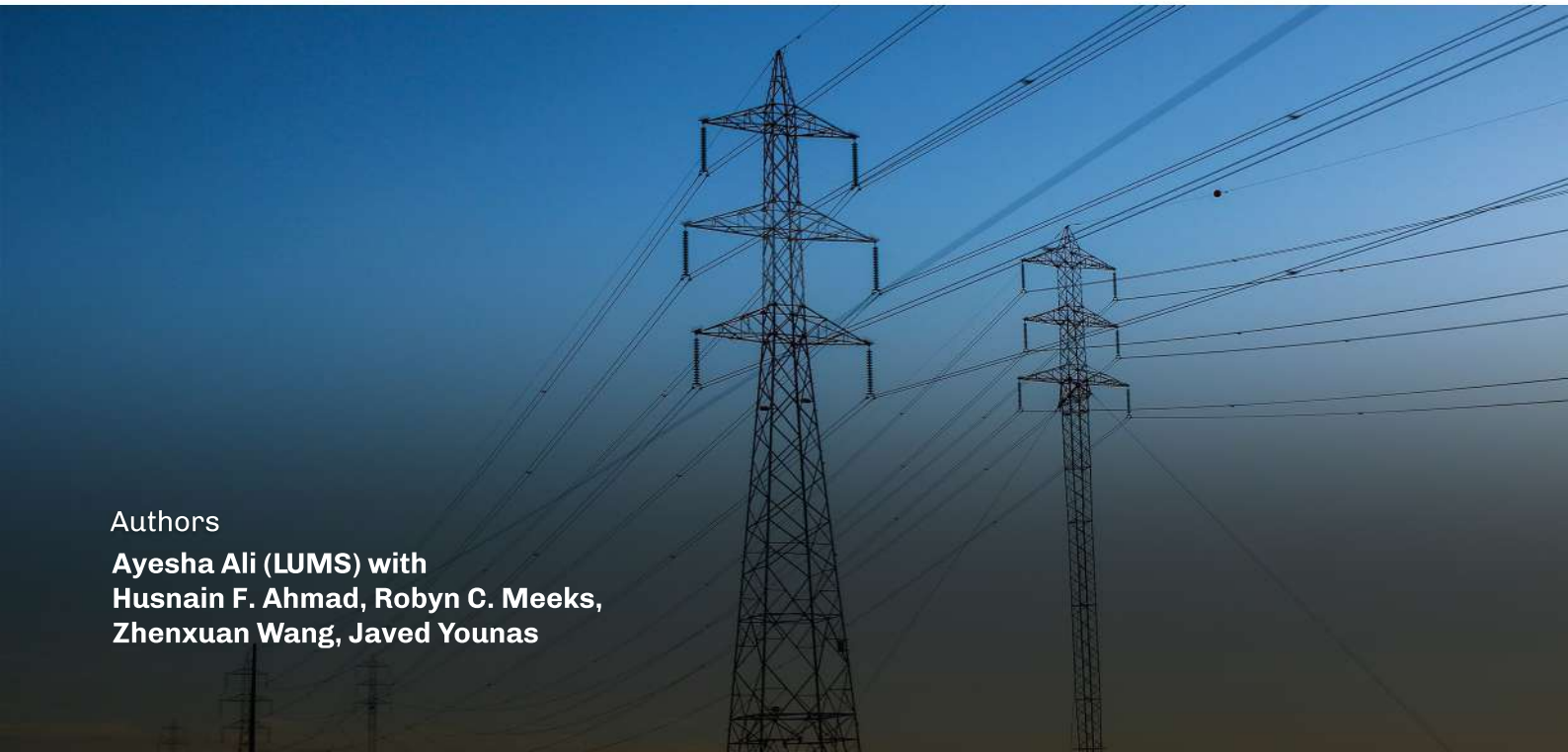
High transmission and distribution (T&D) losses along with low bill payments are key factors undermining the ability of electricity distribution companies in Pakistan to achieve cost recovery. Low cost recovery results in poorly maintained infrastructure, frequent loadshedding, and rising tariffs, besides adding to the energy sector circular debt and added fiscal burden on the government. This policy brief synthesizes evidence from two research studies evaluating Karachi Electric's (KE) recent efforts to improve cost recovery. The first paper evaluates the effects of a purely technical or infrastructure intervention. Starting in 2018, KE accelerated the conversion of bare distribution wires in areas of high theft to aerial bundled cables (ABCs). Resultantly, theft (unbilled consumption) went down in a sustained manner in the newly converted areas. However, this program on its own was not sufficient to improve bill payments, highlighting the need for complementary initiatives to tackle low bill payments. The second piece of research qualitatively explores the perceptions of managers and customers about the impacts of a multi-pronged intervention, Project Sarbulandi. Under this initiative high loss areas of Karachi between 2019 and 2022, received a package of interventions to improve infrastructure, offer financial incentives to staff based on recoveries, and build customer trust through community engagement activities. Despite these integrated efforts, we do not find an improvement in customer perceptions and trust. Both studies provide evidence and policy insights on pathways to mitigate the financial crises facing electricity utilities in developing countries.



Authors

Ayesha Ali (LUMS) with Husnain F. Ahmad, Robyn C. Meeks, Zhenxuan Wang, Javed Younas

INTRODUCTION

Poor electricity service quality in developing countries adversely affects both firms and households. There is growing interest in evaluating technical and non-technical interventions for improving cost recovery, but there is limited casual evidence on interventions that address theft and the resulting unbilled consumption.

Reasons for poor electricity service include distribution companies' inability to recover full cost of services due to:

- High subsidies on consumer tariffs
- Bill non-payment or delayed payment
- Electricity theft or unbilled consumption

It is also equally important to understand and unpack the actual and perceived channels through which interventions work (or not). In the context of developing countries where institutions are financially constrained, investments in utility infrastructure must be well-reasoned and supported. There is thus, a call for a better understanding of the role of a broader array of interventions, in reducing electricity losses.

South Asia, is the region with the most power outages in the world. As of FY 2019-2020, Pakistan's distribution companies reported T&D losses between 9% and 39%. KE's average loss rate of 19.7% (NEPRA, 2020), hides considerable heterogeneity and very high losses within the utility's service territory.

"Losses" refer to Transmission and Distribution losses, which have two components.

1. Technical losses, typically below 6 % and expected due to natural dissipation in the distribution system.
2. Theft, which is the major contributor to losses. High unbilled consumption is the primary reason why losses are three times greater in low and lower-middle income countries than in high income countries.

ABOUT THE RESEARCH

Pakistan's power sector continues to struggle with frequent outages and financial challenges marked by high incidences of unbilled consumption and non-payment of bills. Historically, tariffs were set substantially below the cost of supplying electricity. These challenges persist despite the power sector having undergone major reforms since the 1990s[1]. The high-cost and largely non-renewable generation mix in Pakistan has economic, fiscal and environmental consequences.

Karachi Electric (KE) is the distribution company serving Karachi, a sprawling mega city of over 20 million people. KE is a private, vertically integrated, and monopoly provider. KE introduced ABCs in 2015. Historically, KE field staff continuously monitored high loss areas to detect and disconnect kundas (illegal connections) and fine perpetrators. In 2018, KE launched a widespread conversion of bare distribution wires to ABCs in high loss areas, with the goal of making the electricity infrastructure more theft-resistant. To build upon this infrastructure upgrade, KE further implemented Project Sarbulandi in 2019.

[1] The power sector in Pakistan is currently regulated by the National Electric Power Regulatory Authority (NEPRA)

This policy brief is based on two research studies conducted in Karachi, Pakistan. **Table 1** provides main information on both research studies.

Table 1: Details of the Research Studies

	SWITCHING TO THEFT RESISTANT CABLES	PROJECT SARBULANDI
OBJECTIVE	The empirical paper evaluates the impact of a supply-side technology aimed at reducing unbilled consumption, on the utility's financial measures and consumer outcomes. This technical solution contrasts with incentive-based interventions with similar goals of improving utility cost recovery.	Qualitative analysis of a utility intervention named Project Sarbulandi. The goal was to understand KE's theory of change to help identify possible mechanisms to reduce theft and improve cost recovery, and compare and contrast managers' views from those of customers'.
DETAILS	The intervention involved making distribution lines theft-resistant. Essentially, an upgrade from bare, low voltage distribution wires to twisted and insulated aerial bundled cables (ABCs) that prevent connections that bypass meters.	Project Sarbulandi, was a multi-pronged intervention that increased budgets to improve infrastructure, provide incentives to staff, and expand customer engagement activities. Local offices (IBCs) could customize various technical, managerial, and customer-facing interventions.
DATA & METHOD	The study uses a unique combination of datasets, comprising utility data of 1,900 feeder lines for over three years, panel data on billing-related outcomes for approximately 3,000 residential utility customers, and household survey data collected by authors in Fall 2021 for the same residential customers. Identification strategy exploits the differences in the installation timings of ABCs across Karachi over time [2]. The study uses a staggered DID approach.	This project was implemented in a subset of six of the twelve high loss IBCs in Karachi, in 2019. Data was gathered from interviews (in 2020) with the general managers (GMs) of the sub-divisions that had either implemented or yet had to implement the project. Focus groups were also conducted with customers in areas where the project was implemented. Inductive thematic analysis was conducted on qualitative data.

[2] The utility's roll out strategy depended on predetermined feeder-line characteristics. The identification strategy is thus, based on the assumption that, conditional on fixed effects, roll-out of theft-resistant cables is exogenous. Thus, controlling for feederline fixed effects to account for time-invariant characteristics of different areas, time varying changes across KE's management offices across the city. Event-study models demonstrate the absence of pre-trends in outcome measures. Interested readers are referred to the full paper.

RESEARCH FINDINGS

This section lists main findings along with policy implications from both research studies.

01 The main finding of the empirical study is that **the conversion of bare wires to theft-resistant cables significantly and meaningfully reduced losses by 8.2 percentage points.** Note that the baseline mean loss rate was 38.7%. These effects on losses persist for at least two years after installation, indicating that this was not just a short-run effect of removing illegal connections during the installation process.

02 The authors also find that **conversion from bare wires significantly increased bill payment** [3], but this effect dissipates over time. This smaller effect on bill payments is not surprising. The cables prevent illegal connections, but do not provide additional mechanisms for enforcing bill payment.

03 Results also show **that after the reduction in utility losses, both the hours of load shedding [4] and consumers' complaints to the utility decrease**. A more detailed analysis, however, indicates an increase in complaints related to utility billing errors.

04 Even though results indicate improvements in both utility finances and service delivery following the technology upgrade, the authors find **no significant differences in customers' trust in the utility**. In fact, customers in areas with theft-resistant cables are more likely to believe that the utility makes billing errors.

05 Further exploratory analyses indicate that (presumptive) newly formal customers consume fewer units of electricity than incumbent customers. Not just that, a substantial portion of this consumption is below the cutoff for the bottom tier of the increasing block price. This suggests that the newly formal customers are poorer than the incumbents. It also highlights the need for tariff reform to better protect the lower income consumers.

06 The qualitative analysis of efficacy of Project Sarbulandi shows that post-implementation, managers perceive improvements in cost recovery. They credit the improvements to infrastructural changes (specifically ABC conversions), financial incentives (bonuses tied to bill recoveries) which increase employee morale, and improved customer trust through community engagement camps. However, this perspective starkly contrasts customer perceptions, which indicate near-universal distrust of KE and little knowledge of the project, aside from an awareness of visible changes in the distribution infrastructure. These contrasting perspectives highlight that efforts for building trust between the utility and the customers need to be better designed and implemented.

[3] This effect is lesser and noisier compared to the impact on losses.
[4] The effects on the hours of load shedding are linked to the utility's policy of allocation of load shedding based on losses, and may not be generalized.

To understand the underlying mechanism of the observed impact, the authors first assess whether the observed effects on losses reflect a reduction in technical losses. After ruling out the possibility that technical losses are a significant channel, the authors interpret the changes in losses to be driven by reductions in theft or unbilled consumption. Further, the results provide evidence of both an increase in the number of formal customers and an increase in the billed units consumed by formal customers. These results are indicative of cables causing both previously fully and partially informal consumers (i.e., those that were using both kundas and formal connections) to shift to formal connections.

The greater the intensity of cable conversion within a feeder-line, the larger the effects were on both financial measures (losses and bill payment). Losses decreased more in the feeders that had higher levels of losses at baseline. Similarly, bill payment increased more among the feeders with medium and low levels of baseline payments.

POLICY IMPLICTIONS

01

Taken together, the results suggest that moving to an equilibrium with greater willingness to pay may require complementary demand-side reforms targeting bill payment and tariff reform. As discussed in the previous section, formalization is driven by the poorest of the poor converting to formal connections. This further highlights that the intervention may have had the greatest effect on the poorest households, suggesting that such interventions ought to be paired with additional tariff and social assistance reforms for the poorest households.

02

Another policy recommendation based on the findings is the need to evaluate the validity of any theory of change. Even though Project Sarbulandi was appreciated nearly unanimously by all managers, customers were only aware of the visible technical upgrades.

03

There is a need to devolve decision making, as evident from the success of the bottom-up approach exercised in addition to the technical upgrade to theft resistant cables. While it may be true that these main effects were driven primarily by infrastructure upgrades, the bottom-up approach apparently increased the buy-in from the KE field staff.

04

Greater customer engagement complements huge infrastructure interventions. However, what the utility's administration may view as "better billing" and customer-friendly procedures may result in greater customer dissatisfaction when implemented *without* their trust.

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A Publication prepared by

RabiaSaeed (Research Fellow)

MehrunissaSultan Awan (Research Assistant)

Department of Economics, Lahore University of Management Sciences

For information or collaboration,
please reach out at **rabia.saeed@lurns.edu.pk**

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