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LOST SLEEP, LOST STUDY TIME: UNEQUAL ELECTRICITY OUTAGES AND THEIR DISRUPTION OF LOW-INCOME AND HIGH-INCOME HOUSEHOLDS IN KARACHI

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Abstract

In Karachi, K-Electric (KE) schedules load-shedding by feeder, assigning longer outages to feeders with high aggregate technical and commercial (ATC) losses. This design links a household's outage burden to the behaviour of its neighbours, and because high-loss feeders cluster in low-income and informal areas, it raises an equity question. This paper reports a pilot household survey of 52 households in three Karachi areas, collected in 2026: Lyari ($\boldsymbol{n = 16}$), Orangi Town ($\boldsymbol{n = 18}$) and DHA ($\boldsymbol{n = 18}$). Households reported outage frequency and duration, the longest outage of the week, the outage pattern, backup equipment and its running cost, and the biggest disruption caused. Lyari households reported a mean of 7.2 outage-hours per day (bootstrap 95% CI 5.1 to 9.4), Orangi Town 2.3 (1.4 to 3.3) and DHA 0.08 (0.0 to 0.2). Differences across the three areas were large and statistically significant (Kruskal–Wallis $\boldsymbol{p < 0.001}$), and the contrast between the two lower-income areas and DHA corresponds to a rank-biserial effect size of about 0.79. Median monthly electricity bills in DHA were roughly nine times those in Lyari and Orangi Town combined. Every DHA household had a UPS or generator, while 2 of 16 Lyari and 5 of 18 Orangi Town households did; no katchi abadi household reported any backup (0 of 14). About 89% of all reported outage-hours were borne by households with no backup at all. Among the few lower-income households that ran generators, the generator's running cost equalled a median of about 56% of their electricity bill. These patterns suggest a two-layer inequity: some people face more outages than others, and not everyone has the same ability to protect themselves from these disruptions. Since the sample size is small and not randomly selected, it's important to view these results as preliminary findings that could pave the way for a more extensive study using detailed feeder-level data.

1 Introduction

Electricity outages are often discussed as a technical problem of supply and demand. They are also a distributional problem: when supply falls short, someone must go without, and the rule used to choose who determines who bears the burden. In Pakistan, shortfalls have been managed through scheduled load-shedding for

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many years, and households have responded by buying uninterruptible power supply (UPS) units, generators and, increasingly, solar systems (jamil?; arshad?). The ability to buy these substitutes depends on income, so the same outage can be a minor inconvenience for one household and a serious loss of sleep, study time, income or food for another.

Karachi presents a pretty straightforward example because the rules for allocation are crystal clear. KE puts out a list of feeders that fall under the load-shed category, assigns each one a loss percentage, and classifies them as Medium, High, or Very High Loss. They also share a daily outage schedule for each feeder (kea?; keb?). According to KE, the load-shedding is determined by the severity of losses, "regardless of the area or the type of people" served by a feeder (nepra?). However, the regulator has taken issue with this approach. In a ruling reported on September 1-2, 2026, NEPRA stated that basing load-shedding on ATC losses lacks a legal foundation, instructed KE to cease this practice, and mandated focused actions against specific thieves and defaulters instead (tribune?; ary?); see Section 3.

This paper asks a descriptive question that a household survey can address even at small scale:

How do outage frequency, duration and severity differ between two lower-income areas of Karachi (Lyari and Orangi Town) and a high-income area (DHA)?

Does the ability to buy backup power, and its cost relative to the electricity bill, differ across these areas?

Within the lower-income areas, are outage burdens related to housing type, tenure or bill size?

The contribution may be modest, but it's definitely tangible: we've gathered household-level primary data from the week when KE's current feeder schedule was in effect, and we've paired it with KE's own published feeder classifications.

2 Background and Related Work

Load-shedding and fairness. In their analysis, (heylen?) delve into the fairness of load-shedding plans by employing Gini-based inequality indices. They view these plans as a method of distributing a burden that primarily impacts a specific group of consumers, while the benefits are enjoyed by everyone. Meanwhile, (harish?) utilize feeder-level data from an Indian utility to demonstrate that the disparities in load-shedding essentially create a welfare transfer between rural and urban consumers. Similar evidence emerges from other cities; for instance, a study in Ghana regarding the "dumsor" outages, highlighted by Graphic Online, revealed that a wealthy neighborhood in Accra received around 98% of the potential power hours, whereas one of the poorest areas only got about 31

Self-insurance. Research on Pakistani households reveals that those with the means often turn to UPS units, small generators, and solar systems. The choice they make largely hinges on their energy consumption levels and how they perceive the utility of these options (jamil?, based on 952 respondents in Islamabad and Rawalpindi). The costs associated with these technologies vary significantly: a techno-economic analysis conducted in Quetta found that the levelized cost for UPS-based backup is around 13.06 US cents per kWh, while a diesel generator system comes in at about 29.19 cents per kWh (pmc?). This means that while UPS units are generally cheaper to run, they have a limited duration, whereas generators can handle longer outages but at a steeper running cost. Additionally, (arshad?) points out that the widespread adoption of UPS systems can actually burden the grid due to inefficiencies in charging, illustrating how self-insurance can have repercussions for the overall system.

Energy justice. The energy justice literature frames outages through distributive, procedural and recognition dimensions (sovacool?). This paper focuses on the distributive dimension: who bears the outages, and who can afford protection.

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Informal settlements in Karachi. Estimates regarding the percentage of Karachi's population residing in katchi abadis can differ significantly depending on the source and the year, ranging from around half to as much as 60%. Notably, Orangi Town, which is the largest informal settlement in the city, was officially recognized by the Sindh government as regularized in May 2025 (euaa?, citing Business Recorder, 24 May 2025). In this paper, the term "katchi abadi" is used to describe households classified by the author as living in unofficial settlements lacking proper documentation, and it shouldn't be interpreted as reflecting the legal status of the entire town.

3 Institutional Context: How KE Allocates Outages

Three facts from official or regulator sources frame the analysis.

3.1 Feeder categories. KE's published list of feeders under the load-shed category contains 623 feeders (keb?).Feeders are categorized into three final groups: Medium, High, or Very High Loss, based on ATC loss figures. According to the author's count from the published list, KE's Lyari-I and Lyari-II distribution areas together have around 60 feeders listed (7 in Medium, 12 in High, and 41 in Very High). Meanwhile, Orangi-I and Orangi-II account for about 58 feeders (8 Medium, 13 High, and 37 Very High). In stark contrast, the Defence area has only 3 listed feeders (2 Medium, 1 High, and none in Very High). It is worth noting that these counts are manually tallied from the published list, and KE's distribution areas do not perfectly align with the administrative towns.

3.2 Scheduled hours. An independent review of KE's schedule PDF, reported that Medium Loss feeders were scheduled for about 6 hours per day and High and Very High Loss feeders for about 12 hours per day (pakera?). This is a secondary description of KE's document (kea?). The survey week therefore falls inside the period when this schedule was in force.

3.3 Regulator findings. In the beginning 2026, the NEPRA Complaints Resolution Committee made a notable decision that underscored KE's position: load-shedding is influenced by the extent of losses, irrespective of the area or type of customer. The committee pointed out NEPRA's performance standards concerning shedding priorities and emphasized the need for a fair rotation system. They also brought up a hefty Rs 50 million penalty that was slapped on KE, which the company is currently appealing. Furthermore, the committee directed KE to move the complainants' supply to a feeder that wouldn't experience load-shedding, and they set a three-month deadline for this transfer (nepra?). Fast forward to mid 2026, NEPRA reported that average outages for High Loss feeders hit 10 hours and 39 minutes, with a staggering 81.9% of these feeders surpassing the 10-hour threshold. Meanwhile, 68.4% of Medium Loss feeders faced outages of six hours or more, exceeding their six-hour limit. NEPRA also instructed KE to cease ATC-loss-based feeder-level shedding (tribune?). Additional news reports indicated that unannounced outages impacted around 2.37 million consumers (minute?). KE has stated that it is actively working with the regulator (tribune?). In mid 2026, reports surfaced about temporary load management measures across Karachi, including DHA, due to an LNG shortage, which KE later confirmed had been resolved (ary?). It's worth noting that these recent developments occurred after the survey week and aren't included in the data.

4 Data and Methods

4.1 Data collection

The author gathered the data firsthand during 2026. Using a structured questionnaire, they collected information from each household, including details like housing type, ownership status, household size, average electricity bill (in

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PKR), the number of daily outages, how long each outage lasted (in hours), the longest outage of the week (also in hours), the outage pattern (whether it was daily or random), the type of backup system in place, the monthly running cost for that backup (in PKR), and the biggest disruption caused by outages (like sleep, study, or internet issues). While specific outage dates and start times weren't recorded, the analysis relied on daily counts and durations instead of a time-stamped series of outages.

The analytic sample consists of 52 households, broken down into Lyari (16 households), Orangi Town (18 households), and DHA (18 households). This study zeroes in on consumer grid electricity. Notably, the author chose to exclude DHA households that have solar panels to steer clear of the complexities that come with self-generation. This decision is a key aspect that will be explored further in Section 7 7.

4.2 Data cleaning

The author asked that entry mistakes be corrected without further consultation. All corrections were rule-based, are listed in full in Appendix 10, and affect 9 of 52 records:

UPS running cost set to zero (1 record). Per the author, a UPS has no running cost apart from maintenance. One Orangi Town household recorded a UPS cost of PKR 300; this was set to 0.

Inconsistent outage pattern (1 record). One Orangi Town household was coded as having "Daily" outages but reported zero outages, zero duration and a zero longest outage. Its pattern was recoded as "None".

Impossible daily outage hours (1 record). One Lyari katchi abadi household reported 8 outages of 4 hours each, which implies 32 hours in a 24-hour day. This is not physically possible. Rather than guess the intended value, the household's daily-hours figure was treated as missing for outage-hour statistics (its other variables are retained). A sensitivity check capping it at 24 hours raises the Lyari mean from 7.2 to 8.2 hours per day and does not change any conclusion.

Generator cost recorded as zero (6 records, all DHA). Six DHA households with generators recorded a running cost of zero. Because the author specified zero cost only for UPS units, these were treated as missing rather than as true zeros (a zero could reflect cost inclusion in building or society charges). Cost-burden statistics for DHA generator owners therefore rest on only 2 households.

Blank backup type was coded as "None", and blank outage pattern and disruption fields for households without outages were coded "None" or "None reported".

Housing labels were harmonised ("Flat in Building" and "Apartment" to "Flat").

The data sheet contained a single DHA block. The author's brief refers to DHA and DHA Lifestyle; the data supplied contain no separate Lifestyle block, so all 18 DHA records are analysed as one group.

4.3 Variables

Daily outage hours is the number of daily outages multiplied by the reported duration per outage. This assumes that the reported duration is the typical duration of each outage. Longest outage is the longest single outage in the week. Any backup is a binary indicator for a UPS or generator. Bill is used as a proxy for consumption and, loosely, for socioeconomic status; it is not income. Generator cost share is generator monthly running cost divided by the monthly electricity bill.

4.4 Statistical methods

Given that the outcomes are skewed and many values hit zero, we opted for non-parametric tests in our analysis. We used the Kruskal–Wallis test for comparing the three areas, and for pairwise comparisons, we applied the Mann–Whitney U test, making sure to adjust with Holm across the three pairs. For proportions, we turned to Fisher's exact test, and for assessing correlation, we used Spearman rank correlation. To measure the effect size in the lower-income versus DHA

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comparison, we calculated the rank-biserial correlation. When it comes to confidence intervals for the means, we relied on percentile bootstrap intervals based on 10,000 resamples. Lastly, we summarized the inequality in outage burden using Jain's fairness index (jain? means perfectly equal, values near $1/n$ mean one unit bears nearly all of the burden) and the Gini coefficient. All tests are two-sided. With three areas and 52 households, p-values should be read as descriptive, and several analyses in Section 5.5 are explicitly exploratory.

5 Results

5.1 Sample

Sample characteristics by area.

	Lyari	Orangi Town	DHA
Households	16	18	18
Mean household size	6.2	5.9	5.4
Katchi abadi / Flat / House	8 / 4 / 4	6 / 7 / 5	0 / 6 / 12
Owned / Rented	8 / 8	10 / 8	15 / 3
Median monthly bill (PKR)	4,000	5,300	35,500
Bill range (PKR)	800 to 9,000	800 to 11,500	8,000 to 76,000

The median DHA bill is about 8.9 times the Lyari median and 6.7 times the Orangi Town median. The bill per household member, a rough proxy for per-capita consumption, has a median of about PKR 793 in Lyari, 800 in Orangi Town and 6,788 in DHA.

5.2 Outage exposure (RQ1)

L6.2cmccc & Lyari & Orangi Town & DHA
Households with at least one daily outage & 15 of 16 (94%) & 13 of 18 (72%) & 2 of 18 (11%)
Mean outages per day & 4.4 & 1.4 & 0.1
Daily outage hours: mean (95% CI) & 7.2 (5.1 to 9.4) & 2.3 (1.4 to 3.3) & 0.08 (0.0 to 0.2)
Daily outage hours: median (IQR) & 6.0 (4.0 to 9.5) & 2.0 (0.25 to 3.75) & 0 (0 to 0)
Households with 6 or more outage-hours per day & 9 of 15 & 2 of 18 & 0 of 18
Longest outage of the week: mean (95% CI) & 5.4 (4.2 to 6.8) & 3.9 (2.8 to 5.1) & 1.1 (0.3 to 2.2)
Households with longest outage of 6 hours or more & 6 of 16 & 5 of 18 & 1 of 18
Pattern: Daily / Random / None & 15 / 1 / 0 & 13 / 4 / 1 & 2 / 4 / 12

Outage hours are very different across the three areas (Kruskal–Wallis $H = 30.8$, $p < 0.001$). All pairwise comparisons remain significant after Holm adjustment: Lyari versus DHA ($p < 0.001$), Orangi Town versus DHA ($p < 0.001$) and Lyari versus Orangi Town (adjusted p about 0.001). Pooling Lyari and Orangi Town, the mean difference in daily outage hours relative to DHA is 4.4 hours (bootstrap 95% CI 3.1 to 5.9), with a rank-biserial effect size of about 0.79. The longest weekly outage also differs across areas (Kruskal–Wallis $p < 0.001$). The share of households experiencing any daily outage is much higher in Lyari than in DHA (Fisher $p < 0.001$) and in Orangi Town than in DHA ($p < 0.001$), but not significantly different between Lyari and Orangi Town ($p = 0.18$).

There are two key points about Table [tab:outage] that really deserve to be highlighted. First off, the two lower-income neighborhoods are quite different from each other: households in Lyari experienced about three times as many outage hours compared to those in Orangi Town. This significant difference means that lumping them together as a single "low-income" group overlooks important variations. Secondly, it's important to note that DHA isn't completely free from outages either. Out of 18 households surveyed in DHA, six reported at least one outage lasting an hour or

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more during the week, with the longest being 7.5 hours. Additionally, four households mentioned experiencing outages in a random pattern. So, the difference here is more about the extent and impact of outages rather than a complete lack of them.

5.3 Inequality indices

In the analysis of 51 households with valid outage hours, we found that the pooled Gini coefficient for daily outage hours stands at 0.66 (with a bootstrap 95% confidence interval ranging from 0.56 to 0.74), while Jain's index is at 0.36. This suggests a significant inequality in how the burden of outages is distributed. When we look at Jain's index across the three area means, it comes out to 0.54. If we were to distribute the total reported burden of 150.5 outage-hours per day evenly among the 51 households, each would face about 2.95 outage-hours daily. Compared to this benchmark, households in Lyari would see a decrease of roughly 59%(from 7.2 to 2.95), those in Orangi Town would experience an increase of about 28% (from 2.3 to 2.95), and DHA households would rise from 0.08 to 2.95. It's important to note that this benchmark is purely arithmetic; it doesn't serve as a prediction or policy suggestion, but rather highlights the current disparity in outage hours.

5.4 Backup and the cost of self-insurance (RQ2)

Backup equipment by area.

	Lyari	Orangi Town	DHA
No backup	14 of 16	13 of 18	0 of 18
UPS	0	1	10
Generator	2	4	8
Any backup	2 of 16 (13%)	5 of 18 (28%)	18 of 18 (100%)
Katchi abadi households with any backup	0 of 8	0 of 6	not applicable

Every DHA household had backup, and the difference from the two lower-income areas is significant (Fisher $p < 0.001$ in each pairwise comparison; 7 of 34 lower-income households versus 18 of 18 in DHA). The difference is concentrated in UPS ownership (1 of 34 versus 10 of 18, $p < 0.001$); generator ownership differs less sharply (6 of 34 versus 8 of 18, $p = 0.052$). No katchi abadi household in either area, 0 of 14 in total, reported any backup.

Backup is also unequally effective at reaching the people who need it. Of the 150.5 outage-hours per day reported across the sample, about 134 hours (89%) were borne by households with no backup at all. In Lyari, the 13 households with valid hours and no backup averaged 7.7 outage-hours per day.

Running costs can really weigh heavily on families, especially in lower-income neighborhoods where backup power is a necessity. In fact, six households in these areas relied on generators, facing monthly expenses ranging from PKR 1,300 to 6,000. When you compare these costs to their electricity bills, the generator expenses accounted for anywhere between 26% to a staggering 118% of their bills, with a median around 56%. In DHA, two households using generators reported running costs that made up about 30% and 11.5% of their electricity bills, respectively. However, since we have limited data from DHA (as noted in Section 4.2) and only six lower-income households to analyze, these comparisons should be taken with a grain of caution. Still, the trend aligns with engineering insights showing that generators are significantly more expensive per kWh than UPS storage (pmc?). It's interesting to note that those households facing the most unreliable power supply and the lowest bills are the ones bearing the brunt of generator running costs.

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5.5 Within the lower-income areas (RQ3, exploratory)

Within Lyari and Orangi Town combined ($n = 33$ with valid hours), outage-hours were lower in households with larger bills (Spearman $\rho = -0.38$, $p = 0.028$), and the relationship was clearest within Lyari ($\rho = -0.55$, $p = 0.033$; $n = 15$) and weak and non-significant within Orangi Town ($\rho = -0.15$, $p = 0.56$). By housing type, katchi abadi households reported a mean of 6.8 outage-hours per day ($n = 13$), flats 3.5 ($n = 11$) and houses 2.4 ($n = 9$); katchi abadi versus all other housing was borderline (Mann–Whitney $p = 0.052$) and the three-way comparison was not significant ($p = 0.11$). The most striking cell is Lyari katchi abadi, where the mean was 10.8 outage-hours per day ($n = 7$ valid), compared with 2.1 for Orangi Town katchi abadi ($n = 6$). Ownership status was not related to outage hours (owned mean 4.1, rented 5.0; $p = 0.73$). These within-area results are exploratory: they were not specified in advance, involve small cells, and should not be treated as confirmed findings.

5.6 What outages disrupt

In a survey of 38 households that experienced outages, sleep emerged as the top disruption for 15 of them, while study-related issues affected 17 households and internet problems were noted by 6. Breaking it down by area, sleep was the main concern in Lyari, impacting 10 out of 16 households. In Orangi Town, study disruptions were more prevalent, affecting 9 out of 18 households. Meanwhile, in DHA, where all 6 households reported disruptions, study issues were the most common, affecting 5 of them. It's important to note that the disruption categories were limited to those included in the questionnaire, so this data doesn't provide insights into other areas like work, income, food storage, or health impacts—topics that a future survey should definitely address.

5.7 Comparing the survey with official feeder data

The survey figures are noticeably lower than the hours implied by KE's categories and by NEPRA's findings. KE's schedule assigns about 12 hours per day to High and Very High Loss feeders, which make up roughly 88% of the listed feeders in Lyari and 86% in Orangi Town by the tally in Section 3.1, and NEPRA reports average outages above 10 hours on High Loss feeders. Reported hours in this survey are about 7.2 per day in Lyari and 2.3 in Orangi Town. Plausible explanations include that the sampled households sit on Medium Loss or less-affected feeders, that respondents under-reported or averaged over days with different cuts, that the schedule was not fully applied during the survey week, or that outage counting differed from KE's cycle accounting. The survey cannot distinguish these, because households were not matched to feeders. This gap means the survey is better evidence of relative differences between areas than of absolute outage hours in any one area.

6 Discussion

Exposure is unequal and tracks the allocation rule. The gradient across the three areas—Lyari at the top, Orangi Town in the middle, and DHA at the bottom—clearly reflects a loss-based allocation. In this scenario, the Defence area has just three listed feeders, while both Lyari and Orangi Town boast nearly 60 each. Although the survey doesn't examine the mechanism directly since households aren't matched to feeders, the noticeable gap in direction and size aligns perfectly with what the feeder lists suggest.

Self-insurance compounds the gap. Households in DHA experienced less exposure to outages and had universal protection, whereas those with the highest number of outage hours often lacked any backup systems. In fact, none of the katchi abadi households had backup options at all. For lower-income households that did have backup, the costs were high compared to their bills. This situation highlights a two-tiered inequity: first,

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there's the unequal exposure to outages, and then there's the unequal ability to cope with them. This aligns with the broader observation that a household's capacity to cope really hinges on the resources they have available. (jamil?).

The pattern is not simply "informal versus formal". Orangi Town katchi abadi households reported fewer outage-hours than Lyari katchi abadi households, and Orangi Town's flats and houses were similar to its katchi abadi. Neighbourhood-level and feeder-level conditions may matter more than housing type per se, which fits a feeder-based rule.

Policy relevance. If KE follows NEPRA's directive to put an end to feeder-wide, ATC-based load shedding, we might see a shift in how the outage burden is shared across different areas. Conducting a repeat survey would allow us to compare the situation before and after this change. NEPRA emphasizes that paying consumers shouldn't bear the consequences of others' defaults on the same feeder, which is a principle of fairness that the survey's findings directly address. However, the data doesn't clarify whether the targeted disconnection approach would actually be fairer or more dependable in real-world scenarios.

7 Limitations

This is a pilot study and the limitations are substantial.

Small, non-random sample. A total of fifty-two households were surveyed across three different areas. The selection process was based on the author's access rather than random sampling, which means these households might not accurately reflect their neighborhoods. As a result, the confidence intervals are quite broad, particularly when it comes to the results for specific subgroups.

Exclusion of DHA solar households. We intentionally left out DHA households with solar panels to concentrate on grid consumption. Since solar households tend to be some of the most self-insured, this exclusion probably downplays the level of self-insurance within DHA and could skew the overall backup picture for DHA. As a result, the study really only reflects the experiences of DHA grid-only households, rather than DHA as a complete entity.

No matching to feeders. If we don't have the feeder identity, the survey won't be able to determine if the outage hours align with the loss category. Plus, we won't be able to make sense of the discrepancy between the survey hours and the official schedules mentioned in Section 5.7.

Self-reported outage data and a one-week window. Outage counts and durations are recalled or estimated, and one week t may not represent other seasons. No dates or start times were recorded, so timing, night-time outages and clustering cannot be analysed.

Constructed daily-hours variable. Daily hours are the product of reported count and typical duration, which assumes uniform outages. One record produced an impossible value and was excluded.

Data cleaning decisions. Corrections were rule-based and disclosed (Appendix 10), but they involve judgment, especially the treatment of zero-cost generators in DHA. The data supplied contain no DHA Lifestyle block.

Bill as proxy. Electricity bills reflect consumption, tariff slab, arrears and appliance stock, not income. Katchi abadi classification is a field judgment.

Multiple testing and exploratory analyses. Section 5.5 in particular is exploratory and uncorrected for multiplicity.

Secondary sources. The number of listed feeders comes from the author's own manual count, while the scheduled hours are taken from a secondary description found in KE's schedule PDF. As for the regulatory and press events in 2026, those details have been gathered from various news sources.

Causation. All results are associations. The survey cannot say that loss-based allocation caused the gradient.

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8 Toward a Solution: Implementation and Quality of Life

The survey points to two separate problems that need two kinds of response: who is exposed to outages, and who can afford protection when outages happen. The measures below are proposals grounded in the survey findings and in the regulatory record in Section 3. They are not tested interventions, and costs have not been estimated.

8.1 Proposed measures

L4.4cmL3.8cmL2.3cmL3.4cm

Measure & Evidence it responds to & Who acts & Main risk

Measure & Evidence it responds to & Who acts & Main risk

End feeder-wide shedding and replace it with targeted action: disconnect individual thieves and defaulters, install aerial bundled cables and smart (AMR) meters on the highest-loss feeders & NEPRA's September 2026 direction; 89% of reported outage-hours fell on households with no backup & KE, under NEPRA supervision & Enforcement is slow and costly, and supply shortfalls (such as the October 2026 LNG shortage) still require some shedding

Where shedding is unavoidable, rotate it across areas and shed at transformer (PMT) level rather than feeder level, using the rotation and proportionality principle in NEPRA's performance standards & Outage gap of about 7 hours per day between Lyari and DHA; NEPRA's April 2026 decision & KE and NEPRA & Equal sharing moves some outages onto households that have never faced them, which will be politically contested

Publish an equity report by distribution area each quarter: mean outage-hours, share of households facing 6 or more hours, and Jain's index & No public measure currently shows who bears the burden & NEPRA, with KE data & Self-reported utility data may be unreliable without an independent check

Give 48 hours' notice of planned outages and avoid night-time and exam-period cuts where possible & Sleep was the main disruption in Lyari (10 of 16 households) and study in Orangi Town (9 of 18) & KE & Night-time demand is also when supply is often tightest

Offer low-cost, financed backup for lower-income households: pay-as-you-go UPS or solar-plus-battery units, and shared community charging points in katchi abadis & None of 14 katchi abadi households had backup; generators cost the lower-income owners a median of about 56% of their bill & Provincial government, banks and microfinance lenders & Mass UPS charging adds load to the grid (arshad?), and informal tenure complicates lending

Protect critical loads first: clinics, schools and water pumping. Several listed feeders carry pumping-station names (for example Lyari Pumping, Qasba Pumping and Sultanabad Pumping), and whether they supply water systems should be checked & Outages affect sleep, study and internet in every area surveyed & KE, the Karachi Water and Sewerage Corporation, and the health and education departments & Classification errors may protect the wrong feeders.

The engineering evidence backs up the financing option. A techno-economic study conducted in Quetta found that a hybrid solar-battery-generator system has a levelised cost of around 8.3 US cents per kWh. In comparison, UPS backup systems come in at about 13.1 cents, while diesel generators are significantly higher at 29.2 cents (pmc?). If we see the same trend in Karachi, a financed solar-battery unit could actually be cheaper to operate than the generators that many lower-income households currently rely on. However, this is just a hypothesis that needs to be tested locally, not a conclusion drawn from this paper.

8.2 Implementation sequence

Measure first. Match a sample of households to their KE feeders and record outage start times, so that outage-hours can be linked to feeder category. Publish the baseline equity report.

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Pilot narrowly. Choose a small number of high-loss feeders in Lyari and Orangi Town and apply PMT-level shedding, AMR meters and cable upgrades, with comparable feeders as a control. Offer financed backup to households in the pilot area.

Review against stated gates. Continue only if outage-hours in the pilot area fall, theft and recovery on the feeders do not worsen, and households without any backup decline.

Scale and keep measuring. Extend to more feeders in stages and repeat the household survey each year.

8.3 Measuring quality of life

Living standards take a hit during outages, impacting everything from sleep and studying to earning an income, food storage, and the costs associated with coping. The survey focused mainly on sleep, study, and internet access, so it would be beneficial to include additional factors like work interruptions, food spoilage, health impacts, and monthly coping expenses in the follow-up. Some suggested indicators could include outage hours per household each day, the percentage of households experiencing six or more outage hours daily, the proportion without backup systems, the cost of generators as a percentage of the electricity bill, the share of people reporting disruptions in sleep or study, and Jain's index across different areas. For example, a potential target could be ensuring that no area's average outage hours exceed twice the city-wide average, while also aiming for Jain's index to increase from 0.36 in this sample to around 0.8. Keep in mind, these thresholds are just starting points for discussion and not definitive recommendations based on the current data.

8.4 Trade-offs and what is not known

Targeted enforcement might take years to implement, and during that time, consumers in high-loss areas could still find themselves cut off unless rotation rules are put into action. While financed backup can assist individual households, it doesn't really address the overall supply shortage, and widespread UPS charging could actually increase peak load issues. Plus, the survey doesn't provide insight into whether these measures would be effective, as it only covers one week in three different areas without matching feeders. The pilot and evaluation design mentioned earlier aims to tackle that question before any major commitments are made.

9 Conclusion

In this pilot study, we observed a significant drop in outage burden as we moved from Lyari to Orangi Town and then to DHA. Interestingly, the protection against outages increased in the opposite direction. Households in DHA experienced almost no outage hours and had universal backup systems in place, while those in Lyari faced around seven hours of outages daily and had nearly no backup options. In fact, none of the katchi abadi households had any backup at all. When lower-income households did resort to using generators, the costs associated with running them took up a hefty portion of their electricity bills. These observations align with a feeder-based allocation system that tends to concentrate outages where losses are the highest, alongside a self-insurance market that only the more affluent can access. However, these findings don't definitively prove either of these mechanisms. In Section 8, we suggest a phased response that should be piloted and evaluated before any broader implementation. The logical next steps for this research involve conducting a larger, randomized sample, linking each household to its KE feeder and category, tracking outage start times, and repeating the survey after KE has acted on NEPRA's directives.

10 Data corrections log

L2.0cmL4.3cmL4.2cmL3.2cm
Area & Record & Issue & Action
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Lyari & Katchi abadi, rented, 9 members, bill 4,000 & 8 outages × 4 hours = 32 hours per day (impossible) & Daily hours set to missing; other fields retained
Orangi Town & Flat, owned, 7 members, bill 8,700 & Pattern "Daily" with 0 outages, 0 duration, 0 longest & Pattern recoded "None"
Orangi Town & Flat, owned, 8 members, bill 6,200 & UPS with running cost 300 & Cost set to 0 (UPS has no running cost)
DHA & Six generator households (flat rented 5 members bill 16,000; houses with bills 53,000, 20,000, 31,000, 46,000, 62,000) & Generator running cost recorded as 0 & Treated as missing, not as zero
All & Blank backup, pattern, disruption cells & Missing codes & Recoded to None / None reported
All & Housing labels & Inconsistent wording & Harmonised to Katchi abadi / Flat / House

REFERENCES

Aidoo, K. The Dumsor Report, as reported in "66 per cent of 'dumsor' unplanned, report," Graphic Online (Ghana). graphic.com.gh.

ARY News (2026, October). K-Electric starts load shedding in exempted areas of Karachi; K-Electric ends temporary load management. arynews.tv.

Arshad, N., Ali, U., et al. (2016). Effects of uninterruptible power supply systems on Pakistan's power sector. Energy for Sustainable Development. doi:10.1016/j.esd.2016.09.004.

European Union Agency for Asylum (EUAA) (2025). Pakistan Country Focus: Housing and living conditions (citing Business Recorder, 24 May 2025, on the regularisation of Orangi Town). euaa.europa.eu.

Express Tribune (2026, 2 September). NEPRA orders K-Electric to end load-shedding. tribune.com.pk.

Harish, S. and Tongia, R. Do rural residential electricity consumers cross-subsidise their urban counterparts? Brookings India working paper. brookings.edu.

Heylen, E., Ovaere, M., Van Hertem, D. and Deconinck, G. (2018). Fairness of power system load-shedding plans. IEEE International Conference on Systems, Man, and Cybernetics (SMC), pp. 1404–1409.

Jain, R., Chiu, D. and Hawe, W. (1984). A quantitative measure of fairness and discrimination for resource allocation in shared computer systems. DEC Technical Report TR-301.

Jamil, F. and Islam, T. (n.d.). An analysis of power outages induced electricity backup choice in Pakistan. NUST School of Social Sciences and Humanities (IAEE proceedings abstract).

K-Electric (2026a). Load-Shed / Maintenance Schedule (schedule PDF applicable from 5 August 2026). ke.com.pk/load-shed-schedule.

K-Electric (2026b). List of Feeders under the Loadshed Category (July 2026). ke.com.pk.

Minute Mirror (2026). NEPRA orders K-Electric to end illegal load shedding. minutemirror.com.pk.

NEPRA (2026). Decision of the Complaints Resolution Committee in Complaint No. KElectric-KHI-50660-02-25, 29 April 2026. nepra.org.pk.

Pakistan Era (2026, 1 October). How to check your K-Electric load shedding schedule in Karachi (analysis of KE schedule and feeder list). pakera.pk.

Techno-economic modelling of hybrid energy system to overcome the load shedding problem: A case study of Pakistan. PubMed Central, PMC9041839.

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Volume 4 • Issue 6 • October 2026

Sovacool, B. K. and Dworkin, M. H. (2015). Energy justice: Conceptual insights and practical applications. Applied Energy, 142, 435–444.