PRIORITIES FOR PAKISTAN'S ENERGY SECTOR

In the ongoing discourse surrounding climate change and sustainability, the energy sector holds a pivotal space for action and reform. Addressing challenges within the energy sector become even more imperative as Pakistan strives to meet its commitments to international agreements like the Paris Agreement. Pakistan's energy landscape is already fraught with complexities ranging from financial burdens to governance issues. The headwinds facing Pakistan's power sector are well known: rising tariffs are pricing out the poor, the cost of generating electricity is becoming increasingly expensive, and theft is widespread. The circular debt – the amount owed to power producers – stood at 2.7 trillion PKR in June 2023. At best, short-term fixes can offer temporary relief along the road of reform; at worst, they can cause serious detours that derail progress on fixing core issues in the sector. Obtaining affordable and reliable electricity for all requires substantial medium to long-term changes in (i) tariff design, (ii) governance, and (iii) the promotion of renewables.

This note highlights the core priorities in these three key areas. Many of these gel with the plans laid out in the National Electricity Plan (2023-2027). Where relevant, we indicate priorities that could be dealt with in the near term. Overall, the note will point towards strategies for enhancing affordability, reliability, and sustainability in the generation and distribution of electricity. Rooted in the recognition of the intertwined nature of energy and climate concerns, these priorities are framed within the broader context of transitioning towards a more sustainable energy future.

An effort to redesign tariff structures, improve governance and make way for embracing renewable energy sources, will not only help Pakistan make its energy sector more fiscally sustainable, but also contribute meaningfully to global efforts aimed at mitigating climate change. Such an approach underscores the interconnectedness of energy policy and climate action, highlighting the importance of concerted and strategic interventions in pursuit of a greener, more sustainable future.

REDESIGNING ELECTRICITY TARIFFS

A. Context

Pakistan faces twin problems of having to rationalize electricity prices to better align with costs while ensuring it does not make access to electricity out of reach for the average consumer. First, a brief primer on how prices are currently set. All costs—ranging from fixed expenses like capacity costs to variable ones like energy charges, technical and non-technical losses, and other operational charges—are aggregated and recovered from the year's projected demand. Discrepancies between projections and allowed losses are rectified the following year as a prior year adjustment component. Because of varying operating costs and distribution losses, each DISCO (distribution companies) has different costs of delivering electricity to the end consumer. Using the total revenue requirement, tariffs for each consumption category is calculated.[1] Cross-subsidies are inherent in this system: within customer categories (e.g. large residential users pay above cost, small users pay below cost); across customer categories (e.g. industry subsidizes residential); and across locations (e.g. efficient, low cost DISCOs subsidize poor performing DISCOs). To maintain a uniform tariff nationwide, the government offsets inter-DISCO differences through an annual Tariff Differential Subsidy (TDS), which amounts to approximately PKR 300-350 billion. The national average tariff in FY23 was just below 25 PKR/kWh, a substantial rise from 18 PKR/kWh the previous year.

Redesigning electricity tariffs in Pakistan is not only essential to make the energy sector inclusive and fiscally strong, but also plays a crucial role in advancing climate change mitigation and sustainability goals. By reforming tariff structures, Pakistan can incentivize energy efficiency, promote renewable energy adoption, and reduce greenhouse gas emissions associated with conventional energy generation. Moreover, by targeting subsidies based on income and wealth rather than embedding them in electricity tariffs, the country can enhance social welfare while promoting equitable access to clean energy. These measures align with global efforts to combat climate change and towards building a more sustainable energy future for Pakistan.

[1] This is a simplified explanation. In reality there are more complexities, especially with how these different components are aggregated.

B. Fixed Charges

The current approach for pricing electricity does not account for how customers change their behaviors in response to price changes. Instead, the pricing method is rooted in an accounting perspective based on achieving projected revenue targets primarily by adjusting variable tariffs (i.e. prices paid per kWh consumed). A further inefficiency is that the current pricing system aims to recover fixed costs associated with installed capacity through variable tariffs instead of fixed charges.

When faced with rising electricity prices, households have several adaptation strategies that can help lower their bills. They might reduce electricity usage, transition to off-grid alternatives like solar, or resort to electricity theft. Each of these activities under the current tariff regime lower the billed electricity units, and consequently, lower the revenue needed to pay the high capacity payments. For example, 10% less units were sold in FY23 relative to FY22, likely due to higher prices.

As highlighted in the National Electricity Plan, raising fixed charges across customer categories is one option to consider[2] These will ensure that the government recovers a baseline revenue despite the behavioral adaptations of the household. Revenue will become more stable. Current fixed charges are low, ranging between 200-400 PKR/kW/month for commercial, industrial, and agricultural users, but not residential.

There are several possible ways to implement fixed charges:

Vary fixed charge by consumption slab. This is easy to introduce but retains some of the described problems where as consumers switch between slabs due to change in prices, the government revenue changes accordingly.

Vary fixed charge by peak load demand. There is further design choice here to vary these fixed charges by peak load over past several months, or the current month, or by single or three-phase meters. For reference, CPPA (Central Power Purchasing Agency) - responsible for the purchase of electricity from power plants on behalf of distribution companies in Pakistan - charges DISCOs roughly 4,000 Rs/kW/month.

Charge a true fixed cost which does not vary with load or consumption. This will give the most stable revenue stream. To reduce the burden on the poor this can be rebated upon appeal, which requires documentation demonstrating poverty status.[3] Alternatively, it can also be targeted geographically.

To address affordability issues, variable charges can be slightly reduced to compensate for an increase in bills. While the reduction in variable charges means that revenue increase will not be as high for the government, the revenue stream will still become more stable.

The precise design which would work the best for Pakistan's case, and the ideal fixed charge amount can only be determined through piloting or phased roll-outs. We can assist with this task and advise independent research be done in collaboration with the government to better understand and measure the implications of introducing fixed charges.

C. Tariff Differential Subsidy (TDS)

Households and businesses in Islamabad or Faisalabad currently face higher prices of electricity because of electricity theft and losses in less functioning DISCOs like PESCO, QESCO, or SEPCO, operating in Peshawar, Quetta and Sukkur respectively. Without the TDS, prices in well-performing DISCOs would be lower, and the government would not need to step in to finance the inter-DISCO cross-subsidy. Removing the TDS requires an act of national legislative reform, and as

[2]The NEP targets raises fixed charges to reach 20% of the fixed cost of supply by end 2027

[3]Check section I.D. on residential subsidies for more details

such would run into political barriers. Despite this, there is no economic or technical rationale for ensuring every Pakistani is offered electricity at the same price. This simply does not reflect the true cost of supplying electricity, and as such distorts the system.

While removal of the TDS raises prices in some DISCOs, it should be noted that there is an additional fiscal benefit due to lower prices in well-performing DISCOs like IESCO in Islamabad or FESCO in Faisalabad. Because Pakistan has an excess of contracted electricity supply, there is a disproportionate share of capacity payments relative to energy payments in the generation sector. Lowering prices in large DISCOs will likely lead to an expansion in electricity consumption, reducing surplus capacity in the system.

The annual cost of TDS subsidies amounts to approximately PKR 300-350 billion. Eliminating these subsidies could enhance the viability of distribution companies for private investment by allowing them to price services according to costs. Additionally, the savings could support the early retirement of inefficient power plants, thereby reducing generation costs.[4]

D. Residential Subsidies

The current tariff structure embeds cross-subsidies: those who consume low amounts of electricity are subsidized by those who consume high amounts of electricity. If the objective is to alleviate the financial strain of electricity costs on low-income households, a more efficient method would be to offer subsidies as direct transfers based on income and wealth, rather than embedding them in the electricity tariff. Direct transfers offer three advantages. Firstly, they grant individuals the flexibility to allocate the funds as they deem fit, ensuring better welfare outcomes. This implies that a smaller amount of subsidy can then generate the same amount of welfare, making this a fiscally superior choice. Secondly, this approach can benefit even those impoverished households that are energy-dependent but remain off the grid. Finally, direct transfers can also be targeted based on income and wealth through programs such as Benazir Income Support Program (BISP), Pakistan's flagship social protection cash transfer initiative. Basing subsidies on income and wealth removes the inefficiencies introduced by infusing subsidies into tariffs and offering lower tariffs for reduced consumption. For instance, a wealthier household with multiple meters could exploit the system by ensuring each meter has low consumption, thereby benefiting from subsidies for which they are not the intended recipients of, increasing the fiscal burden of the subsidies.[5]

Implementing a subsidy program through direct transfers, such as those facilitated by the BISP, poses specific design challenges. Firstly, transitioning subsidies from the power sector to direct cash transfers requires removing them from electricity tariffs and allocating funds from the national budget. This approach involves charging all consumers the actual unit cost of electricity and providing targeted subsidies to households within specific Proxy Means Test (PMT) thresholds. Optimal thresholds could be established through pilot studies.

However, the coverage of BISP primarily encompasses the poorest segments, and may miss middle-income households. To extend subsidies to the latter, updating the BISP database or allowing self-registration with income, wealth, and electricity meter verification at BISP centers can be useful. Another significant hurdle is the fiscal implication of decoupling subsidies from electricity tariffs. Without cross-subsidies, funding must be sourced directly from the treasury, which might strain fiscal resources. A potential remedy is defining a category of 'unprotected customers'—those who fail to register with BISP—who would get higher electricity bills. The additional revenue could subsidize the targeted cash transfers. It is important to note that the efficiency gains from direct cash transfers may reduce the overall need for cross-subsidies, aligning with the government's objectives to lower the magnitude of cross-subsidies.

Any such restructuring should be carefully pilot-tested to ensure precise targeting and to maintain fiscal discipline within the power sector. We can help design and evaluate pilots to support this activity. In short, given Pakistan's investments into social protection through BISP and NSER (National Socio-Economic Registry), social protection goals should be funneled through the power sector. This aligns with ongoing efforts laid out in the NEPRA (National Electric Power Regulatory Authority).

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[4] Plant retirement will be discussed in more detail in the Renewables section.

[5] Another example is of households with solar

IMPROVING GOVERNANCE TO LOWER LOSSES

A. Context

The financial impact of units lost beyond NEPRA targets was PKR 160 billion in FY23. Total losses have effectively remained unchanged for the past 5 years.[6] The problem does not end there: an additional PKR 212 billion[7] could not be recovered from users in FY23 as customers' bills went unpaid. Summing up these losses and unpaid bills over time, the total receivables owed to the power sector stand at just below PKR 2 trillion. It is no surprise that fixing the receivables problem in turn fixes the lion's share of the circular debt problem. Fundamentally, these are governance issues: an inability to enforce payments for electricity across the country.

Rapid access to high-quality data is essential for effective governance. It is a crucial step that governments must prioritize, as lacking such data makes it impossible to design, target, and assess the effectiveness of policies. Furthermore, data enables rapid deployment of corrective measures.

Poor governance of the energy sector also has climate implications. By reducing electricity theft and collection losses, Pakistan can optimize energy distribution efficiency, leading to lower overall energy consumption and reduced greenhouse gas emissions associated with electricity generation. Additionally, recovering outstanding receivables creates space for investment in renewable energy infrastructure and promotes the transition towards a more sustainable energy mix. Overall a more efficient and sustainable power sector is better equipped to withstand the impacts of climate change, such as extreme weather events and disruptions to energy supply. Moreover, By improving revenue collection and reducing losses, governments can allocate more resources to invest in renewable energy infrastructure, accelerating the transition towards a low-carbon energy system.

B. Reducing Electricity Theft and Collection Losses

Numerous factors contribute to electricity theft and collection losses. Typical enforcement drives ('combing operations') result in short-term gains. Once they end, the kundas return. A sustainable solution to the electricity theft problem involves combining incentives with technologies to ensure that all electricity consumed is paid for.

Incentives

People steal because the perceived costs of doing so are small (i.e. consequences are low or unlikely); because they do not value the product (e.g. low quality); or because they believe it is not something that must be paid for (e.g. electricity is a right). Potential solutions can encompass social mobilization, outsourcing collection duties to third parties, incentivizing meter readers through various incentive plans, and strategically deploying audits or enforcement drives to make them less predictable.

Technology

Technology reduces the ease at which a user can steal. Utilizing technological advancements like aerial bundle cables, smart meters, prepaid meters, and targeted load-shedding at the transformer level could all bring improvements. These require large capital investments and thus form part of a longer term solution. Relying on technology alone, however, is often insufficient: incentives, discussed above, can ensure that the full gains from technology adoption are realized. For example, several states in India have invested heavily into smart metering technology but they did not see financial returns because they lacked the willpower to enforce disconnections of non-payers.

Given Pakistan's diverse settings, these solutions have varying levels of return on the invested rupees. To discern the most effective approach for a specific context, it is essential to initiate rigorous pilot projects (e.g. A/B testing or randomized controlled trials) that can provide evidence on what works. This data will guide policy makers in deciding which solution warrants broader implementation in each setting. Taking time to carefully evaluate pilot projects over a

[6] The financial cost of all transmission and distribution losses is around 556 billion Rs.

[7] 250 billion Rs including KE

few months is a more financially prudent approach than endlessly debating potential solutions without concrete evidence or, worse still, committing to a solution without truly understanding its effectiveness. We can help design and evaluate these pilots with additional data collection.

C. Recovering Receivables

For the FY23, outstanding receivables account for PKR 1.9 trillion, or 70% of Pakistan's circular debt, with running defaulters comprising PKR 900 billion. Of this amount, PKR 800 billion sits with those who have not cleared their bills for more than 3 years. QESCO in Balochistan is another notable outlier. Although Balochistan represents less than 7% of Pakistan's total population, it accounts for 33% of the country's agricultural electricity consumption. Agriculture consumes 72% of QESCO's total electricity, contributing to receivables of approximately PKR 400 billion, or 20% of Pakistan's net receivables in DISCOs.[8]

DIFFERENT APPROACHES TO RECOVERING RECEIVABLES CAN BE TESTED

01 Encouraging defaulters to settle a portion of their outstanding receivables by offering discounts or amnesties. For example, a one-time discount can be offered for long-term defaulters to pay back. Unless a sufficient share is paid back after the discount is offered, users should then get permanently disconnected.

02 Offering structured payment plans to defaulters, allowing for easier repayment. For instance, scheduling payments during seasons with traditionally lower bills, like the winter months. Pilots can test the best method of offering installments.

03 For QESCO, amnesties on significant fractions of the receivables can be combined with the solarization of agricultural tubewells. Receivables can be written off in exchange for the solarization of tubewells or implementation of solar micro-grids, paid for by the consumer. This will ensure that the receivables in QESCO stop growing.

These strategies may be reinforced by deterrent measures, including the disconnection of services for non-compliance by a specified deadline. Determining the effectiveness of these recovery strategies, and the optimal fraction of receivables to be written off across different customer segments necessitates pilot studies, which we can help design and conduct.

D. Revenue Linked Supply Schedule (RLSS)

A important factor contributing to customer dissatisfaction is the substandard quality of electricity supply, attributed to frequent and prolonged load-shedding periods when electricity is intentionally cut off to reduce losses. This practice, known as the RLSS policy, dictates that electricity feeders with high ATC losses are subjected to more extensive load-shedding. The underlying rationale is to incentivize customers to reduce electricity theft by associating less theft with improved supply quality.

However, there are significant concerns regarding the implementation of the RLSS policy. Anecdotal evidence indicates that distribution companies may not consistently apply the RLSS policy, leading to unnecessary load-shedding on feeders with low losses. Additionally, the accuracy of recorded losses per feeder is questionable, with suspicions that

[8]Remarkably, the average annual electricity consumption per agricultural connection in QESCO exceeds 106 MWh, five times the average in LESCO.

losses from one feeder might be inaccurately allocated to another. Addressing these issues necessitates the deployment of a sophisticated data system capable of precisely tracking electricity units supplied to both feeder and grid stations and verifying the integrity of feeder loss data.

Another critical issue is the potential reduction in government revenue attributed to the RLSS. By reducing the electricity supply to high-loss feeders, paying customers in these areas are billed for fewer units than they would have been under continuous supply, thereby lowering revenue. This concern, also highlighted by NEPRA, suggests a need for a pilot study in high-loss feeders to evaluate the revenue implications of the RLSS scheme. This pilot would provide valuable insights into the policy's impact on revenue, informing decisions on its potential expansion. The research team is positioned to assist in designing and executing this pilot study.

PROMOTING RENEWABLES

A. Context

How and at what cost Pakistan sources its future electricity needs will be critical for sustaining its economic growth. Owing to dramatic technological innovations and a favorable geography, renewables are the most promising technology to supply these needs in Pakistan. Large-scale solar is now generating the cheapest electricity ever known (below 1.5 US cents/kWh). The plummeting costs of wind and solar, as well as complementary technologies like batteries, are only expected to continue. However, despite these trends, the generation of electricity in Pakistan remains an expensive affair. There is an overhang of inefficient power plants using old, costly technologies. Even new plants based on local fuels, like Thar coal, are at best on par with average global costs for utility-scale solar in high potential areas like Pakistan. Pakistan's ample hydropower generation boosts the ability to expand the share of solar and wind in its electricity mix because hydel can lower the costs of that variable energy (intermittency) places on grid management.[9] Different policy environments, grid infrastructure, and costs of capital may ultimately change whether coal or solar is cheaper in Pakistan. If so, this does not reflect the fundamental technology costs, but rather institutional and market failures that can be corrected. Even dispensing with environmental goals, Pakistan retains a renewable energy imperative purely from the need to power its economic development in the most cost-effective and secure way.

Thus promoting renewables in Pakistan not only addresses the country's energy needs but also contributes significantly to climate change mitigation and sustainability efforts. Shifting towards renewable energy sources helps reduce Pakistan's reliance on fossil fuels, thereby lowering greenhouse gas emissions. Investing in renewable energy also reduces Pakistan's dependence on imported fossil fuels, enhancing energy security and resilience to supply disruptions. This reduces vulnerability to fluctuations in global fuel prices and geopolitical tensions, promoting long-term stability and sustainability in the energy sector. Investing in renewable energy infrastructure further strengthens Pakistan's resilience to the impacts of climate change by diversifying its energy mix and reducing vulnerability to extreme weather events and natural disasters. Finally, transitioning from thermal power generation to renewables opens avenues for accessing international climate finance mechanisms and support.

B. Encouraging Investment

The primary constraint on renewables is the high cost of capital. Pakistan's benchmark lending rate locally is around 20%, far higher than some of its neighbors like India (8%) or Vietnam(7.5%). Renewable energy consists predominantly of upfront capital investments. Once built, their marginal costs approach zero, as all that remains are operating and maintenance costs. Financing these upfront capital costs are therefore the primary hurdle for investment. Pakistan currently does not offer an attractive investment environment, which significantly raises the cost of capital and hence vanishes the prospects of having bankable renewable energy projects. To address this, SBP financing schemes are limited in size and scope and could be enhanced. In the short term, the government should allow price discovery (within price bands) through solar/wind auctions rather than sticking to hard-coded tariffs for solar or wind (previously set at 3.5-4 US cents/kWh) that were deemed too low for investors given the investment risks in the country.

To reduce risk and spur investment, the government has thus far only provided long- term PPAs to renewable projects. By

[9]Hydro has a faster ramp rate than thermal plants and can also be used for pumped storage.

guaranteeing payment for 25 years, this lowers the cost of capital for investors and hence reduces the ultimate electricity generation tariff. The implication is that the government is locked into paying this rate for the entire period. In the future, as innovation continues or as Pakistan's macro risks subside, even cheaper solar or wind projects may become available. Thus, there is a fundamental tension that the government must balance: giving adequate benefits in the form of a PPA to bring in investment while minimizing the government's own downside risk that comes from being locked-in to these contracts. One option could be to shorten the duration of PPAs, for instance to 10-15 years, after which projects enter CTBCM as merchant plants. The payback period – the time it takes for a project to recoup its system costs – can be as low as 5 years for a project in a high-potential area (though the debt repayment period may be longer). Reducing PPA durations by 10 years might raise the tariff slightly but could give greater flexibility for the government to dynamically optimize its mix of power producers over time.

C. Early Retirement of Inefficient Plants Using International Climate Finance

Pakistan has a surplus of generating capacity contracted to expensive thermal power plants, often awarded uncompetitively. As a result, renewables can only feasibly meet future electricity supply needs, not current ones. There is a deep fiscal challenge associated with having excess capacity: PPAs in Pakistan are 'take-or-pay', which means the government either buys electricity produced by plants or pays them capacity payments for being available.

When the government buys power, it can at least sell it onto customers and earn revenue; this is not the case when making capacity payments to plants that sit underutilized. Capacity has value for system stability, so capacity payments themselves are not inherently problematic. However, when there is too much capacity due to poor planning, these payments can begin to act as an increasingly large fiscal drag. Around 2% of Pakistan's GDP is spent on capacity payments annually.

Adopting renewable energy in place of existing thermal power generation can open new opportunities for obtaining international climate finance. Mechanisms such as the Asian Development Bank (ADB)'s Energy Transition Mechanism offer novel ways to finance the early retirement of existing thermal power plants to create space for renewables. Medium sized gas or diesel plants could be suitable candidates for such mechanisms. An important aspect for tapping into international climate finance is the notion of additionality. If a wind farm is earmarked to be built by a private party regardless of outside funding, then there is no additional impact from the international donor's perspective of helping finance it. Furthermore, there must be a convincing case that the wind farm displaces electricity generated from thermal power plants. It is for these reasons that early retirement of thermal plants and other similar finance mechanisms have garnered interest internationally as they ensure additionality.

D. Enhancing the Grid

Engineering models of Pakistan's power system (e.g. PLEXOS) demonstrate the clear potential of renewable energy: optimal penetration rates of variable renewable energy (wind, solar) should today be approaching 30%. The current rate is well below 10%. This analysis takes onboard the existing power grid as well as the system costs that variable energy brings, such as the potential need to pay premiums for peak plants to be able to fill gaps in supply during low solar or wind periods. Pakistan is therefore operating well within the current potential of its existing grid infrastructure. Pakistan's existing grid has the capability to adopt far more variable renewable energy than is currently in the system. The intermittent power that is generated from renewable energy is a long-term issue that requires investments and changes to the power system, especially as variable energy forms a larger share of the electricity mix.

Investments into upgrading and extending the transmission system are critical and should not be delayed. The existing network has been designed to transport power between the north and south of Pakistan. This transmission trunk runs from the hydropower generation in the mountains of northern Pakistan, through the industrial heart of Punjab, and down to the commercial hub of Karachi. The grid was not placed in anticipation of large-scale solar or wind in Balochistan or Thar Desert. A comprehensive grid extension plan should consider the future likely development of renewables in these areas. The needs in the short-term may be small, but they are likely to grow substantially as the country begins scaling up its investments into solar and wind, especially as these may be placed far away from the existing backbone of the grid. Lastly, in addition to an expansion of physical transmission infrastructure, investments into improving automation and control systems for managing the grid will be useful to handle greater shares of variable energy in the electricity mix.