Sustainable Pakistan: Addressing climate-driven demands and fiscal challenges for electricity

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Pakistan's electricity crisis threatens economic stability, with rising costs and unreliable supply straining households and businesses. Bold reforms and a renewable energy transition are essential for a fiscally sustainable, affordable power sector.

KEY MESSAGES:

1. **Pakistan's power sector has an affordability crisis.** Electricity consumers in Pakistan face unaffordable costs due to restrictive tariff protections and rising energy prices.
2. **A fiscally sustainable power sector is a prerequisite for affordable energy.** Systemic issues—especially foreign-exchange-linked capacity costs, theft, and collection failures—elevate electricity prices and compromise Pakistan's fiscal stability.
3. **Pakistan has tremendous opportunities to leverage wind and solar power.** Pakistan can transition to a sustainable, affordable energy future by leveraging renewables, reforming tariffs, and modernising infrastructure to ensure long-term economic and energy security.

Climate change presents a significant challenge for Pakistan. For Pakistan, this means warmer winters, increasingly frequent heat waves (Nasim et al., 2018), and a higher incidence of droughts. Climate change has grave relevance for Pakistan as rising temperatures are associated with decreased labour productivity, reduced agricultural yields, and increased mortality rates (Matthews et al., 2017).

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One way for households to mitigate these adverse effects is by increasing their electricity consumption, for cooling through fans, air conditioners, and refrigeration, along with improving access to water during droughts through tubewells. Per our calculations, a 1°C rise in temperature can lead to an 8.5% surge in electricity demand. Additionally, our analysis of IESCO data, an electricity distribution company in Pakistan, shows electricity consumption almost doubles during the summer months. As households will increase their electricity demand due to rising temperatures over the next decades, it becomes important to ensure they have access to an affordable and reliable electricity supply; otherwise, there will be a drastic decline in their quality of life. This growth brief demonstrates why an affordable and reliable electricity supply continues to be an elusive goal for the households of Pakistan and how they can attain it.

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KEY MESSAGE 1

Pakistan's power sector has an affordability crisis.

Electricity is expensive in Pakistan. Tariff protections are limited to a strict qualification criterion. Households must consume less than 200 kWh per month for six consecutive months to qualify. This threshold is difficult to maintain—running just two 100-watt fans and two 60-watt bulbs would consume 230 kWh. Islamabad Electric Supply Company (IESCO) microdata from 2018-2019 shows that 66% of households with an electricity load under 5kW and consumption below 700 kWh qualified for protected status for less than six months in 2019 and remained exposed to high tariffs.

It could be assumed that low average electricity consumption means high prices do not affect many households, as lower usage would result in lower bills. However, this is not the case, since even low energy consumption still results in bills that make up a significant portion of household income (Hussain et al., 2024). Assessing the burden on unprotected households is essential for understanding electricity affordability in Pakistan because:

1. Electricity use in Pakistan varies seasonally, with very high summer consumption and low winter consumption.

2. Exceeding the 200 kWh threshold in one month removes protection from high tariffs for six months.

3. Low average consumption is often due to high prices and unreliable supply rather than affordability.

Figure 1 illustrates the relationship between electricity bills, average price, and the share of income spent on electricity. The left panel shows sharp price jumps due to the stepwise tariff structure and various surcharges. The right panel highlights that consuming 230 kWh costs PKR 8,167—around 20% of an average household's income. However, GDP per capita overestimates affordability due to high income inequality. Data from the Household Integrated Economic Survey 2018-2019 suggests that many households earn closer to PKR 15,000 per month, meaning basic electricity consumption is an even greater financial strain.

Figure 1: The relationship between electricity bills, average price, and the share of income spent on electricity

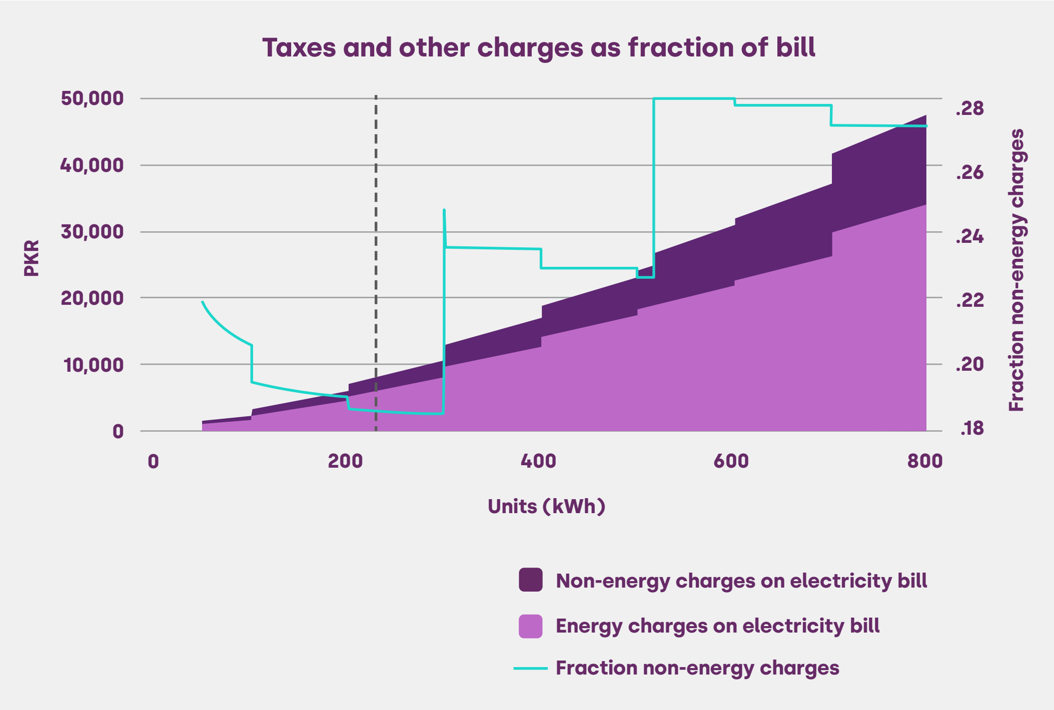
Notes: The left panel shows total electricity bills (green line) and average price per kWh (violet line) against consumption. The right panel illustrates the fraction of income spent on electricity, assuming a monthly income of PKR 40,000. A household consuming 230 kWh pays around 20% of its income. Figure generated by the authors using IESCO prices as of 27 August 2023, with fuel price adjustment based on consumption two months prior.

One reason for the high cost of electricity bills is the inclusion of additional charges unrelated to the current month's consumption. These comprise fuel price adjustments (FPA) to account for unforeseen increases in fuel prices, quarterly adjustments (QTR) to account for unexpected theft and collection losses, escalating capacity payments, financing cost (FC) surcharge associated with circular debt, electricity duty (ED), and income tax (IT), which is levied on bills exceeding PKR 25,000.

Figure 2 delineates the electricity bill into energy charges and non-energy charges.[1] The figure illustrates how non-energy charges range from 18% to 28% of the bill and increase with the units consumed. The big jumps at 300 and 500 units can be attributed to the rise in FC surcharge and the imposition of income tax, respectively. Energy charges account for 72-82% of the bill and, thus, constitute a substantial portion of the bill. The causes for the high energy charges will be investigated in a subsequent section.

1. The term "non-energy" charges is used loosely here as it includes FPA adjustments; however, it is important to note that FPA relates to energy consumption from two months prior.

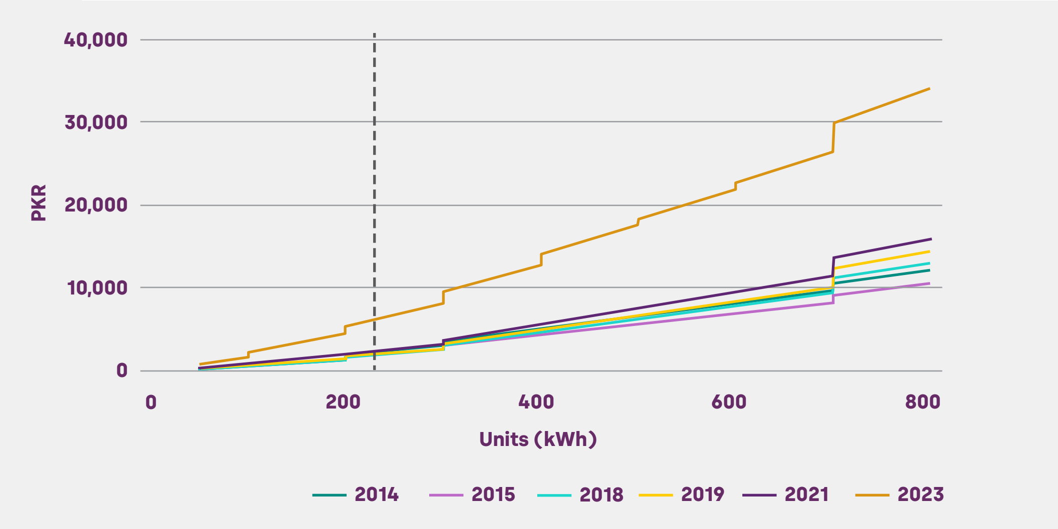
Figure 2: Fractions of energy and non-energy charges of an electricity bill



Notes: The left y-axis (in rupees) shows energy charges (violet) and non-energy charges (purple) against electricity consumption, while the right y-axis (green line) represents the fraction of the bill attributed to non-energy charges. The graph highlights that energy charges make up the largest portion of the electricity bill. Figure generated by the authors.

Figure 2 shows that while taxes significantly add to the electricity bill, high energy charges remain the primary driver of rising costs. This is especially concerning as most taxes are applied as a percentage of these charges, compounding their effect. But how high are these charges relative to the past? Figure 3 tracks energy charges over the last decade, showing a sharp rise since 2015 and an even steeper increase post-2021. For a household consuming 230 kWh per month, energy charges have surged by 265%, while overall tariffs have increased by an astounding 290%.

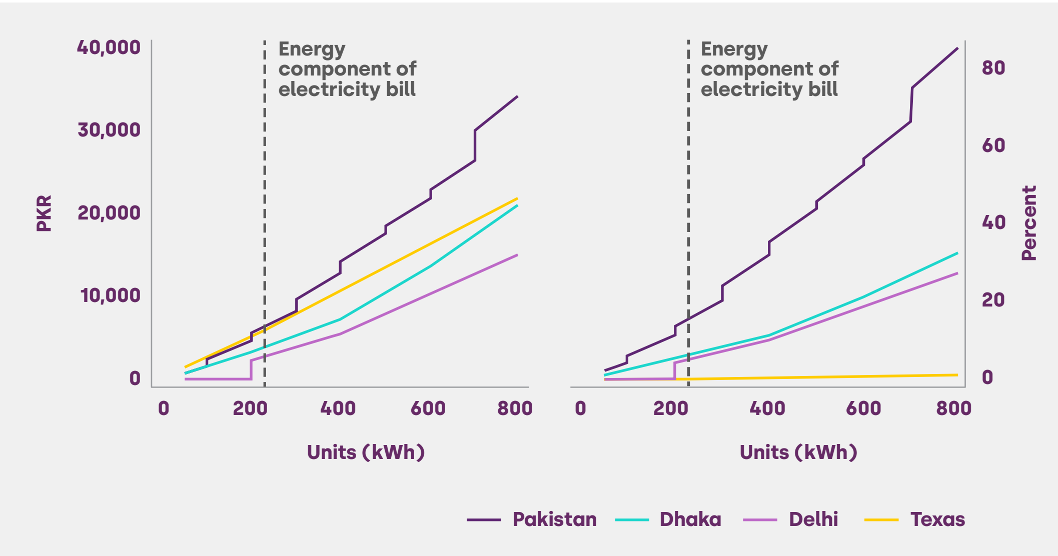
Figure 3: Growth in energy charges of electricity bills, 2014-2023



Notes: This figure plots the total energy charges against electricity units (kWh) consumed. It shows the drastic increase in the energy charges of electricity bills over the last decade. Figure generated by the authors.

Comparing Pakistan's energy charges internationally provides further perspective. Figure 4 contrasts electricity prices in Austin, US; Dhaka, Bangladesh; and Delhi, India. While Pakistan's higher prices compared to India and Bangladesh are expected, given that Pakistan has a more inefficient electricity sector afflicted by theft, poor infrastructure, and non-payment, it is striking that some high-income regions offer cheaper electricity while having much higher incomes and greater energy consumption. The right panel of Figure 4 underscores this issue, showing that Pakistani households allocate the highest share of their income to electricity. A household consuming 230 kWh per month spends about 17% of its income on energy charges—compared to 5% in India, 6% in Bangladesh, and just 0.4% in Texas. This reflects a worsening affordability crisis, where even running two fans and two bulbs has become prohibitively expensive over time and relative to other countries.

Figure 4: Energy charges across various cities and as shares of household incomes



Notes: The left panel of the figure plots the total energy charges against electricity units (kWh) consumed for other countries, such as India (Delhi), Bangladesh (Dhaka), and USA (Austin). The right panel shows the energy charges as a fraction of the monthly income, where we use GDP per capita for 2022 for each location. Figure generated by the authors.

Despite these high costs, the quality of supply remains poor. National Electricity and Power Regulatory Authority data from 2021-22 shows load-shedding in Peshawar Electric Supply Company's service areas 25% of the time and in Karachi-Electric's areas 14% of the time. Some distribution companies (DISCOs) report lower outages, but their data includes industrial feeders, underrepresenting the residential experience. Anecdotal reports suggest even worse conditions, with some rural areas facing up to 16 hours of load-shedding daily (Dawn, 2023). This means households not only pay some of the highest electricity prices relative to income but also receive unreliable service.

Looking ahead, rising temperatures and economic growth will drive electricity demand higher, especially among low-income households. Since their per capita consumption is already low, they have the most room for growth yet, are most vulnerable to affordability issues. While wealthier households can switch to solar power, poorer families remain dependent on an increasingly costly grid, straining their wellbeing. Understanding the root causes of high electricity prices and identifying solutions is crucial to ensuring a more equitable energy sector—the focus of the next section.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KEY MESSAGE 2

A fiscally sustainable power sector is a prerequisite for affordable energy.

Electricity is expensive in Pakistan because of high cost of production and distribution. This section explores key factors driving rising prices and potential solutions. Addressing these issues is crucial, as they are systemic, long-standing, and have left the power sector financially unstable. Without major policy interventions, electricity prices will likely remain high, especially as climate change drives up demand. While multiple supply and demand factors contribute, this section highlights the most critical ones.

To understand electricity pricing in Pakistan, it is essential to examine how tariffs are set. Broadly, all costs—including fixed expenses like capacity charges, variable costs like energy charges, and additional factors such as theft, collection losses, and distribution companies (DISCO) operations—are aggregated and recovered over projected annual demand. Any gaps between projected and actual costs are adjusted the following year. Since DISCOs have different operating costs and transmission and distribution (T&D) losses, their cost structures vary. However, tariffs for each consumption category are set so that total revenue remains fixed, with higher-paying customers effectively subsidising lower-paying ones. To standardise tariffs nationwide, the government covers inter-DISCO cost differences through an annual tariff differential subsidy, which amounts to approximately PKR 300-350 billion.

Supply-side: Capacity costs and power purchase agreements

Capacity costs refer to payments made to electricity producers to ensure the availability of generation capacity, regardless of the actual volume of electricity produced. These payments cover the debt financing of power plants and provide a return on invested equity. As fixed costs, they remain unchanged regardless of electricity generation. The specifics of these capacity costs are outlined in power purchase agreements, which include government-approved licenses and upfront tariff agreements.

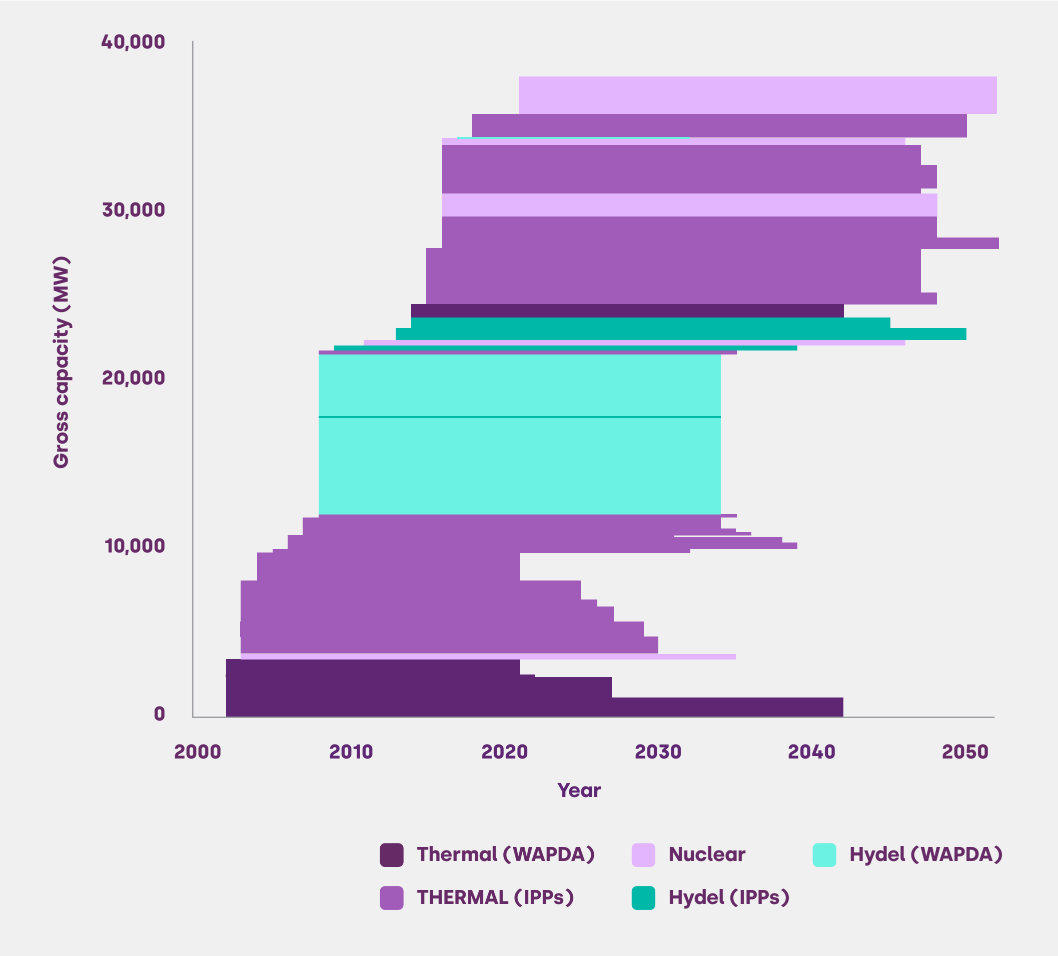
Why are capacity costs significant? When assessing the total cost of generating a single unit of electricity—including permitted losses and capacity costs—the projected cost for the fiscal year 2023-2024 is PKR 30.6/kWh. Removing capacity costs while keeping other factors unchanged would reduce this to PKR 12.8/kWh, a nearly 60% reduction. Notably, the anticipated capacity payments for the fiscal year 2023-2024 in Pakistan amount to approximately

PKR 2 trillion, comparable to the country's defence budget. This entire amount will be recovered through electricity tariffs, making capacity costs a key driver of high electricity prices.

These costs are not only substantial but also long-term financial commitments. Power purchase agreements typically span over two decades, sometimes extending up to forty years. Figure 5 illustrates agreements for power plants in Pakistan, excluding solar, wind, bagasse (renewable energy through sugarcane waste), and K-Electric facilities, covering approximately 92% of the country's generation capacity when K-Electric is omitted. The figure shows thermal independent power producers (IPPs) constitute the largest share, followed by hydropower plants under the Water and Power Development Authority (WAPDA). The duration of these agreements is particularly significant. Many of the thermal IPP contracts signed between 2015-2017, for example, will remain active beyond 2040.

To understand the scale of capacity payments, it is important to examine the underlying factors. A key driver is Pakistan's reliance on foreign capital and debt for power projects, with returns on both equity and debt often indexed to the USD-PKR exchange rate. Between 2015-2017, when much of the capacity was added (Figure 5), the exchange rate was below 100 PKR/USD; today, it stands at around 300 PKR/USD. This threefold depreciation has significantly raised capacity payments. Figure 6 highlights how thermal IPPs, which account for the largest share of generation, receive a disproportionately high share of total payments. While thermal IPPs set up under the China Pakistan Economic Corridor (CPEC) contributed 12% of total capacity in fiscal year 2021-2022, they received nearly 30% of payments due to their heavy reliance on foreign debt. Some non-CPEC thermal IPP agreements were renegotiated between 2020-2021 to remove exchange rate indexation from certain costs, but significant exposure to currency fluctuations remains.

Figure 5: Power purchase agreements for thermal, nuclear, and hydropower plants

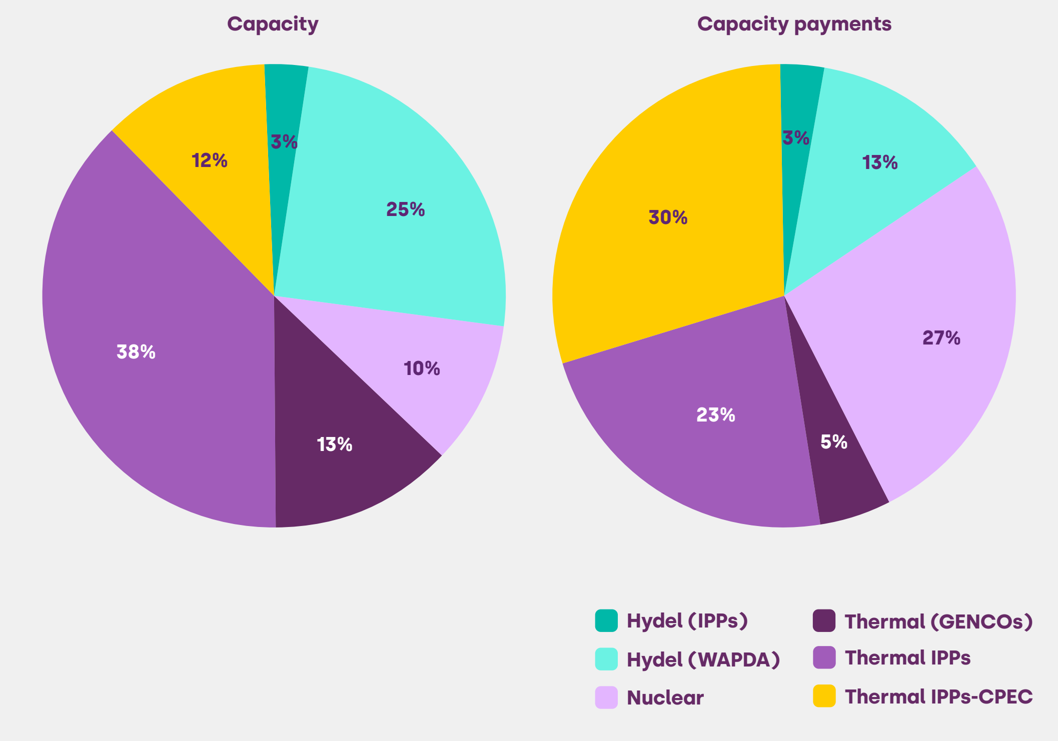


Notes: Power purchase agreements (PPAs) for thermal, nuclear, and hydropower plants in Pakistan (FY 2021-2022, NEPRA). Rectangles represent PPAs, with height for capacity and length for duration. Colour-coded by plant type; thermal includes coal. Figure generated by the authors.

Power purchase agreements can benefit low- and middle-income countries by ensuring a stable electricity supply and are common in countries like Bangladesh and India. However, Pakistan's currency instability sets it apart. Over the past two decades, economic crises have consistently led to sharp devaluations, causing electricity generation costs to spike at the worst possible times. Since electricity is essential for households and industries alike, this procyclical cost pattern worsens economic downturns. The situation is further strained by thermal IPPs' reliance on imported fossil fuels, which weaken the currency and drive up PKR-based payments under existing contracts.

As policymakers navigate these challenges, key questions arise. With climate change driving up demand for affordable and reliable energy—especially during extreme temperature events—additional capacity will be necessary. The choice of fuel is critical, and as discussed later, shifting from fossil fuels to renewables is ideal. Policymakers must also weigh the long-term costs of power contracts against their benefits. In Pakistan, much of the current capacity is built to meet peak demand in June, while energy needs drop for the rest of the year. Given these fluctuations, entering expensive dollar-indexed contracts for additional capacity requires careful fiscal scrutiny.

Figure 6: Share of capacity and capacity payments for thermal, nuclear, and hydropower plants



Notes: This figure plots the share of capacity and verified capacity payments in FY 2021-2022 from NEPRA State of Industry Report 2022 (Table 34) by type of power plant. Thermal category includes coal plants. Figure generated by the authors.

Demand-side: Electricity theft and collection losses

Electricity theft and collection losses severely impact the fiscal health of the power sector and drive up electricity prices. The scale of the problem is significant. According to NEPRA's State of the Industry Report (NEPRA, 2023), Pakistan generated 154,000 GWh of electricity in FY 2021-2022, but distribution companies billed only 125,000 GWh, reflecting a 19% loss between generation and delivery. Additionally, 9% of the billed amount remains uncollected. This implies that for every 100 units generated, 28 are lost to theft or non-payment—an unsustainable level for any business.

These losses have multiple consequences. First, regulations allow part of the losses to be passed on to consumers through higher tariffs. Second, the remaining losses contribute to the growing power sector debt, which has surged to 4-5% of GDP. For perspective, Pakistan's tax-to-GDP ratio stands at about 10%, according to the IMF's 2023 country report. This debt accumulates as delayed payments to power producers, rising interest costs, or direct borrowing from the financial sector. In cases of borrowing, the government bears the interest burden. Recently, an FC surcharge was added to electricity tariffs to help cover both interest and principal payments on power sector debt. Lastly, these losses increase the sector's risk profile, discouraging investment unless companies receive high-return power purchase agreements to compensate for payment delays. This contributes to the high cost of independent power producer (IPP) contracts.

It is important to understand the underlying causes of the prevalent electricity losses. Figure 7 derives from microdata sourced from surveys of 1,600 randomly chosen households. This figure, for each average monthly payment-to-bill ratio bin, depicts the percentage of the 1,600 households that fit within that specific range. A bimodal payment distribution is evident, with notable peaks around 0 and 1, interspersed by numerous households that fit between these two values.[2] This highlights three distinct customer behaviours: those who habitually avoid their bills, those who attempt to pay but often fall short, and those who consistently meet their payment obligations. The challenge of collection losses predominantly pertains to the first two groups.

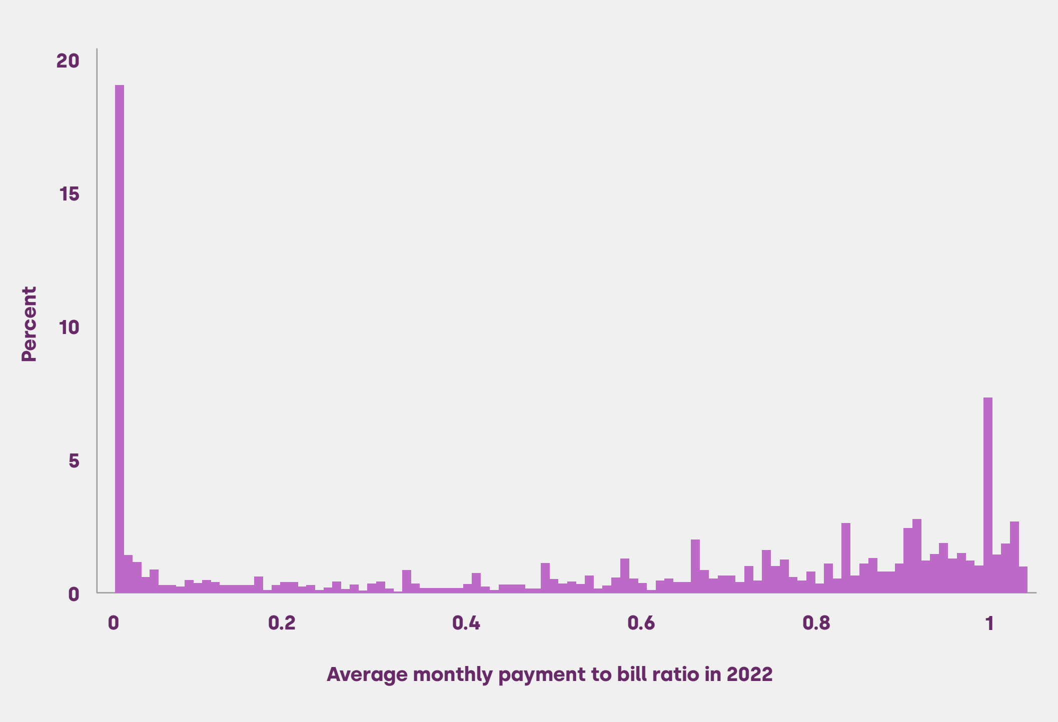
Several factors explain these behaviours. Those who try to pay but often fall short likely face rising prices and financial constraints, especially in remote villages where frequent tariff changes make it difficult to adjust consumption. They pay what they can afford. Meanwhile, those who consistently avoid payment may exploit influential contacts, collude with corrupt meter readers, or believe electricity should be free or that the government is overcharging. The lack of trust in the government is compounded by the fact that in many villages, there is extensive load-shedding despite the very high prices.[3]

As temperatures rise, households' energy needs will intensify, and the challenges of these losses are set to increase unless timely reforms are introduced. Addressing this issue is complicated, as multiple factors could be driving households to engage in such behaviours, each requiring a unique remedy. For instance, to counteract widespread mistrust towards the government, social mobilisation initiatives might prove effective. Determining which solutions are most apt for specific contexts is crucial and requires research. Nonetheless, the benefits of addressing these losses are significant. Curtailing them could alleviate the circular debt problem, reduce electricity costs, and bolster investor trust in the power sector.

2. Approximately 30% of the surveyed households had a *kunda* or an unmetered connection to the electricity lines. Plotting Figure 7 separately for those observed with *kundas* and without *kundas* does not reveal any significant differences.

3. This aligns with the concept of electricity being viewed as a fundamental right, as discussed by Burgess et al., (2020).

Figure 7: Average monthly payment-to-bill ratio for sample households in 2022



Notes: This figure plots the fraction of households from a sample of 1600 households in the town of Charsadda, Khyber Pakhtunkhwa province against their average monthly payment-to-bill ratio in 2022. Figure generated by the authors.

KEY MESSAGE 3

Pakistan has tremendous opportunities to leverage wind and solar power.

As Pakistan's energy demand grows, sourcing power affordably will be key to economic stability. Renewables, supported by technological advances and favourable geography, offer the best solution. Large-scale solar now produces the cheapest electricity, and costs for wind, solar, and storage continue to drop. Yet, outdated, inefficient power plants drive up generation costs. Even new local fuel plants, like Thar coal, which costs PKR 5-7 per kWh, can only match global solar costs in Pakistan's high-potential areas (Express Tribune, 2024). If coal appears cheaper, it reflects policy and financing inefficiencies, not technology costs—issues that can be addressed. Even without environmental concerns, renewables are essential for cost-effective energy.

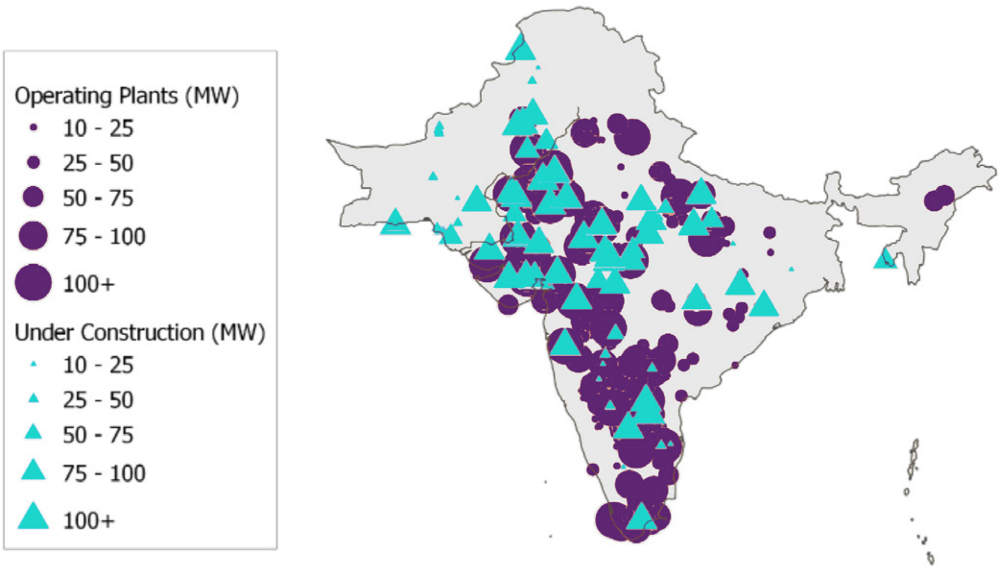
Renewables also strengthen energy security. Unlike fossil fuels, they are immune to global price shocks that destabilise Pakistan's balance of payments. Hydropower, with fast ramp rates and pumped storage potential, can support variable wind and solar. Yet, Pakistan remains reliant on imported fuels, making it vulnerable to crises like the rerouting of gas from Pakistan to Europe after Russia's invasion of Ukraine. Additionally, a cleaner energy mix would reduce air pollution from industry, transportation, and thermal power. This shift would also benefit exports, as policies like the EU's Carbon Border Adjustment Mechanism (CBAM) will tax high-emission imports, making a low-carbon grid essential for competitiveness.

However, a rapid shift to renewables faces hurdles. They require high upfront investment, and with no local manufacturing, imports strain foreign reserves. The grid is congested and lacks the capacity to support large-scale renewables. Key locations, such as the Thar Desert for solar, need dedicated infrastructure. Financing is a major challenge, with high capital costs due to macroeconomic instability, circular debt, and policy uncertainty deterring investors. Even when projects overcome these barriers, they struggle to replace existing thermal generation locked into long-term contracts until the 2040s. While solutions exist for managing intermittency, Pakistan remains far from high levels of variable generation, requiring new mechanisms such as demand-side management and peak-time incentives. Though the country has a clear renewable energy imperative, realising its potential will require addressing these structural barriers.

Opportunities

The Thar Desert stretches from eastern Pakistan into western India. On the Indian side of the border, Rajasthan has some of the cheapest solar electricity in the world (3 US cents per unit, 8.4 PKR); on the other, Pakistan has few solar farms. Rajasthan alone has 24 GW of installed solar capacity, while Pakistan's total installed solar capacity is just 3.1 GW (NEPRA, 2024). Even if Pakistan meets its 2030 goal of 13 GW in solar capacity, it will still have only half the solar capacity Rajasthan has today. Western India generates solar power at a levelised cost of 3-4 US cents per unit, far lower than Pakistan's average electricity generation cost. By comparison, CPEC coal power plants have levelised costs of 6-8 US cents per unit, nearly double, while older Residual Fuel Oil/Regasified Liquefied Natural Gas plants are even costlier.

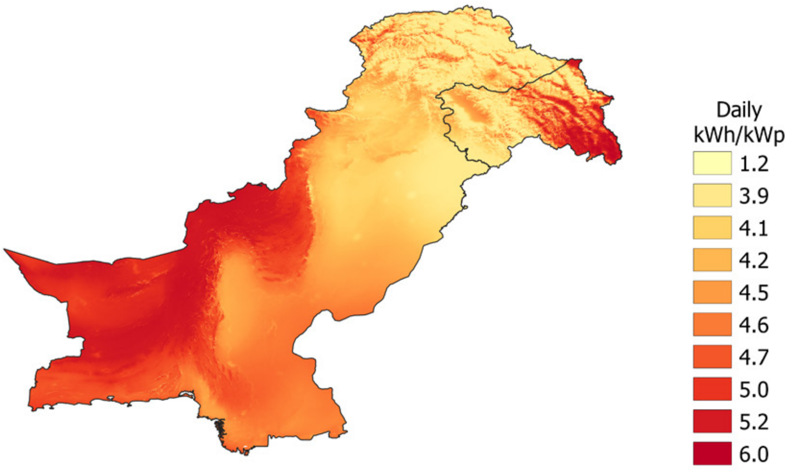
Figure 8: Solar plants in Pakistan and India (operational and under construction)



Notes: This figure shows the operational and planned solar plants (in megawatts) in both India and Pakistan. There is much higher incidence right across the border despite similar geography and climate. Figure generated by the authors.

Recognising this potential, the government has set a target of 13 GW of solar by 2030. The long-term energy sector plan, Integrated Generation Capacity Expansion Plan, aims to increase indigenous energy sources from 40% to 90% by 2030. While domestic coal expansion is a key part of this strategy, renewables can also play a major role. To accelerate adoption, the Fast Track Solar Photovoltaic (PV) Initiative was launched in late 2022 to add 10,000 MW of solar capacity to the grid, with more than half designated for utility-scale solar farms to replace imported fuels. To attract investment, the initiative offers land leases, 70% foreign exchange rate indexation, a guaranteed off-take by the national power purchaser, and a 25-year power purchase agreement.

Figure 9: Pakistan's solar photovoltaic (top) and wind power potential (bottom)



Notes: The figure at the top shows Pakistan's solar potential in kWh/kWp. kWh/kWp represents the annual energy yield (kilowatt-hours) per unit of installed solar panel capacity (kilowatt peak), indicating how much energy a solar system produces for every kWp of its installed capacity. The figure on the bottom shows the wind potential in meters per second across Pakistan. Source: Global Solar Atlas (World Bank and Solargis, 2020), Global Wind Atlas (Technical University of Denmark and World Bank, 2023).

Renewables offer significant advantages for Pakistan. The Thar Desert and Balochistan have high solar irradiation and wind speeds with minimal competing land uses. Since these regions are sparsely populated, power must be transmitted to demand centres like Karachi and Lahore, which are close enough to make this feasible. Renewables are also highly space-efficient—just 0.071% of Pakistan's land area could generate enough solar power to meet national demand, according to the World Bank (World Bank, 2021).

Hydropower provides a natural complement to renewables, helping address intermittency. Solar and wind generation fluctuate, requiring backup power to stabilise the grid. Hydropower, which can ramp up quickly without thermal ignition, is more efficient than coal and comparable to specialised gas plants. It also enables pumped storage, where excess solar power is used to pump water uphill for later electricity generation—though this technology is not yet deployed in Pakistan. Additionally, many existing power plants rely on outdated, inefficient technology, making electricity generation costly. Reliance on high-speed diesel and furnace oil plants as short-term fixes has further increased supply costs. The lack of competitive procurement for thermal projects has led to long-term contracts with independent power producers, often at inflated costs.

Off-grid solar also offers decentralisation benefits, particularly for remote areas in southern Punjab, northern Sindh, and Balochistan, where grid access is limited but solar potential is high. While not a replacement for grid expansion, off-grid solutions can accelerate electrification. Net metering is also gaining traction in major cities, allowing households with solar panels to sell excess electricity back to the grid at retail rates. Pakistan's net metering policy is among the most generous globally, encouraging wealthier households to invest in solar. However, widespread adoption could strain distribution companies, as high-consumption customers—who generate substantial revenue—are the most likely to switch to net metering.

Engineering models demonstrate Pakistan's significant renewable energy potential. PLEXOS, an advanced grid planning tool, estimates that the optimal share of variable renewable energy should be around 30%, while the current level remains below 10% (World Bank, 2021). This analysis considers the existing grid and the costs associated with variable energy, such as the need for peaker plants to compensate for periods of low solar or wind output. Since hydropower, though renewable, is not classified as variable, Pakistan has ample room to expand its renewable energy share without overburdening the grid. At present, the country is operating well within the capacity of its infrastructure to integrate more renewables.

Pakistan is also transitioning to a more competitive electricity market. Instead of relying solely on long-term power purchase agreements (PPAs) with the Central Power Purchasing Agency (CPPA), new independent power producers will enter a cost-based trading market (CTBCM), allowing low-cost renewables to compete with inefficient thermal plants. However, existing producers will remain under long-term contracts until they expire. A key benefit of this reform is the potential for a domestically financed electricity system in PKR rather than USD, supporting smaller-scale solar projects. Additionally, renewable expansion can attract international climate finance. Programmes like the Asian Development Bank's Energy Transition Mechanism offer funding for early retirement of thermal plants, as seen in the Philippines and Indonesia. Pakistan's medium-sized gas or diesel plants could benefit from similar funding, provided they replace fossil fuel generation rather than proceed independently.

Constraints

Several constraints have hindered the expansion of renewables. The primary challenge is financing. Renewable projects require high upfront capital, while operating costs remain low. However, Pakistan's investment climate makes financing difficult, significantly increasing the cost of capital. The issue is not technological—wind and solar are already cost-effective—but the inability to secure affordable financing. If market failures and distortions were removed, renewables would be unequivocally cheaper than thermal power in Pakistan.

Beyond financing, three key constraints have slowed renewable adoption. First, delayed payments to IPPs make investments riskier. IPPs can go months without receiving full payments from the CPPA; towards the end of 2023, Chinese IPPs alone were owed nearly USD 1.2 billion (Kiani, 2023). These delays force IPPs to refinance debt or seek short-term liquidity, raising overall costs. Second, policy uncertainty discourages investors. The approval process for solar or wind projects takes about two years—roughly the same as the average tenure of Pakistan's governments. Frequent shifts in renewable policy, from feed-in tariffs to competitive auctions, have left investors hesitant. Unclear regulations around approvals, bidding, and grid interconnections further complicate planning. Third, Pakistan's benchmark tariffs for solar and wind, set at just below 3.5 US cents per unit, are among the lowest in the region. However, due to currency depreciation and financial risks, these tariffs have been too low to attract investors, leading to failed bidding rounds. To address this, the latest procurement round raised foreign exchange rate indexation from 70% to 80%, acknowledging that Pakistan cannot match regional solar prices under current conditions.

Expanding renewables also requires modernising Pakistan's transmission network. Compared to Western India, Pakistan lacks high-voltage transmission lines needed for long-distance power transport. While the government commits to building transmission infrastructure for procured projects, congestion in core transmission lines remains a challenge. Most of the grid was designed for hydropower in the north, with little consideration for large-scale solar or wind in Balochistan or the Thar Desert. A long-term grid expansion strategy is essential to accommodate growing renewable investments.

Finally, Pakistan must avoid a capacity trap. The country already has surplus contracted generation, leading to high capacity payments—totalling 2% of GDP annually—under its "take-or-pay" agreements. To attract renewable investment, the government has offered 25-year PPAs, locking in rates for decades. While this lowers financing costs, it also limits flexibility as technology advances. One solution could be shortening PPAs to 10-15 years, allowing projects to transition into Pakistan's competitive power market (CTBCM) after recouping costs. A slight tariff increase could offset the shorter contract period. For instance, reducing solar PPA durations to 14 years might increase tariffs from 4 to 4.6 US cents per unit but offer greater long-term flexibility. Similarly, adjusting the degree of dollar indexation could help balance investment incentives with fiscal sustainability.

1. Setting electricity prices optimally.

Pakistan's electricity pricing is inefficient due to three key issues: an accounting-based approach that ignores consumer behaviour, poorly allocated subsidies tied to consumption rather than income, and fixed capacity payments embedded in unit charges. When prices rise, households reduce consumption, shift to off-grid alternatives, or resort to theft, shrinking revenue collection and triggering further price hikes in a self-reinforcing cycle. Pricing needs to account for these behavioural responses through proper elasticity measurement and adjusted revenue targets.

Subsidies, particularly the tariff differential subsidy (TDS), distort pricing and need to be replaced with direct cash transfers based on income and wealth. Fixed capacity costs, incurred on a "take or pay" basis, also need to be charged separately through a fixed fee model, similar to Benazir Income Support Programme/Ehsaas cash transfers. This would reduce inefficiencies, lower base tariffs, and ensure fairer cost distribution, preventing undue burdens on lower-income consumers while ensuring all grid users contribute to capacity payments.

2. Exploring solutions for electricity losses through pilot research.

Numerous factors contribute to the widespread issues of electricity theft and collection losses, as previously outlined. Potential solutions include social mobilisation, outsourcing collection duties, utilising technological advancements like aerial bundle cables and smart meters, targeted load-shedding at the transformer level, and incentivising meter readers, among others. Given Pakistan's diverse settings, these solutions have varying levels of return on investments. To discern the most effective approach for a specific context, it is essential to initiate pilot projects that can provide firsthand data. This data can guide policymakers in deciding which solution warrants broader implementation in each setting. It's noteworthy that such pilot exercises are sometimes met with scepticism due to the time they require to yield results. However, the value of these pilot projects must not be underestimated. Taking a few months to gather accurate data is a more prudent approach than endlessly debating potential solutions without concrete evidence or, worse still, committing to a solution without truly understanding its consequences.

3. Accelerating the adoption of renewable energy.

To accelerate renewable energy adoption, Pakistan must address financing barriers, infrastructure gaps, and policy uncertainty. Expanding concessionary financing schemes, stabilising macroeconomic conditions, and ensuring timely payments to IPPs will reduce investment risks and lower the cost of capital. A clear and consistent regulatory framework, with streamlined approval processes and stable tariff structures, is essential for attracting long-term investments.

Upgrading Pakistan's transmission infrastructure is also critical, particularly in high-potential areas like Balochistan and the Thar Desert. A national grid expansion plan will need to prioritise high-voltage transmission lines and automation technologies to integrate more renewable energy. Additionally, while long-term power purchase agreements (PPAs) help secure investments, reducing their duration to 10-15 years and gradually transitioning projects to the competitive electricity market (CTBCM) will improve fiscal flexibility. Finally, ensuring fair foreign exchange rate indexation in renewable tariffs will make projects viable without exposing the government to excessive financial risk.

References

Burgess, R., Greenstone, M., Ryan, N., and Sudarshan, A. (2020). The consequences of treating electricity as a right. *Journal of Economic Perspectives*, 34(1), 145-169.

Dawn. (2023, October 2). *Pakistan can generate 100pc green energy by 2050: Report*. Available at. https://www.dawn.com/news/1778250

Express Tribune. (2024, April 14). *Thar coal key to overcoming expensive power woes.* The Express Tribune. Available at https://tribune.com.pk/story/2462513/thar-coal-key-to-overcoming-expensive-power-woes

Hussain, J., Siyal, S., Ahmad, R., Abbas, Q., Yitian, Y., and Jin, L. (2024). Impact of Energy Crises on Income Inequality: An Application of Piketty's Hypothesis to Pakistan. *Economies*, 12(10), 259.

Kiani, K. (2023). Pakistan owes $1.2bn to Chinese power producers. *Dawn*. Available at https://www.dawn.com/news/1778250

Nasim, W., Amin, A., Fahad, S., Awais, M., Khan, N., Mubeen, M., Wahid, A., Turan, V., Rehman, M. H., Ihsan, M. Z., Ahmad, S., Hussain, S., Mian, I. A., Khan, B., and Jamal, Y. (2018). Future risk assessment by estimating historical heat wave trends with projected heat accumulation using SimCLIM climate model in Pakistan. *Atmospheric Research*, 205: 118–133.

National Electric Power Regulatory Authority. (2022). State of Industry Report 2022. Available at https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202022.pdf

National Electric Power Regulatory Authority. (2023). *State of Industry Report* 2023. Available at https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202023.pdf

National Electric Power Regulatory Authority. (2024). *State of Industry Report* 2024. Available at https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202024.pdf

World Bank. (2020). Variable renewable energy integration and planning study.

World Bank and Asian Development Bank. (2021). *Pakistan country climate and development profile*. Climate Knowledge Portal.

World Bank Group and Solargis. (2020). Global Solar Atlas 2.0: *A Free, Web-Based Application to Support Solar Power Investments and Planning*.

World Bank. (2021). *The huge potential of solar and wind in Pakistan.* World Bank Blogs. https://blogs.worldbank.org/en/energy/huge-potential-solar-and-wind-pakistan

Technical University of Denmark (DTU) and World Bank Group. (2023). *Global Wind Atlas 3.1: A Free, Web-Based Application to Support Wind Power Investments and Planning.*

Yu, W., Yang, Y., Savitsky, A., Alford, D., Brown, C., Wescoat, J., Debowicz, D., . (2013). *Indus basin of Pakistan: Impacts of climate risks on water and agriculture.* World Bank.

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