China and the Electrification of the Global South: The Case of Pakistan

In May 2025, Pakistan and India experienced one of the most intense regional conflicts of this century.[1] India responded by suspending the Indus Waters Treaty (IWT), which had been in effect for 65 years. The IWT was signed in 1960, after nine years of negotiations. Brokered by the World Bank, the treaty is regarded as a successful example of international mediation during the Cold War. Then US President Dwight D. Eisenhower called it 'a bright spot in a discouraging world situation'.

India's recent decision to suspend the IWT brought new crises to Indo-Pakistani relations. Apart from diplomatic appeals, what concrete measures can a relatively disadvantaged country like Pakistan take? River development is an essential part of nation building for any modern state. If India leverages its geographical advantage to develop the Indus River, how should Pakistan respond?[2]

The Indus River originates in Xizang (Tibet), China, and flows into the sea through Pakistan. Although the name 'India' comes from the Indus River, the river's main basin lies in today's Pakistani Punjab and Sindh provinces. According to the IWT, India controls the three rivers towards the east (Sutlej, Beas, and Ravi), while Pakistan controls the three rivers towards the west (Indus, Jhelum, and Chenab). Pakistan pays India management fees and India guarantees Pakistan's water rights over the three western rivers. Pakistan receives 80% of the annual runoff from the main tributaries of the Indus River, while India receives 20%. The treaty acknowledges India's right to develop hydropower on the three western rivers but restricts it to run-of-the-river hydropower stations to ensure downstream water supply for Pakistan.

The IWT is not only a water rights allocation agreement but also an international cooperative pact for river development. After the agreement was reached in 1960, the World Bank coordinated an international consortium – including the United States, United Kingdom, Canada, and Australia – which provided Pakistan with approximately $895 million in aid to support the construction of irrigation facilities. These included the Tarbela Dam, the Mangla Dam, and a system of link canals. India, on the other hand, used domestic funds to develop its eastern rivers.[3]

As a symbol of successful mediation between the two countries, the treaty remained unshaken during subsequent Indo-Pakistani conflicts. However, six decades later, the regional situation has dramatically changed – the volume of the Indus River has declined due to climate change, while the population in the upper reaches has increased. Additionally, the power imbalance between India and Pakistan has become more pronounced. When the treaty was signed, both countries had just gained independence and could accept cooperative development under the auspices of international organisations. But over the past 30 years, India's rapid economic growth has widened the gap between the two countries – Pakistan's gross domestic product is

only one-tenth that of India's. Whether driven by the need for its own economic development or the long-standing pursuit of regional dominance, India has actively sought to amend the treaty. Since 2009, India has repeatedly proposed amending the treaty and has taken an increasingly tougher stance.[4] The recent attack in India-administered Kashmir and the subsequent Indo-Pakistani conflict merely provided India with a pretext for direct action. The development of the Indus River is entering a new phase regardless of how the two sides negotiate.

From the Tennessee Model to the Three Gorges Model

Faced with an assertive India, Pakistan must adjust its strategy and independently develop its rivers. In the 1960s, the World Bank-supported Indus River development projects focused on irrigation to stabilise the newly established Pakistani state. However, the critical challenge for today's Pakistan is to develop its rivers to serve urbanisation, industrialisation, and overall modernisation.

For a modern nation, to manage rivers is to manage the nation; to develop rivers is to develop the country. The most typical example is the Tennessee Valley development project in the United States during the 1930s. At the time, the Roosevelt administration built cascading hydropower stations on the Tennessee River and established the Tennessee Valley Authority (TVA) to directly manage the entire river basin's water infrastructure, transforming the region into the fastest-growing economic area in the United States. TVA director David Lilienthal summarised the authority's mission as 'making the river serve the people'.[5] Lilienthal later coordinated and promoted the IWT, and both India and Pakistan's Indus River development efforts were modelled after the Tennessee experience.

Large-scale water conservancy projects can comprehensively enhance state capacity, which is crucial for a country with a weak infrastructural base like Pakistan. The achievements of water conservancy are evident in Pakistan: the Lahore metropolitan area is surrounded by a narrow irrigation canal, and Punjab province has eight similar canals, forming the famous Green Pakistan Initiative. These canals, with a total length of 622 kilometres, 400 auxiliary structures, and a total water delivery capacity of 300 cubic metres per second, irrigate 2 million hectares of land.

The canals have contributed to Pakistan's agricultural base, demonstrating the value of the Tennessee model. But Pakistan's needs have evolved from irrigation to energy – specifically, electricity. According to a 2022 report by China Three Gorges Corporation (CTG), Pakistan's per capita electricity consumption in the 2020–2021 fiscal year was 584 kilowatt-hours – ranking among the lowest in the world. Importantly, 24% of Pakistan's population still lacks access to electricity. Even at Lahore's iconic Wagah Border, where the famous daily Beating Retreat ceremony takes place, the restroom at customs lacks power and has only one functioning faucet.

Increasing hydropower supply has become a priority in Pakistan's river development. In the 1930s, the TVA was renowned for significantly boosting electricity supply to the central agricultural states of the United States, thereby driving industrial development in the basin. In this century, China's Three Gorges Dam project is by far the most exemplary case study. Since the first unit began generating electricity in 2003, the Three Gorges Dam has cumulatively produced over 1.7 trillion kilowatt-hours of electricity, setting a world record of 111.8 billion kilowatt-hours of clean energy produced in a single year in 2020.

The CTG's experience and capabilities align well with Pakistan's needs for Indus River development. The Karot Hydropower Station, developed under the CTG's leadership, became the first project funded by the Silk Road Fund and one of the key initiatives in the China-Pakistan Economic Corridor (CPEC). According to the plan, the CTG will carry out cascade development on the Jhelum River, one of the three western rivers. From south to north, three hydropower stations – Karot, Mar, and Kahala – will be constructed. The now-completed Karot Hydropower Station is Pakistan's fifth-largest, with a main dam height of 95.5 metres, an installed capacity of 720 megawatts, and peak monthly output of 400 million kilowatt-hours during the wet season – capable of supplying electricity to five million people.

Reorganising Social Relations through River Development

Large-scale infrastructure projects like hydropower stations require substantial investment and long-term management. Human factors are as critical as favourable timing and geographic conditions for transnational hydroelectric projects. This requires both personnel training and organisational restructuring.

Pakistan has a population of 240 million people and a long tradition of agrarian labour. However, Pakistan has yet to fully benefit from its labour supply. Pakistani workers are spread globally; official statistics show that in 2024–2025, one million Pakistanis left the country to work abroad. Many Pakistanis believe there are few job opportunities in their own country. The traditional society, rooted in kinship, village ties, and ethnicity, has strong social and economic units dominated by specific clans or ethnic groups. Within this structure, joining the military (or inheriting a family business) was the only way to break free from traditional constraints.

In such a social context, hydropower stations can offer new opportunities. The construction of large-scale infrastructure projects requires a kind of centralisation of power. This process requires integrating societal sectors, selecting talent across strata, and establishing organisations with mobility. Simultaneously, the CTG's hydropower development in Pakistan – from dam construction to operation and management – involves comprehensive workforce training, which gradually aligns local labourers' agrarian work ethic with modern work industrial ethics.

First, the CTG's human resource development in Pakistan breaks geographical barriers by providing widespread employment opportunities. At the Pakistani branch of the Three Gorges Asia-Africa Company, over half the staff are Pakistani, while the Islamabad office is entirely staffed by locals. Pakistan is often seen as a Punjabi-dominated nation, but Three Gorges employees come from all regions: Punjab, Sindh, Peshawar, and even Pakistan-administered Kashmir.

Second, workforce training breaks kinship-based professional monopolies by cultivating a new generation of professionals, some of whom receive training in China and are hired by Chinese energy companies operating in Pakistan.

Third, training brings about job opportunities for women. Due to patriarchal and religiously conservative tendencies, Pakistani women have few job opportunities despite relatively high education levels. The CTG, through its hiring standards based on fairness and inclusiveness, recruits female employees and trains female senior engineers.

From human resource development to organisational restructuring, the CTG's investments in Pakistan have

created conditions for Pakistan's talents to contribute to the nation's development. The significance of this contribution surpasses electricity generation.

Infrastructure as a Form of National Power

US sociologist Charles Tilly summarised European modernisation through the lens of war, proclaiming that 'war makes the state, and the state makes war'.[6] From the perspective of historical sociology, war can both construct a state's 'despotic power' and profoundly develop its 'infrastructural power'. For Western nations, war was the path to building nation states and achieving modernisation, which rapidly and effectively enhanced state power. However, there are contradictions between despotic power and infrastructural power – the former emphasises hierarchical bureaucratic structures and top-down authority while the latter stresses interaction, negotiation, and integration between the state and society, requiring a networked power system. For early European nation states, war drove the growth of both power systems, making it a convenient path for national construction.

Underdeveloped countries in the Global South must reject the European road due to fundamentally different international environments. Therefore, large-scale national infrastructure projects such as transportation, water conservancy, and electricity have become the primary means for underdeveloped countries to build state power. Nationwide infrastructure can establish direct connections between central governments and grassroots authorities, fostering social networks through universal access and creating cohesive societal ties to balance both power types. For example, the South Korean government's construction of the Seoul to Busan highway in the 1960s became the starting point for economic take-off and a key node in rapid modernisation.

Electricity infrastructure is much more impactful than roads. This is because while highways connect regions, linking central cities to secondary cities and rural areas, electricity connects individual households. The centralised control and decentralised distribution of power generation and transmission also align with the dual requirements of despotic and infrastructural power. The cycle of electricity production and charging, being both an energy commodity and a public good, reflects the dynamic transformation from state power to state capacity.

However, the uneven spatial distribution of infrastructure and the resulting unequal benefits can create crises of legitimacy. French Marxist philosopher Henri Lefebvre summarised this phenomenon as the binding of state power to space, emphasising that the state shapes social relations within spaces, with spaces forming the foundation of state power.[7] In terms of electricity supply, the production of electricity represents the starting point of state power, while the access to electricity represents the endpoint and realisation of state power. Failure to coordinate production and access can lead to power struggles.

Pakistan resembles a rectangular shape, stretching long from north to south and narrow from east to west. The north, blessed with mountains and rivers, is ideal for hydropower development. The south – with vast plains, valleys, and deserts – has rich coal reserves suitable for thermal power. During British colonial rule, two electricity supply centres were built in the north and south of Pakistan. The main power grid and most transmission and distribution lines in Pakistan are operated and managed by the National Transmission & Despatch Company (NTDC). In the southern city of Karachi and its surrounding areas, the power supply is independently operated by the Karachi Electric Supply Company. Furthermore, NTDC has established several regional distribution companies across the country to transmit electricity locally. Pakistan relies on a

single north-south transmission line, while the construction of branch and feeder lines depends entirely on local capacity. Consequently, major cities with greater resources have better distribution networks, while electricity distribution remains inadequate in remote or underdeveloped areas.

Despite significant regional disparities, Pakistan's national policy adheres to the principle of fairness and uniformity in electricity consumption. Pakistan's electricity policy is based on two key principles: first, the 'joint generation' policy, which ensures that all provinces share the country's power generation resources; and second, the 'uniform tariff' policy, which requires consumers across the nation to pay the same electricity rate. To facilitate electricity sharing, Pakistan introduced private power supply companies tasked with transmitting electricity to specific regions and groups. At the same time, the Pakistani government introduced a tariff differential subsidy for certain regions and groups in order to maintain the uniform tariff, which ultimately led to a massive fiscal deficit.[8] Taking the 2010–2011 fiscal year as an example, the federal government provided subsidies amounting to 259 billion Pakistani rupees (approximately 3 billion US dollars in 2011 exchange rates) to the power sector, exceeding 10% of Pakistan's total federal budget.[9]

The failure to achieve universal access to electricity has not only placed immense pressure on Pakistan's national finances but also turned public infrastructure projects into focal points of regional and ethnic conflicts. For instance, the prolonged confrontation between Sindh and Punjab originated with the construction of the Tarbela Dam in 1974, marking the emergence of overt regionalism in Pakistan.

The Challenges of Pakistan's State Capacity

China's lessons for Pakistan extend beyond electricity generation. China has built the world's largest power grid, which is centred around the Three Gorges Dam. Pakistani experts have noted that grid expertise is the CTG's strongest asset, as most power generation companies rarely engage in grid building.

Considering the relatively controllable nature of hydropower resources, flexible electromechanical equipment, and simple grid topology, hydropower stations hold advantages as grid hubs. With the advancement of the CPEC, Pakistan has constructed multiple hydropower stations and implemented cascade development on several rivers within the Indus River basin. Consequently, the transmission and distribution grid must be upgraded to avoid challenges in electricity sales. If the construction of large-scale hydropower facilities represents the concentration of resources to accomplish major tasks, then the transition from constructing power stations to building the power grid is a process of moving from the macro to the micro and linking with local units.

State power embodied in electricity infrastructure has dual attributes discussed earlier: large dams and hydropower stations exhibit despotic power, whereas grids constitute infrastructural power. British colonial rule in the subcontinent focused on establishing despotic power systems while minimising infrastructural power investments so as to preserve the traditional social structures. By 1853, British India had built a 20-mile railway test line, which expanded to 45,000 miles by 1947, making it the world's fourth-largest railway system at that time. Yet, 70% of British Indian railways connected ports to inland raw material production areas – essentially colonial trade corridors – rather than forming an interconnected domestic network.[10] This point-to-point infrastructure exemplifies the power structure of British India. Similar to India's railways, Pakistan's earliest power facilities were concentrated in major cities like Karachi and Lahore, as well as

military fortresses like Rawalpindi, forming the point-to-line connections that define Pakistan's grid. Pakistan inherited the British colonial authorities' power system and its non-standardised infrastructural power features. Since its founding, Pakistan has co-opted local elites and acknowledged their traditional power networks. As for the patronage relationships widespread in Pakistani society, the approach has largely been one of assimilation rather than reform.

As previously mentioned, while Pakistan's electricity subsidies are substantial, the country also suffers from extreme power losses. Between 2005 and 2015, the average transmission and distribution loss in Pakistan's power grid was as high as 20.84%, compared to an international standard of just 7% during the same period.[11] According to studies by the CTG, 50% of Pakistan's electricity consumption is attributed to non-technical losses (electricity theft), while other research estimates this figure to be 30–40%. This severely undermines the revenue of local power generation companies. As per calculations by the CTG, the highest electricity bill collection rate in Pakistan is only 85%.

Such theft rates should be viewed as structural issues rather than regulatory failures. US technological historian Thomas Parke Hughes schematised the expansion of electricity systems from 1880 to 1930 into five stages: invention, technology transfer, system growth, substantial momentum, and planning and transformation.[12] Each stage is led by different actors – for example, the first three stages were driven by inventors, engineers, entrepreneurs, and financiers, while the latter two required involvement from government or public institutions. For underdeveloped countries, the construction of electricity systems often rapidly bypasses the first three stages, failing to foster sufficient technological market momentum. Without corresponding financing mechanisms, technicians, and management expertise, large-scale construction cannot be sustained. Similarly, without robust industrial demand, massive electricity supply lacks customers, rendering scale effects unachievable. Without an expanded electricity market, the transition to public services cannot occur, thereby preventing the realisation of infrastructural state power.

When formal electricity supply fails to deliver public services, electricity theft under informal power structures becomes widespread, tolerated, or even abetted by power officials and grassroots officers – this is often intertwined with partisan and ethnic politics. In Balochistan and interior Sindh, 75% and 64% of electricity supply remains unpaid respectively – this is equivalent to an implicit federal subsidy.[13]

For Pakistan, reshaping the grid equates to rebuilding infrastructural power systems, which requires adjustments to long-standing non-standardised power structures. It is clear that a fragile energy system cannot support the electricity demands of 240 million people. Therefore, the Pakistani government has repeatedly pursued power system reforms and attempted to abolish uniform pricing, but ensuing social protests and livelihood pressures have forced the government to stabilise tariffs. The administration of Prime Minister Shehbaz Sharif made power system reform a priority but efforts have focused on resolving the debts of private power suppliers, with no progress on nationwide grid construction.

If large-scale grid construction is not immediately feasible, are there alternative paths to support Pakistan's electricity supply and residents' electricity rights? Amid escalating geopolitical tensions, are there other avenues for accessing electricity beyond hydropower-grids?

Photovoltaics as a Means of Enhancing State Capacity

If the CTG provides a top-down pathway from river development to national power systems, China also offers Pakistan a bottom-up approach to access electricity through photovoltaics (PV).

Due to frequent power outages, affluent Pakistani households, hotels, schools, hospitals, and others typically rely on diesel generators for emergencies. However, PV panels are gradually replacing diesel generators at various levels of Pakistani society and driving the growth of the energy storage industry. In Pakistan, many affluent households and even new residential areas rely on rooftop solar installations. PVs have also been integrated into the lives of middle- and low-income Pakistanis, with solar facilities visible in informal settlements in Islamabad and Lahore. Traveling through rural Pakistan, one can see simple roadside sheds equipped with solar panels, where people can charge their mobile devices.

In 2024, Pakistan imported approximately 16 gigawatts of PV components, nearly one-third of the country's total installed power generation capacity (45 gigawatts) as of June that year. Of the 16 GW, only 0.63 GW was used for centralised solar, with the rest being distributed PVs. According to a report by Pakistani think tank Renewables First, Pakistan's power generation capacity increased to 46.2 million kilowatts in 2024 with the commissioning of three new solar power plants, raising the share of utility-scale renewable energy in the country's installed capacity from 6% to 7%. Distributed energy resources in Pakistan grew significantly, with net metering capacity doubling from 1.3 million kilowatts in 2023 to 2.5 million kilowatts in 2024, and reaching 4.9 million kilowatts by March 2025.[14]

In Pakistan, PV installations and distributed power generation have begun replacing previous electricity rationing methods. PVs offer a low-cost path to electricity access, particularly for middle- and low-income Pakistanis. Pakistan is naturally endowed with long hours of sunlight, with Punjab province averaging 6.8 hours of sunshine per day, making it ideal for the use of distributed PV systems. Electricity access becomes possible with just a solar panel and a storage battery. This pathway is made possible due to China's industrial capacity, which produces 97% of the world's PVs and accounts for 99% of Pakistan's PV imports.

Distributed PVs have significantly reduced the burden on Pakistan's official electricity services. The public power sector can focus on serving industrial and commercial clients, whose large-scale electricity demand aids the construction of Pakistan's national grid. From a national development and capacity building perspective, PVs are not just clean energy but a tool for strengthening Pakistan's infrastructural power. By lowering the threshold for accessing electricity, the Pakistani state can provide universal access to electricity and facilitate broader economic participation. In Lahore, 95% of farmland has switched to solar-powered water storage. With an average installation capacity of 5–10 kilowatts per household, this can cover an irrigation area of 2–5 hectares.[15] Emerging economic activities, such as social media content creation, also benefit from electricity.

From a technical standpoint, distributed PV power generation directly links electricity supply to end-users, enabling access to rural areas and urban informal settlements. The basic power units formed by distributed PV systems can be quickly interconnected to establish microgrids, which can then be seamlessly integrated into Pakistan's still-developing national grid framework. These foundational units of PV-based grids are not only reliable but also resilient, offering the potential to transform severe rent-seeking and electricity theft issues into regulated price negotiations.

For Pakistani farmers living in traditional village communities and relying on kinship ties for economic activities, the emergence of new social relations will drive the formation of new economic networks. This new integration of space and state power is beneficial for enhancing Pakistan's state capacity.

China as Development Partner and Model

Pakistan's goal of developing the Indus River remains unchanged despite climate change and regional political-economic developments. To address these new challenges, Pakistan seeks diversified and comprehensive utilisation of the Indus River, transitioning from irrigation to integrated power development. Since its founding, Pakistan has viewed the Indus River's holistic development as a crucial tool for nation building. While the construction of large-scale infrastructure has, to some extent, enhanced the credibility of the Pakistani federation, its limited equitability created new controversies.

In the face of geopolitical pressures, Pakistan needs stronger state capacity. Without the benefits of conjunctural opportunities or geographical advantage, the country must cultivate its own social conditions. Pakistan must invest in public infrastructure for both economic development and national capacity building – this aligns with the intention of the CPEC.

China offers the Global South both development capabilities and a model for leveraging economic growth to strengthen state capacity. In the past, greater emphasis was placed on China's role in promoting large-scale public infrastructure projects in developing nations. With the establishment of China's industrial advantages, the role of new technologies in strengthening state capacity should be recognised. The diffusion of new technologies is critical for structural transformation.

The international order has undergone disruptive changes since the end of the World Anti-Fascist War, creating divergent outcomes within the Global South. The importance of state capacity building has now superseded mere economic development, as economic growth must go hand-in-hand with good governance. Pakistan's challenges are not isolated cases, but reflective of broader trends in the Global South. The role of China's hydropower and PV sectors in addressing Pakistan's energy needs underscores the supportive role that Chinese enterprises can play in enhancing the capacities of Global South countries. Enhanced state capacity can be used to improve public welfare, and vice versa. Together, these two dimensions lead to conducive social conditions for the modernisation of nation states.

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Notes

[1] Editor's note: In April 2025, 26 civilians were killed in a terror attack in Indian-administered Jammu and Kashmir. In response, India launched Operation Sindoor, launching missile strikes into alleged terrorist bases in Pakistan.

[2] US Department of State, *Foreign Relations of the United States, 1958–1960, South and Southeast Asia, Vol. XV*, US Government Printing Office (1992).

[3] India and Pakistan (1960). *The Indus Waters Treaty (IWT)*.

[4] Sadaf Taimur, 'India, Pakistan, and the Coming Climate-Induced Scramble for Water', *Salzburg Global* (15 October 2020).

[5] David Lilienthal, *Democracy on the March: The Story of the Tennessee Valley Authority* 《民主与大坝：美国田纳西河流域管理局实录》, translated by Xu Zhonghang, (Shanghai Academy of Social Sciences Press, 2016): 9.

[6] Charles Tilly, 'War Making and State Making as Organised Crime', in *Bringing the State Back In*, ed. Peter Evans, Dietrich Rueschemeyer, and Theda Skocpol (Cambridge University Press, 1985).

[7] Majed Akhter, 'Infrastructure Nation State Space, Hegemony, and Hydraulic Regionalism in Pakistan', *Antipode* 47, no. 4 (2015): 849–870.

[8] Ijlal Naqvi, *Access to Power: Electricity and the Infrastructural State in Pakistan* (Oxford University Press, 2022): 30–31, 2, 78.

[9] Ibid.

[10] Latika Chaudhary, Bishnupriya Gupta et al., *A New Economic History of Colonial India* (Routledge Press, 2016): 141–144, 27.

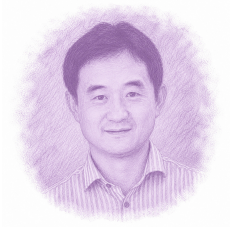
[11] Ibid.

[12] Thomas Parke Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Johns Hopkins University Press, 1988): 14–17.

[13] Ijlal Naqvi, *Access to Power: Electricity and the Infrastructural State in Pakistan* (Oxford University Press, 2022): 30–31, 2, 78.

[14] Renewables First, *Pakistan Electricity Review* (2025).

[15] Renewables First & Herald Analytics, *The Great Solar Rush in Pakistan* (2024).



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