VERRHA RESEARCH

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Submission of Comments on IGCEP to NEPRA

Urgent Concerns Regarding Hydro-Heavy Focus in the Indicative Generation Capacity Expansion Plan (IGCEP) 2025-2035

Summary and Recommendations:

This document presents comments and recommendations for improving the Indicative Generation Capacity Expansion Plan (IGCEP) 2025-2035. While we appreciate the commendable efforts and steps undertaken to address the key gaps found in the previous iterations of IGCEP, we find the plan's continued hydro-heavy focus highly objectionable.

The latest plan envisions adding up to 10,760 MW of new hydropower projects by 2035 – 41 percent of the total new capacity additions and almost a doubling of the current hydro capacity. This trajectory is set to create a catastrophic situation where Pakistan will be locked into expensive, high-risk hydro projects which will command nearly 34% of the generation mix, raising its share by 7 percentage points. Critically, this significantly exceeds the 26 percent combined share allocated to the truly renewable, least-cost, and flexible solar and wind energy projects.

This persistent reliance on hydropower represents an uncritical adherence to the most defective parts of the previous iterations. Continued investments in risky hydropower will derail Pakistan's energy transition, undermining sustainability, affordability and reliability. These mega investments will increase the country's debt, and with increased flood and drought risks, will further increase our ecological vulnerabilities, and fuel conflict around water usage federating units. Massive displacement and resettlement issues impact not only the communities in mountainous areas, particularly in the Swat, Indus, and the Kunhar 'hydropower corridors', but these have long-term and recurring impacts on the downstream and lower riparian communities. Scientific and economic evidence, amply cited in the detailed comments, sufficiently demonstrates that hydropower, whether reservoir, pondage or run-of-river, imposes irreparable environmental damages, coupled with massive hidden socio-economic costs on society. These costs are insufficiently considered in environmental and financial impact assessments of the projects, which are often marred by procedural failures.

This neglect also characterizes the current IGCEP, which has failed to apply the least-cost principle in an adequate and consistent manner. We urge the NEPRA to address these issues before approving the plan. Unless these problems and the externalized costs are fully accounted for and addressed, the objective of providing least-cost, affordable, sustainable and climate-sensitive solutions to Pakistan's energy/power challenges will remain a dream.

We recommend the following immediate and concrete steps:

a. **Financial Transparency:** Release all PC1s of the projects for independent evaluation, and release of the methodology for cost calculations to identify gaps.

b. **Comprehensive Costing:** Increase the scope of 'costing' methodologies to explicitly include long-term, recurring, and cumulative costs, such as the impact of upstream hydro projects on downstream and deltaic communities.

c. **Impact Assessment:** Conduct ecosystem-wide studies of one-time, recurring, and accumulated impacts and climate risk assessment of the planned and ongoing cascade run-of-river projects on main stems and tributaries of the Indus, Swat, Panjkora, Kunhar, and other major mountainous rivers.

d. **Optimization of Ecosystem Services:** Release information on how the competing demands on scarce water resources (for hydropower, coal, agriculture, and urban supply).

e. **Lifecycle and Carbon Footprint analysis:** Conduct assessments of the carbon footprint of the lifecycle of the construction of large reservoir dams, including cost of construction, material-related emissions, methane emissions from reservoirs, and the impact of decommissioning after completion of project lifecycle.

f. **Climate-scenario Modelling:** In light of increased risk of floods, new infrastructure must be built on proper modelling of new and heightened risks. These must be reflected in the costs, by considering insurance costs, rehabilitation and reconstruction costs in case of failure due to extreme weather events.

g. **Pollution and Monitoring:** Conduct detailed studies of the air and water pollutants in all projects, with effective monitoring and public sharing of the data.

h. **Social Safeguards:** Institutionalize the best practice of Free Prior and Informed Consent and disseminate all project related social, environmental, and economic impact assessment in local languages.

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DETAILS AND ANALYSIS

1. The latest Indicative Generation Capacity Expansion Plan (IGCEP) 2025-2035 represents a commendable step towards addressing the key gaps in generation planning. However, we find the hydro-heavy focus of this year's plan highly objectionable. This persistent reliance on hydropower projects for meeting the country's energy needs – to the detriment of variable renewable energy (VRE) sources – remains the chief shortcoming of the current plan, an unenviable carry-over from the previous iterations. At best, it undermines the favorable shifts and advances incorporated in IGCEP 2025 – upwardly revised share of VRE, exclusion of several high-cost projects, revised criteria for committed projects, and simulations of multiple scenarios, to name a few. We believe that this hydro-dominated plan further risks compounding the affordability, sustainability, and reliability of Pakistan's energy sector.

2. We fundamentally question branding large hydropower as 'renewable'. Such classification stands at marked odds with the government's own previous policies, such as one outlined in ARE 2019. The social, political and environmental impacts are exacting tremendous costs from local peoples, human and non-human communities, and exacerbate environmental and climate change issues. Dams are both adversely impacted by climate change, and are indeed a significant contributor to global greenhouse emissions, especially when compared against other renewables like wind and solar.

3. The cost has been and will be borne disproportionately by the most marginalized and poor communities of the nation. It is then important to consider these costs. Proper accounting and transparency may very well lead to the conclusion that research and communities have highlighted for a long time. We worry that if these costs are considered, not only do these projects become financially unviable, but it is clear that they primarily transfer these externalized costs to project-proximate and lower riparian communities of the Indus Valley.

4. We have raised similar concerns in the last three iterations of IGCEP (2021-31, 2022-32 and 2024-2034). Large hydropower and indigenous Thar coal projects remain the cornerstones of Pakistan's energy plans.

5. For instance, in our comments for IGCEP 2021, we pointed out that:

   > "...if these challenges are not sufficiently addressed and alternatives are not fully explored, the shift to hydropower will create a myriad of problems including: worsening the water and environmental crises in Pakistan, increasing water distribution conflicts, destroying river and wetlands ecology, increasing coastal erosion and sea intrusion, and *increasing the risk of severe floods that may cause tens of billions of dollars in damages.*" (emphasis added)

6. For our comments on IGCEP 2022, we wrote:

   > "This year's plan repeats the old mistakes. Touting coal as 'indigenous' and hydropower as 'renewable', the NTDC continues down a path that relies on false and dated solutions despite the presence of better alternatives... [L]arge hydro projects have a history of delays, inflated costs, reduced profits, along with incomplete assessment of the social and environmental impacts. In Pakistani context these are also a politically charged

issue, linked directly to water scarcity and exacerbation of floods. These projects are likely to exacerbate food insecurity and intra-provincial conflict.”

7. Unfortunately, not much has changed in the general trend towards bad decisions, ‘committing’ projects for reasons that defy the ‘least-cost’ rationale undergirding the entire IGCEP exercise. We reiterate our reservations, with regards to the design, technical, economic, social, and environmental problems associated with the committed and anticipated mega projects of IGCEP. We rely on scientific and policy literature to present some of the major issues of climate change mitigation, adaptation, and the Loss & Damage approach to energy development.

8. This is the wrong climate for investments in large dams. Not only will these plans increase our carbon footprint and subsequently make the impact of climate change worse, they are also increasing the environmental and ecological damage to Pakistan’s water system. The government needs to do a better job of including *all* costs associated with large infrastructure projects, including long-term, recurring, and cumulative costs – particularly when it relates to issues of water management, riverine ecosystems, groundwater quality and quantity, and the overall impact on public health outcomes.

IGCEP 2025-35: Outlook and Concerns

9. The IGCEP 2025 carries forward the overall shift from imported fuels to indigenous sources of power generation introduced in the previous iteration, while making some positive adjustments. First, hydropower share in the energy mix, though reduced by four percent from the targeted mix in the previous plan, remains central, rising from 28 percent in 2024 to 34 percent in 2035. Second, the share of variable renewable energy (wind and solar) nearly doubles, increasing from 13.3% in IGCEP 2024 to 27%. Meanwhile, conventional thermal energy sources, particularly fossil fuels, remain significant, projected at 39 percent of energy mix by 2035.

10. The current version of IGCEP projects a share of 27 percent for VRE in the energy mix – almost a doubling of the current share. This increase is both consistent with the IGCEP 2021 and 2022, as well as the Alternate and Renewable Energy (ARE) policy of 2019 which kept the VRE share at 30 percent. It is also a favourable shift from the previous plan of 2024 which had reduced its share to 13.3 percent. The relative and absolute decline of fossil fuel-powered plants such as RLNG, furnace oil, and natural gas is also a promising step that needs to be expanded and deepened further. This general trend of retirement ought to be extended to ‘indigenous’ and imported coal, which continue to pose environmental and social threats.

11. Despite the commendable exclusion of billions of dollars of costly and unnecessary projects – including hydropower schemes such as Kedam-Madyan and Gabral-Kalam projects – the overall plan heavily skewed toward hydropower. Hydropower projects alone account for 46.5% of the total net capacity additions between 2024–2035. Its share in the energy mix is projected to rise to 34 percent, meeting an estimated 48 percent of total energy demand in 2035. The list of committed projects also reflects this lopsidedness: out of 50 projects expected to add generation 17,586 MW of capacity, 29 projects (58%) are hydropower projects, contributing 6255 MW (36 percent) of the increase.

12. The IGCEP 2025 new criterion for "committed" projects – just 10% physical and financial progress – is a step in the right direction, yet it remains overly lenient and discretionary, even if stricter than IGCEP 2024. This lax criteria has allowed several hydropower projects to bypass least-cost optimization and a fair competition with more cost-effective and environmentally friendly VRE projects, leaving the plan's outcomes at odds with the principle it claims to uphold. The least-cost criterion has also been applied inconsistently. While federal projects like Mohmand Dam and Dasu – politically-driven – continue to hold committed status, the plan considers Least Cost Violation (LCV) for Diamer Bhasha. On the other hand, key provincial projects, such as the Kedam-Madyan and Gabral Kalam hydropower projects in Khyber Pakhtunkhwa, are excluded from this 'committed' category and subjected to least-cost evaluation.

13. Most of the hydropower energy will be generated using large dams. While the IGCEP report doesn't list the design specification of the various projects, a quick analysis shows that the committed and candidate projects include large dams[1], such as Tarbela extension, Diamer Bhasha, Dasu, Mohmand, and others. While the report lists several 'run-of-the-river' with, most of the share of additional hydropower generation is from large dams.

14. The report lists some hydropower projects as 'existing' or 'completed' even when these aren't fully operational or have faced damages in recent floods. The Neelum-Jhelum project and Ranolia Hydropower Project, suffered damages during the 2022 floods. Both are yet to be restored and rehabilitated. The severe flooding in the Swat river in June-July 2025 also disrupted construction works on Mohmand Dam, damaging equipment and access roads. The costs of such failures must be considered for all such projects.[2]

15. The IGCEP report justifies this shift to hydropower based on two arguments: carbon emissions reduction, and reliance on indigenous sources of fuel. Evidence from existing hydropower dams in Pakistan and elsewhere in the world shows a different story. Here we outline some of the technical, environmental, social, and economic problems associated with large dams and hydropower.

16. The IGCEP process as a power planning has listed the specific goals, as: "to determine a *minimum cost* strategy for long-range expansion of the power generation, transmission and distribution systems adequate to supply the load forecast *within* a set of *prevailing* technical, *economic* and *political constraints*." (emphasis added, IGCEP 2025, p6). Unfortunately, as we outline in the following sections, many of the large projects, especially hydropower and coal plants are neither least cost, nor attentive to the political constraints particularly when considering the social and economic impact on communities threatened by these projects.

The Problems of Hydro:

17. Large hydropower dams, particularly mega dams with extensive reservoirs, and even those labeled as 'run-of-the-river' but still imposing in scale, have sparked vehement opposition due to

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[1] Using the ICOLD definition of large dams as dams with a height of more than 15 meters.

[2] Javed, F. (Aug 13, 2025). *Mohmand Dam recovers in one week after heavy disruption*. Gwadar Pro. https://gwadarpro.pk/1955563280786685954/mohmand-dam-recovers-in-one-week-after-heavy-rain-disruption

their profound and often irreversible impacts on both the environment and local communities. Despite proponents touting hydropower as a clean energy solution, the reality is far from benign. Here we discuss some of the most well-established findings around the social, environmental, economic, and climatic impact of hydel electricity from large reservoirs *and* run-of-the-river dams.

Climate-related concerns

18. **Large dams are not suitable for current climate context:** The current climate context is defined by extreme weather events. The Himalayan-Karakoram mountain ranges are one of the global hotspots of this change, and experts have predicted extreme weather events, particularly floods with a combination of rapid glacial melt and extreme rains. Large dams are usually built with 100 year flood levels in mind, but given the likelihood of extreme weather these projects may not be feasible. Moreover, large dams generate greater risk by: increasing seismic risk in mountainous areas, reducing the floodplains ability to absorb large flood events, and increasing methane emissions into the atmosphere as a result of still water in the reservoir.

19. **The glacier burst events are on the rise in the mountains:** Another serious risk factor in terms of large hydropower in the mountains is the risk of glacier busts. The glaciers in the Karakoram-Himalaya ranges are hotspots of climate change, melting at a rapid pace and, in some instances, breaking with the potential to cause glacial lake outburst floods. Studies indicate a notable surge in GLOF events since 2007, with approximately 10 such events occurring between 2007 and 2017 alone.[3] There is also evidence of rapid increase in the number and size of glacial lakes over the past decades. Some 88 new glacial lakes have appeared in Gilgit Baltistan since 2000, increasing the risk of GLOFs. The UNDP has identified 33 existing lakes across GB and KPK as susceptible to GLOFS.[4] The recent devastating floods caused by GLOF events in Gilgit Baltistan should be a cause of concern for Pakistani energy planners as we are bound to face similar extreme events in future. Given this reality, will the NTDC explain what type of risk assessment was undertaken to incorporate these new realities?

20. **Hydrocosting and planning should account for the increasing unpredictability of climate change:** Modern best practices in hydropower project evaluation now demand a "bottom-up" approach to Climate Risk Assessments, which goes beyond historical data to model a wide range of future climate scenarios. According to the IMF Pakistan's hydropower fleet is at a particularly high risk from "increased melting of its 7,200 glaciers in the Hindu Kush– Karakoram–Himalayan system with sudden outbursts of water in the glacial lakes stressing in particular the hydropower infrastructure"[5] with attrition of surface and underground waters also stressing hydropower. The World Bank has also recently found that "precipitation changes and declining water

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[3] Hussain, A., Nasab, N., Bano, D., Karim, D., Anwar, W., Hussain, K., & Uddin, N. (2020). Glacier lake outburst flood modeling of Khurdopin glacier lake using HEC-RAS and GIS. In S. S. Chernomorets & K. S. Viskhadzhieva (Eds.), *Debris flows: Disasters, risk, forecast, protection. Proceedings of the 6th International Conference (Dushanbe–Khorog, Tajikistan), Volume 1* (pp. 208–220). Dushanbe: Promotion LLC.

[4] Mazhar, Y., Atif, S., Azmat, M., & Ahmad, S. (2025). Growing glacial lake outburst flood risks in Ghizer District: A Karakoram anomaly region. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, PP*(99), 1–20.

[5] International Monetary Fund. (2023, July 17). *Pakistan: Request for a Stand-by Arrangement—Press Release; Staff Report; Staff Statement; and Statement by the Executive Director for Pakistan* (Country Report No. 23/218).https://www.imf.org/en/Publications/CR/Issues/2023/07/17/Pakistan-Request-for-a-Stand-by-Arrangement-Press-Release-Staff-Report-Staff-Statement-and-536494

availability could damage riverine ecology, impair water security, and affect hydropower production."[6] Independent studies have also shown that when changing seasonality of water systems and transmission system constraints are factored in, hydro reliance threatens the reliability of supply, increasing thermal reliance in turn. Given Pakistan's present energy system limitations, hydropower's seasonal variability could entail delays encouraging the dispatch for Gas and Local Coal and forcing payments to swell by more than PKR 70bn.[7]

21. **Many dam sites have high risk of earthquake:** The Himalyan-Karakoram-Hindu Kush mountain ranges are susceptible to earthquake events, and a number of the proposed dams are being built in areas of AJK, Gilgit Baltistan, and Khyber Pakhtunkhwa (e.g. GoKPK's Balakot Hydropower Project) with active fault lines and which have in recent years seen extreme seismic activity. Dams built in areas of high seismicity pose a very high-risk potential for downstream communities. Studies have also shown that dams with large reservoirs can trigger earthquakes.[8] What is the potential cost of a dam burst due to seismic activity, along with the aforementioned variations due to rapid climate change?

22. **Will large dams be used for flood protection, and how will this influence energy generation:** With the 2025 floods, WAPDA spokespersons and policy experts have proposed dams as a solution, despite considering the patterns of rain and the fact that most of the large dams are being built in areas that were not significantly impacted by the monsoon this year. If the large dams being built in the hydro pipeline are used for flood events, they will not have enough water stored to meet the high summer energy needs. NTDC needs to clarify how these competing goals will be met in terms of the energy plans.

23. **Is the carbon footprint of mega-dams considered?** A common misconception is that dams have a low carbon footprint. Instead, massive emission of Methane from organic matter collected in the reservoirs is also a major source of concern. A robust body of research since 1990 shows that reservoirs, created by dams, are major sources of methane and carbon dioxide, a greenhouse gas which is 80 per cent in trapping heat than Carbon dioxide. Methane is one of the biggest problems with hydropower. It is organic containing dead animals, vegetation and even fertilizer runoff. It carries off downstream and decomposes in the reservoirs. These decaying compounds eventually reach the ocean and chemical reactions can convert methane into carbon dioxide and other harmful compounds. While dams in non-tropical regions, like Pakistan, tend to perform better than fossil fuel based power plants in terms of their per unit methane emission, they are worse than other renewables like wind and solar by a mile.[9]

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[6] World Bank Group. (2022, November). *Pakistan Country Climate and Development Report* (CCDR Series). World Bank Group. https://openknowledge.worldbank.org/entities/publication/614ddc2b-ca31-53c9-b59c-6bf12a56d336

[7] LUMS (2022). Pakistan Electricity Outlook 2022. https://lei.lums.edu.pk/index.php/pakistanelectricity-outlook-2022/

[8] Moustafa, A. (2015). Earthquake Engineering: From Engineering Seismology to Optimal Seismic Design of Engineering Structures. BoD – Books on Demand.

[9] https://insideclimatenews.org/news/14072023/todays-climate-hydropower-methane-clean-energy/

Financing Issues

24. **Large Dams are Uneconomic:** Multiple studies have shown that large infrastructure projects, and hydropower projects in particular suffer from severe cost underestimation. Bent Flyvbjerg, Professor of Major Programme Management at the Oxford Business School, has meticulously shown that large infrastructure projects – especially large dams --consistently underestimate or completely ignore costs of large projects, and overestimate their benefits. A recent study conducted by a team at Oxford University (Ansar et al, 2014) demonstrated that cost estimates of large dams are "systematically and severely biased below actual values." Projects run into schedule and cost overruns that can range from 150% to 200% of the estimated costs. Projects that are larger have bigger cost overruns. Furthermore, costs are usually higher in developing and underdeveloped countries. If these cost overruns are applied to the case of many of the hydropower projects proposed in the IGCEP 2025-2035, we can expect the capital cost component of per unit electricity to be double. For instance, Diamer Bhasha dam, estimated at 14 billion USD, could cost between USD 20 billion to up to USD 30 billion.

25. **High cost of the hydro pipeline:** Estimates show that the total cost of the hydro pipeline, without including the social and economic costs listed above, can rise from current estimates of USD 31 bn to 49-61 bn. This will likely impact per unit tariff, even if these projects ignore the social and economic costs.

26. **Long gestation periods and difficulty scaling up:** Large infrastructure, in particular dams and hyd el projects don't produce any electricity until various components are completed. Unlike Wind and Solar these projects also don't scale very well. In short, there is limited flexibility once we have committed to large hydro as our central response to the energy crisis.

27. **Comparatively higher transmission costs of hydropower:** Hydropower evacuation is comparatively more expensive, costing 3 to 10 times as solar, thermal and cross-border projects. Much of this is due to terrain (mountains, river crossings, access roads) unaccounted for in planning. Hydropower projects account for some of the largest single transmission investments in NTDC's pipeline. From the Revised Transmission Investment Plan alone, over ~USD 0.95 billion is allocated to major hydro evacuations such as Dasu, Suki Kinari, Kohala, Mahal, Tarbela 5th Extension, and Mohmand. This points to the need of accounting for these transmission costs in tariff-determination process.

28. **Only 15% of the planned capacity will come online in time:** Recent research on the IGCEP hydro pipeline by The Institute of Energy Economics and Financial Analysis (IEEFA) shows that 51% of the projects haven't reached financial closure, and physical construction has begun on only 39% of the projects. Out of these, IEEFA notes that only 15% of the planned capacity will come online in time. This leaves obvious questions about the heavy investment in hydropower given its history of delays and cost underestimates.[10]

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[10] Pakistan's vast hydropower pipeline at risk of not being materialized, https://ieefa.org/resources/fact-sheet-pakistans-vast-hydropower-pipeline-risk-not-being-materialized

Social, Cultural, and Political Costs of Dams

29. **The social costs of dams are massive:** Beyond the added risk and cost overruns, dams also incur large social costs. These occur primarily in terms of displacement and loss of livelihood. These costs are also severely underestimated in the IGCEP 2025-35 calculations. The World Commission on Dam (WCD), established by the World Bank, governments, and civil society actors in 1997, conducted a comprehensive study of large dams and found that global dams displaced about 40-80 million people by year 2000 due to drowning in the upstream areas.[11]

30. **Downstream displaced groups are overlooked:** Studies estimate that downstream displacement due to loss of ecology and livelihoods can be upwards of 472 million people with conservative estimates.[12] This means that the downstream loss of livelihood can be of the order of ten times of the upstream displacement costs. The cost of resettling the displaced must also be reflected in the plans, but is ignored by the EIA and SIA documents. In the context of Pakistan, the WCD conducted a case study of the Tarbela Dam and found that planners in Pakistan have only considered the social impact in the reservoir area of the dam, but not on the downstream areas.[13] Estimates show that by 2000, the total downstream displaced in Pakistan were about USD 16 million people.[14] However, these numbers must have gone up significantly in the past 25 years. These ignored costs are borne by communities, and indirectly by the national exchequer through loss of livelihood and potential revenue through taxation.

31. **Historically vulnerable groups in remote regions are being marginalized further:** A wave of planned and ongoing hydropower projects in remote areas is reinforcing the systematic marginalization of vulnerable groups, including indigenous peoples, cultural and linguistic minorities. In Swat, small indigenous communities such as the Torwali and Gawri already subjected to social, cultural, and linguistic domination by mainstream society – now face additional risks of displacement and dispossession due to a planned cascade of projects on Swat River Basin. Beyond land acquisition, tunneling and water diversion for run-of-river projects are depleting water sources, drying up springs and streams, and rendering common-pool resources such as small hydel stations and traditional watermills inoperable. These disruptions have cascading effects: agricultural losses are driving food insecurity, while displacement and migration are eroding cultural practices and weakening social cohesion.[15]

32. Let us spell out **the social cost of dams recorded in the past two decades**: Dams crush the local plants and animals by modifying their environment. For humans, the blasting and tunneling in

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[11] WCD. (2000). Dams and Development: A new framework for decision-making: The report of the World Commission on Dams. London and Sterling, VA: World Commission on Dams.
[12] Richter, B. D., Postel, S., Revenga, C., Scudder, T., Lehner, B., Churchill, A., et al. (2010). Lost in Development's Shadow: The Downstream Human Consequences of Dams. Water Alternatives, 3(2), 14–42.
[13] Asianics Agro-Dev. International (Pvt) Ltd., & WCD. (2000). Tarbela Dam and related aspects of the Indus River Basin Pakistan. A WCD case study prepared as an input to the World Commission on Dams. Cape Town, South Africa: World Commission on Dams. Retrieved August 10, 2017, from http://s3.amazonaws.com/zanran_storage/www.dams.org/ContentPages/1311315.pdf.
[14] Goodland, R. (2010). Viewpoint – The World Bank Versus the World Commission on Dams. *Water Alternatives*, *3*(2), 384–398.
[15] Torwali, Z. (2025, September 19). Who pays the price for hydropower in Swat? The Friday Times

the construction process leads to landslides, sinkholes, drying up of residents' water sources, and cracked foundations in local houses. On a macro level, people lose farms and businesses. The displacement forced by dams promotes poverty. While it is argued that the negative effects of displacement can be countered with monetary compensation, there are major flaws in the design of financial compensation for the displaced. The compensation is tied with land and asset ownership and documentation. In Pakistan, a majority of the population that lives in the vicinity of dams struggles with poverty and landlessness. They have no means to access just compensation. Lastly, locally, the dam-induced displacement is linked to rural-urban migration, crisis of livelihood, downward pressure on wages, labor and economic informality, stretch on urban resources, and extreme social and financial distress for the displaced, who usually find accommodation in the slums. There have been documented cases of depression, domestic violence, disease and even suicide among the deltaic people displaced in Sindh.[16]

33. **Dams in Pakistan are a big source of water conflicts:** The large dam based hydropower systems create conflicting demands between power generation, irrigation, and maintaining ecological flows for sustainable ecosystems, especially in the downstream area. We have seen this type of conflict emerge repeatedly with the Indus River System Authority (IRSA) and WAPDA at odds during the monsoon months regarding maximum water storage for later irrigation purposes or maximizing hydropower to meet summer demands by releasing maximal water. Unfortunately, environmental flows and downstream ecological communities are not considered a party in these debates, particularly riverine, deltaic, and coastal fishers and land users. Global initiatives and scientific communities have included the ecosystem users beyond energy users and agriculturalists in their stakeholders, with decommissioning and reoptimization of existing flows to meet all these various demands. Are the political, social, and economic consequences being fully considered as Pakistan moves towards further reliance on hydropower, thus increasing the stakes of some while undermining others'.

34. **Lower riparian provinces are also party to this energy planning:** Unlike wind and solar, water is a common-pool resource that, in its current uses in Pakistan leaves little leverage for dams relying on seasonal storage. Pakistan has a long history of water conflict at the international and sub-national levels. In particular, the province of Sindh and the Indus Delta region has seen declining flows over the years, which has added to long-standing grievances. Since most of the hydropower projects will be constructed in KPK or AJK, the gains from any tariffs for these areas are unlikely to be evenly distributed. In fact, Sindh is likely to bear most of the environmental and social cost of these hydropower plants.

35. **Transmission for hydropower leads to centralization and inter-provincial conflicts:** Hydropower development often reinforces centralization in planning and decision-making, fueling political rifts between federating units. This dynamic is particularly visible in transmission planning and expansion, where provinces such as Khyber Pakhtunkhwa (KPK) lack the capacity to establish independent transmission networks. As a result, they remain reliant on the National Transmission and Despatch Company (NTDC) for power evacuation. The recent dispute between the Pakhtunkhwa Energy Development Organization (PEDO) and NTDC over transmission infrastructure illustrates this tension. NTDC's reluctance to prioritize evacuation of power from

[16] Hadi, Abdul, "Dams and Displacement in Turkey and Pakistan", European Journal of Economics and Business Studies, Vol 3, Issue 2, https://revistia.com/files/articles/ejes_v3_i2_17/

hydropower projects in KPK has led to repeated delays and cost escalations, exacerbating provincial grievances.

Environmental Costs

36. **Dams destroy downstream ecology:** The costs of large dams are not only limited to displacement, but the environmental impact of hydropower dams are widespread and well documented. Hydropower impacts downstream river ecology by altering the seasonal flows and by potentially stocking and diverting river flows in the Indus Basin Irrigation System. Sediment trapping is a well-recognized phenomenon and lack of nutrient supply to flood plains, deltas, and wetlands severely depletes the biota and endangers large numbers of animal and plant life. While large dams are the biggest culprits, even small disruption in seasonal flows can have severe impact on fish migration patterns, which will incur economic and social costs for downstream and deltaic fishing communities.

37. **Hydropower will severely damage an already declining Delta:** A study conducted by NASA shows that the Indus Delta is under severe stress due to both climate change and upstream water uses, uses that include irrigation and hydropower use.[17] The consequences of these are alarming, as demonstrated by a recent report by researchers based at the Mehran University of Engineering and Technology, Jamshoro: the Indus Delta is reduced to 8% of its historic size and loses about 200 square km of land each year to coastal erosion; sea intrusion has caused water up to 100 km inland to turn brackish.[18] As per the study, the Water accord of 1991 allocates 10 MAF to the Indus Delta, but it has only received 1 MAF of water during 2018-2019. Water shortages in the Indus Delta have resulted in ongoing protest. While hydropower may not ostensibly 'divert' and 'consume' additional water, the storage of water during high-flow seasons is likely to cause further decreased flows. The Delta, once with 17 active creeks, now only sees seasonal water in Khobar and Khar creek. As per the NASA study, 960 sq km of land was lost between 1992 and 2000 due to reduced flows, primarily attributed to water shortages in the upstream projects. It is necessary to address these concerns in the hydropower centric energy plans.

38. **The cost of biodiversity loss and migration:** In line with the previous comment, the loss of delta linked to hydropower storage and diversion will cost Pakistan in terms of biodiversity loss and migration. The Indus Delta contains 19 Ramsar sites (wetlands) that are considered vital for the ecology and environment of Pakistan's coastal areas. Many fish species that are an important source of livelihood for the people are going extinct: this includes famous estuarine fish locally known as *palla,* and lobsters. The important delta crop of red rice has also disappeared. The mangroves are also in decline, which provided a wall against cyclones and floods in the coastal belt. These forests and wetlands are also excellent sinks for GHGs. Consequently, about 1.2 million people have already migrated out of the delta, which will add pressures and economic limitations in large urban centers of Karachi and Hyderabad. Can Pakistan continue to ignore and afford these losses?

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[17] Coleman, J. M., Huh, O. K., & Jr, D. B. (2008). Wetland Loss in World Deltas. Journal of Coastal Research, 24(sp1), 1–14.

[18] Siyal, D. A. A. (2018). Climate Change: Assessing Impact of Seawater Intrusion on Soil, Water and Environment on Indus Delta Using GIS and Remote Sensing Tools Final Report 2018, 149.

Unreliable and Risky Projects

39. **Hydropower is an unreliable source of energy generation:** The notion that hydropower provides a cheap solution to Pakistan energy needs is absurd, and not supported by evidence. The decline in hydropower output due to climatic factors like droughts and extreme weather patterns poses significant risks to energy security and environmental sustainability. In 2023, countries such as China, India, Turkey, and Ecuador experienced a notable reduction in hydropower production, leading to a shift towards fossil fuels to meet electricity demands. Climate phenomena like El Niño have exacerbated water scarcity, impacting large dams' ability to generate power. For instance, both the US and China saw declines in hydropower output due to water shortages caused by weather anomalies. Furthermore, the dual impact of climate change, manifesting as both droughts and floods, highlights the need for more interconnected grids to balance regional energy supplies. Extreme weather conditions like floods and their consequences damage the assets of hydropower. For example in 2017 landslides due to higher precipitation resulted in the shutdown of the Callahuanca hydro plant in Peru. The report of IAE assesses climate impacts on 370 hydropower plants by the end of the century in 13 Latin American Countries. These hydropower plants account for 87% of installed capacity. This study shows that the hydropower capacity is projected to decrease due to erratic climate conditions and can have negative implications for electricity security in Latin America. Hydropower is responsible for 50% of electric production in Costa Rica, Peru, Brazil, Uruguay and Venezuela. It even exceeds 70% in Panama, Ecuador and Paraguay.[19] In short, Hydropower is susceptible to climatic fluctuations underscores the necessity of diversifying energy portfolios and investing in grid resilience.

40. **The run-of-river 'mislabeling':** As mentioned above, the IGCEP 2025 lists several 'run-of-river' based hydropower projects, ostensibly to support the claim that many social and environmental costs are minimized. As per the European Network of Transmission System Operators for Electricity, run-of-the-river hydropower is distinguishable from dam or ponding hydropower plants, where the former has natural flows while the latter do not. It is important to clarify the criteria being used to label some hydropower plants as run-of-river, whether these have significant reservoirs or even an upstream large dam. The construction of dams for 'run-of-river' hydropower also makes sense in the context of the rivers with variation in seasonal flows, which is the case for most rivers listed in the hydropower plans, including the Indus, Jhelum, Kunhar, Swat, and Panjkora rivers. It appears that the label of run-of-river is used to 'greenwash' large hydropower dams. Moreover, the cumulative effect of many small run-of-river plants – especially repeated diversions and interruptions of rivers in cascade projects – can be as far-reaching as large-dams, requiring consideration in Environmental Impact Assessment (EIA) studies.

41. **Ecological impacts of run-of-river projects – small or medium – are comparable to those of large-scale dams:** Far from being cheap, clean, and environmentally-friendly, widespread utilization of small run-of-river projects could cause the same ecological and social impacts, as large-scale hydropower projects. Barriers such as weir structures and water diversion through tunnels result in river fragmentation, reduced biodiversity, as well as obstruction of flow of

[19] https://www.iea.org/reports/climate-impacts-on-latin-american-hydropower

sediment, nutrients and fish species.[20] From a community perspective, water depletion downstream of the weir, deterioration of water quality[21], and hydrogeological changes, especially in underground water regimes, are the most significant impacts. Notably, underground construction involving blasting/excavation activities of project components such as tunnels and power stations can cause slope failure and landslides, as well as depletion of springs,[22] which are critical to sources of water supply for agriculture and domestic needs. This puts the food and water security of the local community at jeopardy. Depletion of river beds over long distances also alters microclimatic conditions. These cumulative, basin-wide impacts must be considered for the ongoing cascade projects on Indus, Swat, and other rivers.

42. **Has NTDC incorporated the cost of evolving, dynamic risk of the proposed large and small dams?** Traditional risk assessments often assume the stability of factors defining risks, but such traditional risk assessments are unviable in the context of climate change and human-disturbances in the river basin.[23] Dam risk is susceptible to evolution over time and already existing water and land use patterns. Given that these variations are likely to impact the entire system of water management in Pakistan, would NTDC please explain how these varying risks are estimated and whether these are included in the cost estimates of per unit electricity?

The High-cost of "good" Dams: Specific examples

43. The opacity of **tariff calculations on WAPDA's hydro projects** is a clear cause for concern and belies all principles of transparency, accountability, and least-cost principles at the heart of the IGCEP exercise. Here we discuss some of the major ongoing, recently completed, and even legacy projects to give some analysis of their true costs. Wapda as the main 'owner' of large dams in Pakistan, started offering 'bulk rates' by approval through NEPRA starting 2004, which are calculated on the basis of: Operating & Maintenance costs, including salaries, allowances, and housing grant schemes, apart from replacement and repair of power plant and dam components, and the cost of 'disasters' and 'damages', increased cost of fixed assets, and debt financing costs. To these, we add additional carbon, social, and environmental costs that are externalized and overlooked in the various costing models.

The Troubled Legacy of Tarbela Dam

44. Largely touted as one of Pakistan's biggest, best, and exemplary dams, the **Tarbela dam** is often viewed as a 'model' development project. However, analysis of the various costs of **Tarbela Dam** and its ongoing extensions shows that the dam exacts a heavy cost on Pakistan's people and revenue base.

[20] Anderson, D., Moggridge, H., Warren, P. and Shucksmith, J. (2015), The impacts of 'run-of-river' hydropower on the physical and ecological condition of rivers. *Water Environ J*, 29: 268-276.

[21] Kuriqi, Alban & Pinheiro, António N. & Sordo-Ward, Alvaro & Bejarano, María D. & Garrote, Luis. (2021). Ecological impacts of run-of-river hydropower plants—Current status and future prospects on the brink of energy transition. *Renewable and Sustainable Energy Reviews, Elsevier*, vol. 142(C)

[22] Himdhara Environment Research and Action Collective. (June, 2019). *The hidden cost of hydropower: Environmental hazards and risks of tunneling, excavation and construction in run of the river hydropower projects in Himachal Pradesh*.

[23] Milly, P. C. D., Betancourt, J., Falkenmark, M., Hirsch, R. M., Kundzewicz, Z. W., Lettenmaier, D. P., et al. (2008). Stationarity Is Dead: Whither Water Management? Science, 319(5863), 573–574.

45. The Tarbela Dam Project (TDP) was constructed as part of the Indus Basin Projects together with Mangla Dam and associated infrastructure connecting the Indus tributaries. TDP originally included two power tunnels and two irrigation tunnels on the right side of the dam (at Tunnels 1 to 4) and one irrigation tunnel (at Tunnel 5) and two spillways on the left side of the dam. The expansion of Tarbela dam was designed in stages. In 1980, the first four units were added on Tunnel 1 with an installed capacity of 700 MW. The second extension increased this to 1,750 MW in 1985 through the addition of 6 units to Tunnel 2. The third extension, adding 3 units of 432 MW in 1993, increased capacity to 3,478 MW. In March 2012, a fourth extension was approved to install a power plant of 1,410 MW on the fourth tunnel. The power plant became operational in 2018, increasing the dam's installed capacity to 4,888 MW. A fifth extension under implementation will finance the installation of a plant of 1,410 MW on Tunnel 5 and a 50-kilometer transmission line to transport electricity to the national grid. Once completed, the total capacity of Tarbela will be 6,298 MW.[24]

46. Given the multipurpose nature of the dam, initial planning through the 1960s viewed 75% of the benefits coming from irrigation storage, and only 25% from hydropower. This World Bank funded project is touted as a great success. In 1985, the WB estimated that Pakistan was earning an economic return of 12.5% on the investment in Tarbela for USD 1.497billion, which is about USD 187 million, or USD 1.7 billion in today's prices.

47. Multiple studies of Tarbela's good and adverse impacts are available. While comprehensive environmental and social impact assessments were not carried out during the design and construction of the dam, the 2000 report by the World Commission on Dams (WCD) shows that the dam had numerous adverse impacts, particularly in the downstream region. In the 'barrage areas', ostensibly utilizing Tarbela's stored water, while irrigated land and revenue increase, these areas saw large-scale deforestation, increase of diseases, landlessness, and severe adverse impacts on the livelihoods and lives of fisher, boaters, basket makers, and pastoralist communities. In the Delta, the dam is linked to severe water shortages, coastal erosion, decline in mangroves, and large-scale migration.[25] Increase sugar cane cultivation in Thatta and Badin due to canal diversions, but increased disparities in water distribution; large scale out-migration from the delta. The WCD lists cost overruns at 50-81%, and while it points to the benefits of hydropower and irrigations, it also refers to widespread dissatisfaction with the upstream displaced communities.

48. The major cost of Tarbela pertains not only to the carbon footprint of the reservoir lake and lost ecological services responsible for carbon sequestration, it also has a huge impact due to silt trapping which results in erosion of the Indus Delta. The total accumulated loss in the Indus Delta due to coastal erosion and sea intrusion, is estimated to be around USD 50 billion in current prices.[26]

[24] Tarbela Fourth Hydropower Extension Project (T4HP). (2020). World Bank. Retrieved April 2, 2024, from https://www.worldbank.org/en/news/factsheet/2020/02/25/tarbela-fourth-hydropower-extension-project-t4hp

[25] The WCD study points to the difficulty in isolating the Tarbela dam effect as it is part of the larger Indus Basin Irrigation System.

[26] Abbas, H. (2024). *True Cost of Hydropower in Pakistan: Case Studies: Cost of Hydropower from Tarbela and Neelum-Jhelum Hydropower*, p22

49. The inflated costs of Tarbela, as per independent study, show any claims of ‘cheap’ and renewable hydro-power as fundamentally flawed. As per WAPDA's report, the total energy output at Tarbela during this period amounts to 534 TWh. On average, Tarbela generates 11.61 TWh annually, with reported losses of 18.1% (NTDC 2023), resulting in 9,651 million kWh delivered to consumers each year. The current installed capacity stands at 4,888 MW. This is against the direct costs of Tarbela, which are estimated to be about USD 16 billion.[27] Add to this financing cost of about 124% of direct cost, and we get a figure of approximately USD 20 billion.[28] The O&M costs are estimated to be USD 2.15 billion.

50. Reservoir emissions from large reservoir dams are an important factor in classifying hydro as ‘renewable energy’. Tarbela’s carbon footprint is immense. With construction, reservoir emissions, and the lack of carbon sequestration due to deforestation in project-proximate areas as well as the Indus delta and riverine tracts have given estimates of over 280 million tons of carbon footprint, with its social costs due to climate change impacts around USD 50 billion. [29]

51. Including all the various costs associated with Tarbela dam, the cost of one unit of energy supply over the lifecycle of the Tarbela dam is about USD 0.192, or about **PKR. 53.61 per kWh**.[30]

The Neelum-Jhelum Disaster

52. The recent ‘failure’ at the Neelum-Jhelum Hydropower Plant (NJHP) is an important case when considering the future of the ‘run-of-the-river’ hydropower projects. The 969 MW project had already faced delays- proposed in 1987 with a cost of PKR 15.25 billion, but construction only began in 2008. The project proved difficult to finance, eventually receiving two loans of a total of over USD 1 billion from Chinese investors, an increase of about 600 percent than the initial estimates.[31]

53. The project has suffered severe design failures that have prevented its full operation since it was ‘completed’ in 2018. This 60m tall and 125m long dam has a reservoir of about 8 million cubic meters, and it was expected to generate 5,150 GWh (gigawatt hour) per year at the levelised tariff of Rs 13.50 per unit for 30 years. However, the project was shut down in July 2022 with cracks appearing in one of the tunnels, and investigation of the failure is still under way.[32] Two

[27] c.f. Abbas (2024) *True Cost of hydropower*, p19 The Tarbela Development Fund established in 1968, at 2024 prices, amounts to $1.36 billion, with $324 million remaining from IBDF, $498 million from the World Bank and capital-exporting countries, and a PKR equivalent of $675 million. The 4th extension cost $1.261 billion in 2024, valued by the World Bank (914 million in 2012). The 5th extension, at current prices, amounted to $1.09 billion, with $826.1 million from AIIB, $300 million from the World Bank, WAPDA's 14% contributing $114 million, and NTDC's 1% contributing $8 million.

[28] ibid. The financing cost is $19.8 billion, which is 124% of the $15.96 billion direct cost. The financing assumptions are based on average lending rates ranging between 6.02% to 9.62%, conservatively estimated at 7.5% for repayment over a 25-year period. This is comparable to the Asian Development Bank's loan for the Ghazi Barotha Project, which carried a 14% interest rate over 25 years (ADB 2005). This method results in a financing cost equivalent to 124% of the principal amount, as illustrated by the example of financing $1 billion at a 7.5% interest rate compounded annually over 25 years, totaling around $1.24 billion.

[29] ibid p11

[30] Abbas, 2024, p17

[31] Isaad, H. (2022). *To Build or Not to Build: Keeping Pakistan’s Hydropower Reliance in Check*. IEEFA.

[32] Ahmad Ahmadani, “Fault behind closure of 969 MW Neelum-Jhelum plant remains unclear”, Pakistan Today, July 19, 2022

turbines were shut due to reduced pressure in the tunnel in early April, 2024 within a week of the project recording full capacity generation for the first time. By May 1, 2024, the dam was shut down as the two remaining and functional turbines failed in the headrace tunnel of the 'run-of-the-river' dam. Recent news reports show that the project will require major works for repair, which will add another two years before the dams can be functional and provide the promised 'cheap' and 'renewable' energy.[33]

54. While the **benefits are awaited, the costs of NJHP are already being paid** by local populations and electricity consumers in Pakistan. The project has a hefty cost of USD 5 billion, inflated 500% from early estimates of USD 40 million (or USD 1 bn in current prices) only, owing to design failures and increased cost of financing due to delays.

55. The social and environmental impacts of the NJHP project are not only starkly evident, these have led a massive river and city defense movement in Kashmir. Located merely 42 km north of AJK's capital, Muzaffarabad, this dam has led to protests by citizens of AJK, who already host grievances against WAPDA, dating back to the Mangla Dam era, particularly regarding royalty and water usage charges. Despite their significant contribution to electricity production, locals endure frequent power cuts, compounded by concerns over WAPDA's lack of formal agreements prior to initiating power projects. These grievances culminated in protests, notably against river diversion for the Neelum-Jhelum and Kohala hydropower projects. Fears of the Neelum River drying up prompted initial outcry in October 2017, with subsequent protests intensifying as the Neelum-Jhelum project operationalized in August 2018. The Darya Bachao Muzaffarabad Bachao movement emerged, demanding the rejection of specific tunnels and the maintenance of adequate water flow in the Neelum River. Despite assurances from the Prime Minister, protests persisted, driven by concerns over governmental neglect and the adverse environmental and humanitarian impacts of river diversion. Former Assembly member Raja Abrar highlighted the disproportionate effects of river diversion on livelihoods and the environment. The "Save Rivers Save Muzaffarabad Committee'' organized strikes, advocating for governmental accountability and environmental preservation. The resistance against river diversion underscores the community's steadfast determination to protect their natural resources and collective well-being.

56. The official **tariffs** of the project have also been revised several times due to these additional costs. The completed project is expected to generate 5,150 GWh per year, initially at the levelised tariff of Rs 13.50 per unit for 30 years. This was revised several times to PKR 20 per unit in 2016,[34] with WAPDA asking for revising these tariff's, refused by NEPRA.[35]

57. Independent research on the costing tells a different picture, with tariffs of over PKR 50 per unit. With direct costs of about USD 5.47 billion, with financing about USD 6.3 billion, O&M of USD 4.6billion, social costs estimated at USD 7.42 billion, local environmental impact of USD 2 billion,

[33] Naqash, T. (2024, May 17). PM orders probe into faults at key hydropower project. *DAWN*. https://www.dawn.com/news/1833997

[34] Khalid Mustafa. (2016, November 21). Neelum-Jhelum project's electricity to cost Rs20 per unit. *The News International*. https://www.thenews.com.pk/print/166564-Neelum-Jhelum-projects-electricity-to-cost-Rs20-per-unit

[35] Naqshbandi, A. M. (2022, July 20). NEPRA Rejects WAPDA's Request to Increase Tariff for Neelum-Jhelum Hydro Project. *ProPakistani*. https://propakistani.pk/2022/07/20/nepra-rejects-wapdas-request-to-increase-tariff-for-neelum-jhelum-hydro-project/

and cost of risk of failure (in terms of insurance premium) about USD 1 billion, and cost overruns, the dam is projected to cost a whopping USD 26 billion.[36]

58. The time and cost overruns, the cost of financing, and social costs of Neelum-Jhelum are alarming. The primary drivers of increased generation costs for the Neelum-Jhelum Hydropower project are delays, financial expenses, and social impacts. Seismic activity poses the most significant threat, yet public awareness of its hazards is lacking. While the dam is engineered to fail under specific circumstances to safeguard major infrastructure, the valley inhabitants lack both insurance coverage and access to public emergency plans.[37]

Dasu, Bhasha, and other dam dilemmas

59. These lessons are not only applicable to legacy and newly completed dams, like Tarbela and Neelum-Jhelum, but equally to some of the largest committed dam projects, such as Dasu dam..

60. Consider some estimates on the cost of **Bhasha dam**. The construction of the Diamer Bhasha dam, with its vast reservoir requiring immense amounts of steel and concrete, poses significant carbon costs. Concrete production alone contributes to global CO2 emissions, while the production of steel further exacerbates its carbon footprint. The dam's operation, without methane capture, is estimated to emit CO2 levels comparable to the most polluting coal plants. Additionally, the dam's ecological impact on the Indus delta, particularly on mangrove forests, adds to its carbon footprint. Despite claims of cost-effectiveness, historical evidence suggests massive cost overruns for similar projects in Pakistan, with the Diamer Bhasha dam already experiencing significant delays and budget increases. Estimates put the **total societal cost, factoring in financing and social cost of carbon, at over USD 70 billion**, rendering the current tariff unsustainable for the project's economic viability in the long term.[38]

61. The other flagship dam, **Dasu Dam**, which is touted as a game-changer, recently received an additional USD 1 billion grant, for a total cost estimate of about USD 4.695 billion, expected to generate 8058 GWH after phase I, with eventual target capacity of 4,320 MW and 21,485 GWh after all four phases are completed.Originally appraised at Rs. 479 billion, the official project costs has ballooned by 240 percent to Rs. 1.6 trillion billion ($6.2 billion) due to chronic mismanagement. This makes it the most expensive hydropower project in the country's history.[39] The project is now consuming 14% of Pakistan's entire public sector development budget.

62. The Dasu Hydropower Project has been marred by a lack of procedural transparency and governance failures, as evidenced by tailored pre-qualification criteria for procurement bids and associated tender documents, allegedly under orders from the World Bank. The selection of

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[36] Abbas, H. (2024). *True Cost of Hydropower in Pakistan: Case Studies: Cost of Hydropower from Tarbela and Neelum-Jhelum Hydropower, p19-22*

[37] Abbas, H. (2024). *True Cost of Hydropower in Pakistan: Case Studies: Cost of Hydropower from Tarbela and Neelum-Jhelum Hydropower*

[38] Abbas, H., & Hussain, A. (November 5, 2021). Opinion: Pakistan's Diamer Bhasha dam is neither green nor cheap. *The Third Pole*. Retrieved November 10, 2021, from https://www.thethirdpole.net/en/energy/pakistans-diamer-bhasha-dam-neither-green-nor-cheap/

[39] Rana, S. (April 12, 2025). *Dasu project cost surges to Rs. 1.7 tr*. The Express Tribune. https://tribune.com.pk/story/2539393/dasu-project-cost-surges-to-rs17tr

contractors found to be in violation of qualification requirements reflects systemic problems with project oversight.[40]

63. Moreover, the environmental costs associated with large-scale hydropower projects, such as high reservoir emissions, downstream ecological impacts, and forced displacement of local communities, undermine the project's economic and environmental sustainability. Geological risks, including seismic activity and Glacial Lake Outburst Floods (GLOFs), pose threats to the project's long-term viability. Additionally, the project exacerbates political tensions between upper and lower riparian provinces, potentially leading to conflicts over water resources and undermining national cohesion and water security.

64. Despite the Dasu project being deemed a "low cost, non-carbon RE", the Environmental and Social Assessment conducted in 2014 for the project clearly states that emissions worth 4500 tonnes of carbon dioxide and 38 tonnes of methane are to be expected from the project annually.[41] World Bank environmental and social risk ratings for the project have remained high throughout,[42] and multiple forms and instances of environmental damage have been reported, including, damage from quarries near the project site, impacts on water quality and discharge downstream, as well as significant deforestation and loss of biodiversity such as the western tragopan birds.[43] Resettlement of displaced populations further north is predicted to put increased pressure on land resources and threaten local forests and wildlife. Site preparation at the reservoir and resettled lands have threatened an estimated 21000 individual trees, including 2980 species of fruit and medicinal varieties, with local stakeholders losing access to important sources of food.[44]

65. The problem of forced displacement is endemic to World Bank sponsored projects – especially large hydropower projects – and Dasu in particular appears to have compounded the problem greatly. At least around 7000 individuals have been forcibly displaced and/or resettled, with 34 local villages being abandoned and 353 acres of agricultural land lost. Many stakeholders who have been forced to relocate have reported that not only were they excluded from a direct land compensation (despite being entitled), but that the true costs of their lands have been severely devalued by the applied index. Associated losses such as income from grazing or agricultural land, along with commercial assets such as shops and hotel buildings, simply have not been recorded or taken into consideration. According to the latest Implementation Status and Results Report, out of the community stakeholders involved in World Bank consultations, only 25% had their suggestions actually taken into account.

66. Preliminary costing analysis on **Dasu Dam** shows that the **current official direct costs are about USD 4.9 billion**, financing costs expected to be at least USD 1.8 billion over a 25 year period, and about half a billion for security and decommissioning costs. These costs will be higher if we consider risk of dam failure, carbon costs of construction and deforestation. Using comparative

[40] Ghumman, M. (2024, April 25). NTDC bars CE (DTLP) from discussing tender of Dasu-ISW. *Business Recorder*. https://www.brecorder.com/news/40300218
[41] WAPDA. (2014). Dasu Hydropower Project, Environment and Social Assessment, 73.
[42] Liden, M. J. R. (2023). Dasu Hydropower Stage I Project (P121507) Implementation Status and Results Report, 3.
[43] Khan, M. Z., Rehman, A. (2022, March 16). Conservationists fear for rare mountain pheasant in Pakistan. *Dialogue Earth*. https://dialogue.earth/en/nature/conservationists-fear-for-rare-western-tragopan-pakistan/
[44] WAPDA. (2014). Dasu Hydropower Project, Environment and Social Assessment, 143.

figures for O&M costs over the project lifecycle, this would add another USD 2 billion dollars. This puts **the total capital costs of the project**, excluding social and environmental costs, **to be around USD 7 to 8 billion,** as a conservative estimate that ignores complex, system-wide, recurring and cumulative costs**.**

67. Another large dam that is cited as an example of a good dam is the 213 meter high **Mohmand Dam** on River Swat with a potential capacity of 800 MW and irrigation of 16,737 acres of land storing about 1.2 MAF of water.[45] The dam however is facing financial trouble, delays, and inflated costs and presents a clear example of **climate risks** to large dams.

68. **Climate risks to large dams** are evident in the case of **flood damages to Mohmad dam**. While the dam claims to provide 'flood protection' in the future, the nature and severity of floods is fast shifting. The super-floods of 2010 damaged the Munda Headworks bridge which collapsed in the much larger 2022 floods – 2010 floods saw about 175,000 cusecs of water in Swat at Munda, and by 2022 about 260,000 cusecs.[46] The Munda bridge collapsed and left the under construction dam severely damaged.[47]

69. A preliminary 'true' costing exercise shows that **against the official estimates of USD 1.2 billion** for **the Mohmand Dam project**, will be much higher. If we are to consider merely the additional costs of financing the project (1.5 billion), loss of income of local populations (0.172 million), O&M costs (1.5 billion), additional cost of security and decommissioning (USD 20.25 million), the project may **cost about USD 3.7 billion.** This excludes any cost of cumulative downstream impacts and overall under-anticipated environmental effects.

The Contentious Legacy of PEDO's Run-of-River Projects: Daral Khwarh & Others

70. The issues outlined above also characterize small and medium hydropower projects, especially run-of-river schemes, increasingly being promoted as cost effective, socially and environmentally sound alternatives to large dams, and largely overseen by provincial-based hydropower development authorities.

71. Consider the case of **Pakhunkhwa Energy Development Organization (PEDO)**. A brief analysis of some of its projects shows that the so-called 'small' and 'medium' run-of-river projects fail to live up to their touted image as cheap, clean, and environmentally-friendly sources of power generation. On the contrary, the widespread utilization and expansion of small hydro – whether run-of-river or otherwise – is likely to impose equally irreversible environmental and economic costs on society, as large-scale hydropower projects.[48]

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[45] https://wapda.gov.pk/project-details/63c699ca0ccdd9a8cd307c7b

[46] The definition of small and large can vary, depending on parameters such as height, storage capacity, power output or cost. In terms of power output, projects with a capacity of up to 10 MW are considered small. PEDO's classification suggests a range of up to 75 MW for small hydro, whereas projects with a power output between 75-130 MW are classified as medium. Dawn. (2011, September 25). *Carbon credits to be claimed on 34 projects*. Dawn. https://www.dawn.com/news/661932

[47] PM orders inquiry into damage caused to Mohmand Dam. (2022, August 29). *The Express Tribune*. https://tribune.com.pk/story/2373852/pm-orders-inquiry-into-damage-caused-to-mohmand-dam

[48] Abbasi, T., & Abbasi, S. A. (2011). Small hydro and the environmental implications of its extensive utilization. *Renewable and Sustainable Energy Reviews, 15*(4), 2134–2143.

72. PEDO's projects reveal their systematic vulnerability to flooding and climatic disasters. Since 2008, the organization has added nine small to medium run-of-river hydropower facilities to its portfolio. Due to recurring floods between 2010 and 2022, five of these projects (Malakand HPC, Daral Khwar, Ranolia HPC, Reshun Chitral, and Shishi Chitral) sustained heavy damages, partial or complete, undermining reliability and security of power generation. Rehabilitation of merely three small-scale projects – Daral 36.6 MW, Ranolia 17 MW, and Reshun 4.6 MW – imposed heavy costs of 12.5 billion rupees. Despite the lapse of three years since the 2022 floods, Ranolia HPP remains unrehabilitated and inoperational. On Daral, restoration of sluice gates and flood protection arrangements is yet to reach completion.[49] Recurring floods have also caused significant time and cost overruns, as seen in the Gorkin-Matiltan Project, where construction was suspended after the 2022 floods, delaying its completion by several years.

73. PEDO's run-of-river schemes also elicited strong opposition from local communities. **Pressing concerns** include land acquisition without fair compensation, alongside tunneling of rivers and streams. Water diversion poses multiple risks to households, agriculture, and the local environment. Studies show that water inflow caused by tunneling can have severe impacts on the springs' discharge rate. If these impacts are not predicted beforehand, technical, economic, and environmental challenges could occur[50]. It can threaten to shut down mini-hydel stations and traditional water mills, dry up springs, and deprive households reliant on streams and springs of essential drinking and domestic water supply. It also cuts off irrigation channels, placing subsistence agriculture and livelihoods at jeopardy.

74. The **Karora Hydropower Project (11.8 MW)** in Shangla district stands as a recent test case of the adverse impacts of such projects on communities. Completed two years ago at a cost of R.s 4.6 billion, the project still remains non-operational. However, it has reportedly disrupted 14 small power plants and 12 water mills that have long provided cheap, reliable electricity to off-grid households. The project also damaged 16 springs and 75 kanals of agricultural land, undermining water and food security of local households.[51] Three union councils continue to bear the brunt of these impacts and despite written agreements and assurances, the project affectees are still awaiting fair compensation and promised uplift benefits.[52] These immense social and economic damages remain largely absent from environmental assessment and financial appraisals.

75. **The Daral Hydropower Project (36.6 MW)** in Bahrain also serves as a notable precedent, underscoring the misalignment of hydropower with realities of climate change. Completed in 2018 at the cost of Rs. 9 billion, the project suffered damages during the 2022 floods and again in April 2024.[53] The 2022 floods, which reached catastrophic proportions, caused water

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[49] PEDO. (2024). Annual Report 2023-24. Pp. 13-14, 19, 30-31, 39, 41, 46

[50] Houshmand, K., Soleimani, M., Shahriar, K., & Jalali, S. E. (2018). Introduction of an empirical classification system for evaluating tunneling impact on the discharge of springs (TIS) in the surrounding areas. *Environmental Earth Sciences*, *77*(21), 1-17

[51] Bacha, U. (2025, July 18). *Karora Power Project: Development at the cost of indigenous resources?* Lok Sujag. https://loksujag.com/story/karora-power-project

[52] Our Correspondent. (2025, July 13). *Shangla power project's victims to be compensated*. Dawn. https://www.dawn.com/news/1923777/shangla-power-projects-victims-to-be-compensated

[53] Our Correspondent. (2024, June 10). *Flood-damaged Swat power plant restored*. *The Express Tribune*. https://tribune.com.pk/story/2470675/flood-damaged-swat-power-plant-restored-1

overtopping and dam failure, damaging project components including spillway, sand trap, power channel and switchyard, as well as the power station which was also badly damaged. Dam-induced flooding devastated downstream villages and communities, while also reshaping river morphology. It wiped out the entire village of Jail and destroyed numerous homes and riverbank farmlands. High sediment transport led to temporary blockages in the Swat river, destroying all buildings in Bahrain bazar and elevating riverbeds by 3 to 4 meters in Bahrain.[54] Today, the riverbed aggradation remains a source of residual risk in Swat, where climate change is altering hydrological regimes and intensifying both the frequency and severity of floods.

76. The Daral clearly illustrates the social and environmental harms associated with small- to medium-scale hydropower projects. Despite being cleared on social and environmental grounds, the Initial Environmental Assessment conducted for the project explicitly acknowledged its adverse impacts on fish species, public health, water supply for private and commercial use, and community-owned resources including water mills and hydrostations. It also noted the likelihood of increase in water conflicts resulting from reduced water flows in winter.[55] The ADB's Validation Report also declared the environmental safeguard categorization of the overarching program – of which Daral was one of the subprojects – as inadequate.[56] However, no full-scale Environmental Impact Assessment was carried out to assess, mitigate, and monitor these impacts. Neither were local communities meaningfully consulted for design, planning, execution, and implementation of the project.

77. The outcomes of the project confirm the initial concerns raised by local communities. It has threatened two critically endangered and vulnerable fish species, undermined the river's ecological health, and reduced both the quality and quantity of water available. These changes have exposed river-dependent households to significant public health risks. Approximately 14 watermills and four mini-hydrostations have become inoperable, while the drying up of springs has disrupted agriculture and livelihoods. River depletion has also diminished the valley's scenic appeal, adversely affecting tourism and local businesses.[57] Tunneling, blasting, and excavation have compounded geological fragility, damaging drainage systems and triggering slope failures and run-off events. Moreover, the project access road has facilitated encroachment on forest land and enabled timber smuggling.

78. A similar pattern is also evident in the PEDO's ongoing **Balakot Hydropower Project**, a 300 MW run-of-river facility funded by the ADB. The EIA of the project has failed to undertake a full evaluation of the medium and long term risks and cumulative impacts. The modeling for the baseline, whether aquatic or hydrological, is short-term and limited to seasonal variabilities.

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[54] Lehmann, C., &, Walther., P. (2023). Event Analysis: 2022 Floods in Swat Valley, Pakistan – Synthesis Report. Swiss Agency for Development and Cooperation (SDC).

[55] "Fish breeding and fish movements will be interrupted in the winter season when there will be reduced or no water flow in the Khwar". Asian Development Bank. (n.d.). *Renewable energy development project: Daral Khwar HPP feasibility study (Vol. 3: Environmental assessment) [ADB TA No. 4425-PAK, TAR 34339-01]*. Asian Development Bank. Pp. 14, 16, 22, 38, 39

[56] Asian Development Bank. (2021, September). *Validation Report: The Islamic Republic of Pakistan: Renewable Energy Development Sector Investment Program* (Reference No. PVR-799; Program No. 34339-013; Loan Nos. 2286 & 2287; MFF No. 0005). Asian Development Bank. pp. 7

[57] Bacha, Umar. (July, 2025). Daral Khwar Hydropower Project – a bane of 16 villages. Lok Sujag.

While there is some discussion on the project's impacts on surface water, the impacts on aquifers and the interconnection between surface and groundwater are completely missing from the EIA. Climate change hazards, flood, and seismic risks have also not been addressed despite the project site being particularly prone to these risks being one of the worst affected regions in the 2010 and 2022 floods and the 2005 earthquake.

79. Project activities have already generated severe social and environmental impacts. The diversion of a historically community-owned stream in Sangarh for construction has disrupted seasonal cultivation, threatening local food production and economic resilience. Community resources and natural tourist sites have been damaged, while three watermills and irrigation channels have been impaired due to water diversion. Blasting activities and the construction of transmission towers have heightened landslide and flash flood risks. The movement of heavy machinery and blasting has further contributed to air and noise pollution, with detrimental effects on community health. In addition, tunneling waste (muck) and improper disposal of construction debris have increased soil erosion, sedimentation, and contamination of local water bodies. The deposition of waste along riverbanks has further polluted freshwater sources.

80. These concerns highlight the urgent need for a comprehensive impact assessment of the legacy, ongoing, committed, and planned dams, including a thorough cost-benefit analysis of alternative energy sources, assessment of debt burden, and meaningful consultations with civil society stakeholders, affected communities, and political representatives. Addressing these issues is essential to ensure a responsible and sustainable energy strategy for Pakistan's future.

The Policy of Ignoring Communities

81. **Political constraints as 'elite politics?:** The IGCEP 2025 clearly states that power planning seeks least cost solutions within certain constraints, including *political* constraints. We welcome this inclusion and attention to politics, as this gives a way for communities to voice their grievances. However, when we look at the projects committed, we can clearly see that the concerns of adversely affected communities are not addressed. Will NTDC clarify what it means by the term 'political constraints'? Is this merely code for addressing the concerns of the political elites, establishment powerbrokers, and the financial investors?

82. **Proceduralism as a hindrance to True Costing:** The mandate of true cost can only be met when it is carried out honestly, with good intentions and sound execution. However, we are troubled by our various interactions with NTDC, NEPRA, and other policy officials, when we ask for true costs of these projects. We are told that there are procedures and regulations in place for addressing the 'social and environmental impact' of different projects, and that it is not in the mandate of IGCEP to include these costs. Further, we are assured that the world's best consultants and experts develop these plans. There's a long history of dismissing people's concerns about the harms of the projects, as development experts, policy makers, and international investors externalize the true environmental and social costs without effective participation, informed consent, and free and inclusive consultations with the local and affected communities. Hiding behind such proceduralism is not the way to go.

83. Old lessons forgotten? It also seems that much of the historic work done by activists, communities, and academics is sidelined or ignored. A case in point is the recommendations by the World Commission on Dams on the social and environmental impact of large dams. These costs are systematically excluded from the financial calculation. In a recent report by the World Bank, it is noted that the environmental and social costs of large infrastructure projects are systematically ignored, and often excluded from the scoping studies of these projects.[58] Despite recommendations of rigorous analysis and establishing principles like Free Prior and Informed Consent, the planners in the power sector have systematically fallen short. While we write these comments, we are aware of the long history of engagement between communities adversely impacted by these projects on all formal and informal arenas of contestation. It seems though that the powers that be ignore all the lessons learnt from all the hard work, and return to business as usual.

Our Recommendations and Demands:

84. We register our reservations about the IGCEP 2025's planned dependence on hydropower, despite its well-documented problems. The proposed projects will result in huge **economic cost overruns, severe environmental damage, and adverse social and economic consequences** for lower riparian groups, particularly the communities of Sindh and the Indus Delta.
85. Hydropower's 'fuel,' water, is a scarce and public good. By adding more hydropower without considering existing legal and established claims on water use, the IGCEP 2025 is likely to **increase water conflict** in Pakistan. The true, externalized cost of hydropower is enormous. It is incumbent upon NEPRA, NTDC, and other responsible bodies to account for all these various costs.

86. The IGCEP 2025 ignores rapidly changing climatic conditions, socio-hydrological realities, and global trends where thousands of dams are being removed due to realized economic, social, and ecological costs. These commitments risk locking Pakistan into **costly, technically unsound, environmentally destructive, and politically charged projects**.
87. Following international best practices, all alternative options must be considered. **Wind and Solar offer the greatest potential** and must be prioritized over costly hydropower. Furthermore, planning must include **substantial participation of a broad range of stakeholders**, including direct representatives from impacted communities. To fulfill its mandate, NEPRA must ensure a comprehensive water strategy that integrates energy policy with agrarian policy, livelihood stability, and constructive federation building.

We recommend the following immediate and concrete steps:

a. **Financial Transparency:** Release all PC1s of the projects for independent evaluation, and release of the methodology for cost calculations to identify gaps.

b. **Comprehensive Costing:** Increase the scope of 'costing' methodologies to explicitly include long-term, recurring, and cumulative costs, such as the impact of upstream hydro projects on downstream and deltaic communities.

[58] Young, W. J., Anwar, A., Bhatti, T., Borgomeo, E., Davies, S., Garthwaite III, W. R., Gilmont, E. M., Leb, C., Lytton, L., Makin, I., & Saeed, B. (2019). *Pakistan: Getting More from Water*. World Bank. https://openknowledge.worldbank.org/handle/10986/31160

c. **Impact Assessment:** Conduct ecosystem-wide studies of one-time, recurring, and accumulated impacts and climate risk assessment of the planned and ongoing cascade run-of-river projects on main stems and tributaries of the Indus, Swat, Panjkora, Kunhar, and other major mountainous rivers.

d. **Optimization of Ecosystem Services:** Release information on how the competing demands on scarce water resources (for hydropower, coal, agriculture, and urban supply).

e. **Lifecycle and Carbon Footprint analysis:** Conduct assessments of the carbon footprint of the lifecycle of the construction of large reservoir dams, including cost of construction, material-related emissions, methane emissions from reservoirs, and the impact of decommissioning after completion of project lifecycle.

f. **Climate-scenario Modelling:** In light of increased risk of floods, new infrastructure must be built on proper modelling of new and heightened risks. These must be reflected in the costs, by considering insurance costs, rehabilitation and reconstruction costs in case of failure due to extreme weather events.

g. **Pollution and Monitoring:** Conduct detailed studies of the air and water pollutants in all projects, with effective monitoring and public sharing of the data.

h. **Social Safeguards:** Institutionalize the best practice of Free Prior and Informed Consent and disseminate all project related social, environmental, and economic impact assessment in local languages.