



IPS INSIGHTS

Perspectives On the Issues Shaping Policy

From Glaciers to Grids: Building Climate Resilience into Pakistan's Energy Transition

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The recent debris avalanche and flash flood in Nepal's Langtang region offered another reminder of the growing vulnerability of mountain environments and the infrastructure located within them. On August 26, 2026, a rapid slope failure involving a glacier triggered a debris flow and flooding that travelled nearly 100 kilometers downstream, affecting populated areas and infrastructure along the Lende Khola and Trishuli Khola rivers. The US Geological Survey noted that it remained unclear whether the initial failure constituted a landslide incorporating part of a glacier or a glacial collapse.²

For Pakistan, the significance of such events extends beyond disaster management. The country's energy system is closely connected to its mountain geography through hydropower, water availability, transmission infrastructure and roads providing access to energy assets. At the same time, Pakistan is pursuing an energy transition involving renewable energy, distributed solar, storage and grid modernization. The central question is therefore no longer simply how to make the energy system cleaner, but how to make the transition itself resilient to a changing climate.

Climate Risk Is Becoming an Energy-Sector Risk

Energy planning has traditionally treated climate largely through the lens of mitigation, replacing carbon-intensive generation with cleaner sources. This remains essential, but it addresses only one side of the relationship between climate and energy.

The other side concerns the physical vulnerability of energy infrastructure. Hydropower plants, transmission lines, substations, roads and other supporting infrastructure are exposed to floods, landslides, extreme heat, changing precipitation patterns and other climate-related hazards. Pakistan's experience during the 2022 floods demonstrated that climate shocks can directly disrupt energy access. A World Bank assessment found that damage to the power sector was concentrated particularly in distribution networks and hydroelectric generation stations in the north, while outages affected populations across several provinces.

The lesson is important for the energy transition. A renewable energy asset may have low operational emissions, but this does not make it physically resilient. A hydropower facility can contribute to a low-carbon

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² U.S. Geological Survey, Landslide Hazards Program, "2026 Nepal Debris Avalanche and Flash Flood," August 27, 2026, <https://www.usgs.gov/programs/landslide-hazards/science/2026-nepal-debris-avalanche-and-flash-flood>.

electricity system while remaining exposed to changing hydrology or mountain hazards.³ Similarly, solar and battery systems can support resilience but can themselves be affected by extreme heat, flooding or other localized risks.

Therefore, the transition needs to be evaluated through two questions simultaneously. First, how much does an energy asset contribute to reducing emissions, and secondly, how well can it continue to function under changing climatic conditions?

From Clean Energy to Climate-Resilient Energy

The distinction between mitigation and resilience has important implications for energy planning. If climate risk is considered only after an asset has been designed, adaptation becomes an additional cost imposed on an existing project. If it is incorporated at the planning stage, it can influence site selection, engineering specifications, technology choices, maintenance requirements and financing decisions from the outset.

This approach is beginning to emerge in Pakistan's power-sector investments. In July 2026, the World Bank approved financing for the Grid Stability Enhancement Project, which includes climate-resilient specifications for new transmission infrastructure, including elevated platforms to reduce flood exposure and equipment designed to operate at temperatures of up to 55°C.⁴

Such measures illustrate an important shift that climate resilience can be integrated into the design of energy infrastructure rather than treated solely as a response to disasters.

However, this principle needs to extend beyond individual projects. Major energy investments should systematically assess the hazards associated with their location, the

exposure of supporting infrastructure and the potential consequences of disruption. Climate risk should become part of the investment decision itself.

Distributed Energy as a Resilience Asset

Pakistan's rapidly expanding distributed solar sector creates another dimension of resilience. The country's rooftop solar adoption has largely emerged from consumers responding to high electricity costs and concerns about grid reliability. Yet the cumulative result is a rapidly expanding pool of generation capacity located closer to consumers.

The same distributed architecture can potentially provide resilience during disruptions, particularly when combined with battery storage and appropriate system controls. Solar-plus-storage systems can provide electricity when the central grid is unavailable, while larger configurations can support critical loads such as health facilities, water pumping, communications and emergency services.⁵

The policy opportunity, therefore, is not simply to increase the number of solar installations. It is to determine how distributed resources can contribute to system-level resilience.

This requires distinguishing between a solar panel and a functioning resilience resource. A rooftop system without storage may reduce dependence on grid electricity but may not provide power during an outage, depending on its configuration. Solar combined with storage, critical-load management and appropriate controls can provide a greater degree of resilience.

The transition can consequently move beyond the idea of consumers as passive recipients of electricity. A household or

³ Intergovernmental Panel on Climate Change, "Chapter 6: Cities, Settlements and Key Infrastructure," in *Climate Change 2022: Impacts, Adaptation and Vulnerability* (Cambridge: Cambridge University Press, 2022), <https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-6/>

⁴ World Bank, "World Bank Support to Strengthen Pakistan's Electricity Grid for Improved Reliability and Accelerated Clean Energy Growth," July 9, 2026, <https://www.worldbank.org/en/news/press-release/2026/07/08/world-bank-support-to-strengthen-pakistan-s-electricity-grid-for-improved-reliability-and-accelerated-clean-energy-growth>

⁵ U.S. Department of Energy, "Solar and Resilience Basics," accessed October 5, 2026, <https://www.energy.gov/cmei/systems/solar-and-resilience-basics>

business with solar, storage or flexible demand can become simultaneously a consumer, producer, storage owner and potential provider of system services.

The Grid Must Become More Flexible

A more distributed energy system also places new demands on the grid. Increasing solar penetration can reduce electricity demand from the grid during daylight hours while creating sharper demand for conventional or flexible generation after sunset. Storage can help shift electricity from periods of surplus generation to periods of higher demand, while demand response can reduce pressure on the system during periods of stress.

This means that grid modernization should not be understood simply as expanding transmission and distribution capacity. The future grid will need to be more flexible, digitally enabled and capable of coordinating a growing number of distributed resources.

Climate resilience reinforces this requirement. A resilient grid must be able to withstand physical shocks, detect disruptions, recover quickly and, where possible, continue supplying critical services even when parts of the wider system are unavailable. The objective is therefore not simply to build a larger grid, but to build a system that can respond to changing supply, demand and climate conditions.

The Governance Gap

Climate risk also presents a governance challenge because it does not fall neatly within one institutional mandate. Glacier and weather monitoring, water management, disaster preparedness, energy planning, infrastructure development and electricity-system operation are often handled by different institutions.

The physical risk, however, is interconnected.

A change in mountain conditions can affect water flows. Water flows can affect hydropower generation. Flooding or landslides can damage roads and transmission infrastructure. Damage to transmission can disrupt electricity supply

far from the original hazard. This creates a gap between the production of climate information and the decisions made by energy institutions.

Pakistan therefore needs to move beyond simply generating more climate data. The greater priority is to connect climate information with infrastructure information and institutional decision-making. Energy planners need to know not only that a region is exposed to a particular hazard, but which assets are exposed, what the consequences of disruption would be, and what measures can reduce that risk.

The climate system does not respect institutional boundaries, while governance systems often do. Building resilience requires stronger mechanisms for connecting these institutional domains.

From Climate Information to Resilient Energy Planning

Pakistan's energy transition is already underway, but the climate conditions in which it is taking place are also changing. The policy challenge is therefore to ensure that these two transformations are considered together.

Three shifts are particularly important.

1. Climate-risk screening should become a systematic component of major energy investments, covering site selection, design, financing, operation and maintenance.
2. Distributed energy should be developed as a potential resilience resource, moving beyond the deployment of rooftop solar towards appropriate combinations of solar, storage, critical-load systems and microgrids.
3. Climate, water, infrastructure and energy data should be connected to institutional decision-making, allowing energy planners and operators to anticipate risks rather than respond only after infrastructure has been damaged.

The Nepal event is a reminder that hazards originating in mountain environments can rapidly become infrastructure and development crises downstream. Pakistan does not need to wait for every climate shock to demonstrate the same lesson. The repeated flood events, particularly, the 2022 floods, have already shown how climate events can disrupt infrastructure and electricity services.

The energy transition should therefore be judged not only by how much cleaner the system becomes, but also by how well it can continue to function under climate stress. If Pakistan can integrate resilience into infrastructure planning, distributed energy, and grid modernization, the transition can serve not only as a pathway to lower emissions but also as an opportunity to build a more reliable and adaptable energy system.

