

Pakistan's Renewable Energy Transition: Finance, Policy, and Climate Resilience

The energy sector of Pakistan has been stressed over a long period of time, and the effects of its structural flaws can be recognized in nearly all of the economic indicators. The frequent power outages, electricity price increases, circular debt, and reliance on imported fuels have led to a cycle that impacts households, industries, as well as the fiscal system. Concurrently, the exposure of Pakistan to climatic changes has taken a new level of intensity. Frequent floods, extreme heat, drought like conditions, and erratic weather patterns have continued to play havoc with agriculture, infrastructure, and livelihoods. In this respect, renewable energy is not merely an option but has become an economic prerequisite and climate protection. The clean technologies, such as solar, wind power, hydropower, and others, have the potential to decrease the importation of fuel, decrease carbon emissions, stabilize the cost of power, and provide long-term power security. They are also consistent with the national development objectives and Pakistan, as a signatory to international climate accords. Renewable energy also contributes to SDG 1 (no poverty) indirectly because it helps to reduce the poverty burden on low-income households and leads to a reduction in poverty in the long term, as it reduces energy costs and generates new jobs. These objectives would help Pakistan to fulfill its obligations to global climate treaties and help directly achieve SDG 7 (affordable and clean energy) on clean energy and SDG 13 (climate action) on climate action, so renewable energy investment in Pakistan is critical to the future of its economy.

Over the last ten years, Pakistan has been steadily increasing its own renewable energy proportion, but the increase is still less than what it could be. Hydropower continues to lead the clean energy sector with more than 10,600 MW of installed power. Wind power has reached approximately 1,800 MW, mostly located in the Gharo-Jhimpir wind project of Sindh, and solar power has increased to approximately 600 MW in large-scale facilities, with more than 1,600 MW of rooftop and small-scale plants established under net metering. All in all, the current wind and solar provide close to 6-7% of electricity in Pakistan, and with the introduction of hydropower, the clean energy quota surpasses 30%. The goal of the Alternative and Renewable Energy Policy 2019 is to reach 30% of renewable energy (excluding hydro) by 2030 and close to 60% with the addition of hydropower in Pakistan. These objectives can be strongly associated with SDG 7.2, which is the expansion of renewable energy, and SDG 9 (industry, innovation, and infrastructure), supporting the modernization of industrial and energy infrastructure in countries with the assistance of sustainable technologies.

Pakistan has a number of sources of investment in the renewable energy industry. The investments of the public sector are centered on hydropower, grid fortification, and solarization of state structures. These are long-term investments, and in most cases, they form the foundation for private investors. The leading role is played by the private sector through independent power producers, who develop large solar and wind projects. Such projects are usually built under a Build, Own, Operate, Transfer system, and they are based on

long-term contracts with the government. There is heavy involvement of international development institutions, including the World Bank, Asian Development Bank, the International Finance Corporation, and the KfW, in financing renewable energy and energy reforms. They facilitate their efforts with assistance to Pakistan in terms of concessional loans and risk-sharing facilities, which enable it to strengthen its infrastructure, which is in line with SDG 9.1, which aims at ensuring reliable and sustainable connection of energy

and industry. In the past, the previous stages of CPEC were biased towards coal-based projects, but as of late, there has been a preference for hydro, solar, and wind projects as a result of the global disappointment that China has in financing coal plants abroad. Even with such developments, there is a significant gap in investment in Pakistan, since investors remain uncertain due to financial constraints, institutional gaps, and gridlocks.

Whether the renewable energy projects transform planning into implementation is determined by finance. Currently, in Pakistan, most utility-scale renewable projects are dependent on project financing, where a lender considers the possibility of a cash flow of a project rather than just the assets of the company. This framework is operational in circumstances where the flow of payment is predictable, and government payments are delayed, which influences investor confidence. However, green financing, including loans for rooftop solar systems, small industrial solar plants, and agricultural tube wells, is currently being made available by commercial banks.

The State Bank of Pakistan has been instrumental in providing a transformative role by putting up refinancing plans that reduce the interest rates charged on renewable energy borrowers. With its green banking principles, SBP has been able to encourage its banks to embrace environmental and social risk management principles that enhance the sustainability of projects and mitigate long-term risks. This strategy falls under SDG 12.6 and SDG 17 (partnerships for the goals) because it facilitates local financing and cooperation across nations. Through green bonds and green Sukuk, capital markets are also engaging themselves.



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These products will attract investors who are interested in environmentally friendly investments. Additional benefits from global climate funds include the availability of concessional financing, grants, and technical assistance through the global climate funds, including the Green Climate Fund and the Global Environment Facility, which have been available to Pakistan. Another tool that shows a promising future in terms of commercializing and making renewable energy projects more financially viable and appealing to private investors is blended finance, in which concessional funds are integrated into commercial investment.

The renewable energy environment is affected by a number of institutions. The State Bank favors green lending and management of financial risks. ESG disclosures and green financial instruments are guided by the Securities and Exchange Commission of Pakistan. NEPRA controls tariffs and the licensing of renewable energy, and long-term policy direction is defined by the Ministry of Energy. Effective coordination between these institutions is useful in developing sustainable infrastructure, as per SDG 9.4, which focuses on improving infrastructure using clean technologies. Nonetheless, lack of uniformity in policies and slow implementation tends to slow investment and create uncertainty for developers.

Despite the fact that the renewable energy industry has very good potential, several obstacles prevent investment in the renewable energy industry in Pakistan. The worst of these is the circular debt problem, which has been accruing over the years due to inefficiencies, losses, and late payments, now reaching approximately PKR 2.3 trillion. Any doubt about paying the power producers leads banks to be hesitant, and investors will not be willing to put their money into power producers at will. The capacity to add new solar and wind power is also limited by the transmission infrastructure. For instance, numerous wind initiatives in Sindh cannot be linked to the grid unless transmission lines are built or new tracks are constructed, despite the additional 50,000 MW of solar potential and more than 60,000 MW of wind potential present in Pakistan, which cannot be absorbed into the current grid capacity. Another risk is policy inconsistency.

Changes in net metering policies, tariff adjustments, and delays in competitive bidding are sources of uncertainty in the investment environment. Massive upfront costs of rooftop solar panels continue to be an issue for families and small businesses despite the long-term benefits. The cost of projects and discouragement of investors are also caused by delays in the approval process, multiplication of regulations, and bureaucracy. Lack of local manufacturing of solar panels, inverters, wind turbines, and batteries means that Pakistan is highly dependent on imports, which exposes it to fluctuating exchange rates, further deteriorating investor confidence and slowing down the implementation of renewable energy.

Nevertheless, the potential of the renewable energy future of Pakistan is massive despite these challenges. The need to solarize government buildings, including hospitals, schools, and government offices, is increasingly being demanded, which can save electricity bills and enable governments to allocate money toward societal welfare. Solar rooftop systems are gaining popularity with households and industries as a means of saving on electricity costs and enjoying more control over energy use. With the increase in the number of electric vehicles, solar-powered EV charging

stations provide a new business opportunity. Pakistan also has great potential for producing green hydrogen, especially with low-cost solar power, which later can be utilized in export markets.

Captive solar plants are becoming increasingly popular in industries such as textiles, cement, and steel to enhance competitiveness and minimize the carbon footprint. The creation of local production capacity for solar components will provide lower equipment costs, create workplaces, and enhance energy security, which contributes to SDG 8 (decent work and economic growth) and SDG 9. Another potential source for increasing private investment is the emerging carbon market, where renewable energy, forestry initiatives, and enhancement of energy efficiency can attract investors.

To achieve the full benefits of renewable energy in Pakistan, policy and financial reforms must accelerate. A clear and consistent competitive bidding system for new solar and wind projects should be adopted in the nation to attract low-cost investment. Enhancing green financing programs of the State Bank, including energy conservation, grid renovation, and green hydrogen, will be required to finance more innovative projects. Structural reforms, including better governance, less distribution losses, and rational tariffs, need to be implemented in dealing with circular debt. Upgrades to transmission infrastructure should be emphasized, especially in locations with significant renewable energy, so that new power plants can be connected without delays. Tax incentives on manufacturing solar panels, mounting structures, and energy storage devices in the country can reduce reliance on imported goods and increase domestic manufacturing.

Stability in regulations is necessary, as it will help investors commit to long-term projects. Large infrastructure projects would help diversify the source of funds by promoting the use of green Sukuk. The adoption of solar rooftops can be expedited at the household and commercial levels through a national-level program, decreasing reliance on costly grid power, which will contribute to SDG 1. By motivating banks and businesses to incorporate climate-risk evaluations, the financial flows of Pakistan will align with SDG 17 and SDG 12 (responsible consumption and production).

The Pakistani crossroad is promising. Renewable energy can be a source of sustainable development in the country through a clean energy transition with more than 10,600 MW of hydropower, close to 2,000 MW of wind power, and over 2,100 MW of combined solar capacity from large and small systems. Renewable energy has the potential to enhance economic stability, reduce poverty through lower domestic energy expenditure, and provide thousands of green jobs.

Through better financing frameworks, investment in grid modernization, and regulatory harmonization, Pakistan will be able to transform its power sector and achieve its SDG obligations, specifically SDG 1, SDG 7, SDG 9, SDG 13, and SDG 17. If these measures are adopted, renewable energy investment will become one of the pillars of the economic and environmental future of Pakistan.

About the Author: Dr. Shoaib Ahmed Khatri is an energy systems researcher and Assistant Professor at MUET, whose work focuses on renewable energy modeling, financing frameworks, and policy reforms that support Pakistan's clean energy transition. His research integrates techno-economic analysis, investment planning, and sustainability principles to advance climate-aligned development and ESG-driven energy solutions.