



COUNTRY ASSESSMENT REPORT PAKISTAN

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1.1 Country Assessment Report

Country Name	Pakistan
Introduction	Pakistan is a South Asian country with a population of 241.5 million (PBS 2023 Census) and a nominal GDP of approximately USD 407 billion (FY 2024–25). Its energy system is characterized by a mix of thermal, hydropower, nuclear, wind and solar resources, with high potential for renewable energy expansion. NEPRA’s State of Industry Report 2024 (SOI-2024) provides the most comprehensive overview of the national electricity sector, which informs much of this assessment. Pakistan has significant renewable energy potential, especially in solar and wind. Pakistan covers three major geographic areas: the northern highlands, the Indus River plain and the Balochistan Plateau. Hence, the geography and climate of the region is extremely diverse.

1.2 Electrical Generation and Demand

Generation	Technology	Capacity (MW)
installed capacity as of 30 June 2024	Wind	1,838
	Hydro	10,635
	Fossil/Thermal	28,766
	Biomass	249
	Solar	680
	Nuclear	3,620
Demand	Sector	Demand (GWh)
SOI-2024 net generation: 137,196.07 GWh for FY 2023–24	Residential	N/A
	Commercial/Service/Public Sector	
	Transport	
	Industrial	
	Primary Activities	
	Total	

NEPRA does not disaggregate consumption by sector in SOI-2024. Sectoral benchmarks below reflect established national usage patterns:

- Residential: Largest share of electricity demand nationally; high growth driven by urbanization and rooftop solar displacement.
- Commercial/Service/Public Sector: Significant consumers in urban centers; includes retail, offices, and public services.
- Transport: Currently low but expected to rise with EV policy implementation.
- Industrial: Major demand contributor, especially textiles, manufacturing, cement, steel and fertilizer.
- Primary Activities (Agriculture): Includes tube wells and agricultural processing; significant demand in rural areas.

Per Capita Electricity Consumption: 458 kWh (FY 2022-23; latest reported)

Please note: This is the most comprehensive information available, though it may not be fully precise.

Reference:

<https://www.nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202024.pdf>

1.3 Electrical Interconnection and Import/Export

Connected country	Capacity (MW)	Annual import from country (GWh)	Annual export to country (GWh)
Iran	~100 MW	~18 GWh	0
Additional information	Pakistan has limited cross-border electricity trade. The only operational interconnection is with Iran, through which approximately 100 MW of electricity is imported to supply remote border areas of Balochistan. Reference: https://profit.pakistantoday.com.pk/2025/01/03/pakistan-iran-extend-power-sale-agreement-for-balochistan-border-areas-with-revised-pricing/ This import is relatively small in scale and is primarily used to serve geographically isolated regions that are not fully integrated with the national grid. As such, it does not play a significant role in the overall national power balance. Apart from this arrangement, there is no substantial cross-border electricity trade, and power exchanges occur primarily within the country between the National Grid (NTDC/CPPA-G system) and K-Electric.		

1.4 Market Structure

Pakistan operates a single-buyer market model:

- All grid-connected generation (IPPs, GENCOs, WAPDA hydropower, nuclear) sells to CPPA-G, the central power purchaser.
- CPPA-G sells power to ten government-owned DISCOs.
- K-Electric is a vertically integrated private utility serving Karachi; it buys and sells electricity through interconnections with NTDC.
- The market is not liberalized; no wholesale trading or competitive retail markets exist.
- Distributed solar (via net metering) has grown rapidly, becoming a major driver of renewable adoption.
- Environmental attribute markets are voluntary, and PET operates I-TRACK, Pakistan's REC issuance and tracking system.

Energy Mix (Installed Capacity, 2024)

- Thermal: 62.24%
- Hydropower: 23.01%
- Nuclear: 7.83%
- Wind: 1,838 MW
- Solar: 680 MW
- Bagasse: 249 MW

REC Market

No national REC regulations exist; however, market demand is strong due to export requirements, ESG commitments and upcoming CBAM pressures. I-REC(E) implemented by PET as the Local Issuer accredited by the I-TRACK Foundation, serves as the only active and operational REC mechanism in the market.

Reference:

<https://www.nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202024.pdf>

1.5 Responsible Government Department

Institutional Framework

Ministry of Energy – Power Division (MoE/PD)

- National energy policy, power-sector governance
- Oversight of NTDC, CPPA-G, PPIB, GENCOs, DISCOs

Ministry of Climate Change & Environmental Coordination (MoCC&EC)

- NDC implementation, climate policy, carbon markets
- Focal point for UNFCCC and environmental regulation

NEPRA – National Electric Power Regulatory Authority

- Licensing, tariffs, performance monitoring
- Responsible for IGCEP and DISCO/KE oversight

NTDC (National Transmission & Dispatch Company)

- Owns/operates 500 & 220 kV grid; system operation & planning

CPPA-G (Central Power Purchasing Agency – Guarantee Ltd.)

- Central buyer; manages PPAs, dispatch, settlements

PPIB – Private Power & Infrastructure Board

- Facilitates private power projects & environmental attribute clauses in PPAs

K-Electric

- Vertically integrated private utility for Karachi; engaged with PET on RECs

(Note: AEDB dissolved in 2023; functions absorbed by Ministry of Energy.)

Regulatory Framework

- NEPRA Act (1997) and amendments
- IGCEP (Generation expansion planning)
- NEPRA Net Metering Regulations (2015, amended)
- ARE Policy 2019/2020
- Power Purchase Agreement frameworks including environmental attribute clauses

1.6 Existing/Planned Legislation

Relevant legislation affecting energy/RECs:

- **Private Power Policy 1994** – foundation for IPP development
- **Power Generation Policies 2002 & 2015** – least-cost generation; indigenous resources
- **ARE Policy 2019/2020** – 20% RE by 2025; 30% by 2030
- **NEPRA DG & Net Metering Regulations (2015)** – legal basis for distributed RE
- **Pakistan EV Policy 2019** – indirect demand implications
- **No law yet explicitly addresses RECs or environmental attribute ownership**

New legislation under periodic review includes reforms to net-metering and renewable procurement frameworks.

1.7 Environmental and Renewable Electricity Legislation

- National Climate Change Policy
- Updated Nationally Determined Contributions (NDCs)
- ARE Policy mandates scaling RE capacity to 30% by 2030
- IGCEP shapes RE integration through least-cost modeling
- No legal barriers to REC issuance; no mandatory disclosure of REC use, but increasing alignment with corporate ESG frameworks

Legal framework **permits** certificate systems; does not yet **regulate** them.

1.8 Existing/Planned Certificate or Support Systems

I-TRACK Renewable Energy Certificates (Pakistan)

- PET is the **sole Issuer**
- **1+ GW** registered/under registration
- Operates under voluntary, contract-based model
- Used for Scope 2 claims, supply-chain reporting, buyer ESG requirements
- Includes strong controls for double-counting prevention

Other mechanisms

- CDM (MoCC DNA)
- Voluntary carbon markets: Verra (VCS), Gold Standard
- Net Metering (supports distributed RE generation)

Pakistan has **no legal restrictions** on REC issuance.

1.9 Extent of Engagement with Government

PET maintains continuous engagement with:

- **Ministry of Energy (Power Division)** – The Power Division has shown increasing awareness of renewable-energy attribute mechanisms, particularly as recent PPAs now include clauses related to environmental attributes. While no formal policy has been issued yet, the Ministry has expressed openness to understanding REC frameworks and their relevance to Pakistan’s industrial competitiveness.
- **PPIB** – PPIB has expressed interest in better understanding REC markets, especially regarding environmental-attribute provisions in IPP project agreements. PET has engaged PPIB on how RECs could complement renewable-energy development pipelines and support net-metered volume across the country.
- **NEPRA** – NEPRA does not currently regulate RECs but remains broadly supportive of market transparency and mechanisms that promote renewable-energy uptake. Its work on consumer-protection, net-metering regulations, and the IGCEP indirectly influences the enabling environment for clean-energy tracking systems.
- **MoCC** – MoCC&EC recognizes RECs as a complementary tool to support national climate-reporting frameworks, private-sector decarbonisation, and supply-chain transparency.
- **K-Electric** – KE is actively engaged with PET on the integration of renewable-energy certificates, particularly regarding distributed generation and clean-energy procurement by industrial and commercial consumers in the Karachi service area.

Engagement includes meetings, consultations and information-sharing. Government responsiveness to REC-related discussions has been constructive.

1.10 Expected Response from Government

Based on engagements:

- Government expected to be **supportive** of voluntary REC systems
- MoCC positively views RECs for private-sector decarbonisation
- Power Division is open but requires multi-tier approvals
- No political resistance identified, but **formal national REC regulation is not yet planned**
- Timeframe for formal recognition remains open-ended

1.11 Proposed Restrictions

To preserve environmental integrity:

- Clear ownership of environmental attributes must be established via PPAs or contractual declarations.
- Net-metered installations may require confirmation that exported units are not double-counted.

1.12 Any Other Relevant Information

RE Market Potential:

Many studies have been conducted that reiterated the immense renewable potential Pakistan holds. Due to the climate and geographical variation across the country, Pakistan has great renewable potential for both solar and wind.

Solar:

Pakistan has high solar potential, with roughly half the days in a year receiving strong sunlight. According to the Global Solar Atlas, the country's theoretical solar potential exceeds 2,900 GW, with high irradiation levels across Sindh, Balochistan, South Punjab, and parts of Khyber Pakhtunkhwa. A World Bank assessment further notes that using only 0.071% of Pakistan's land area for utility-scale solar would be sufficient to meet the country's electricity demand.

Most of Pakistan's operational solar capacity comes from residential rooftop and other distributed-generation (off-grid or net-metered) installations, which represent the bulk of solar uptake nationally. Utility-scale solar remains comparatively small: SOI-2024 reports 680 MW of installed solar capacity across CPPA-G and KE systems.

There are six government-funded solar projects totaling 430 MW currently operational, while 22 additional solar projects are in various stages of development, aiming to add approximately 890.8 MW once completed.

According to NEPRA's 2024 Sol report, by June 2024 Pakistan had over 156,372 distributed-generation solar (roof-top / small-scale) installations. Net-metered rooftop solar surged: by 31 March 2025 cumulative net-metered capacity reached ~ 2,813 MW. On the utility-scale front, during FY 2024 three new 50 MW solar plants were commissioned, pushing utility-scale solar capacity higher. This reflects a marked acceleration in solar deployment, especially at the distributed (net-metered) level, which is becoming a significant contributor to Pakistan's overall energy mix.

Wind:

Wind power remains one of Pakistan's most promising renewable energy resources. Earlier national wind-mapping assessments conducted across Sindh, Balochistan, and Khyber Pakhtunkhwa estimated Pakistan's gross wind power potential at approximately 346,000 MW, indicating a strong long-term opportunity for utility-scale development.

The World Bank's Variable Renewable Energy (VRE) Locational Study also identifies high-quality wind corridors in Sindh and Balochistan, particularly in sparsely populated areas where land availability and grid-integration potential are favorable. Balochistan, due to its large landmass and excellent wind and solar resource profiles, continues to be a strategic focus area for future VRE expansion.

According to NEPRA's State of Industry Report 2024, Pakistan now has 1,838 MW of operational wind capacity connected to the national and KE systems. These wind farms—primarily located in the Ghara-Jhimpir corridor in Sindh—contributed to the renewable generation mix and remain the largest segment of Pakistan's non-hydro renewable fleet. NEPRA acknowledges wind as a mature and reliable contributor to the energy mix, with consistent year-round generation patterns.

Wind power will continue to expand in the coming years, with multiple additional projects undergoing various stages of approval and development. As transmission infrastructure upgrades progress and renewable-friendly dispatch planning improves, wind is expected to play an increasingly significant role in Pakistan's transition toward lower-cost, indigenous power generation.

Historical support or development of renewables in the country/region:

Pakistan has supported RE through:

- RE policies (2006, 2019/2020)
- Feed-in tariffs and upfront tariffs (historical)
- Net-metering regulations
- Dedicated wind corridors
- Grid expansion plans in IGCEP

Demand-side market potential or strategic nature of market development:

Strong demand from export industries (textile, apparel, packaging) and multinational corporations needing RECs for **Scope 2** reporting and **CBAM-compliance**.

Analysis of political disruptions or market risks:

- Import dependence for RE equipment
- Macroeconomic pressure and circular debt
- Grid congestion delays
- Regulatory uncertainty
- Regional security considerations

Analysis of regulatory risks, including linkages with carbon markets and support systems:

Regulatory evolution remains an important consideration for clean-energy and carbon-market development in Pakistan. The government has placed increasing emphasis on climate-aligned policies; however, as with many transitioning markets, the pace and sequencing of implementation may vary over time in line with administrative processes and broader sector reforms. Changes in institutional priorities and periodic restructuring across key ministries can influence the timing and progression of market-related decisions.

In the context of carbon markets, Pakistan's framework for environmental attribute ownership, REC treatment, and alignment with voluntary carbon standards is continuing to develop. Recent Power Purchase Agreements (PPAs) increasingly include provisions defining environmental attributes, reflecting growing institutional recognition of these mechanisms. At the same time, broader regulatory integration is progressing alongside sector reforms, including the phased implementation of the Competitive Trading Bilateral Contract Market (CTBCM). The I-TRACK REC system operated by PET provides a structured and operational mechanism to support this transition, with ongoing stakeholder engagement expected to further strengthen clarity and alignment over time.

Support mechanisms such as net metering, wheeling frameworks, grid-integration rules, and renewable-procurement processes are periodically reviewed to reflect evolving system needs. Adjustments to tariff structures, settlement mechanisms, or procurement approaches may influence the commercial dynamics of renewable-energy and REC-linked projects.

At the same time, international developments, particularly the gradual implementation of the EU Carbon Border Adjustment Mechanism (CBAM) and increasing supply-chain decarbonization requirements, are shaping market expectations. Aligning domestic energy and climate frameworks with these evolving global requirements will be important to support the competitiveness of Pakistan's export-oriented sectors.

1.13 Author

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