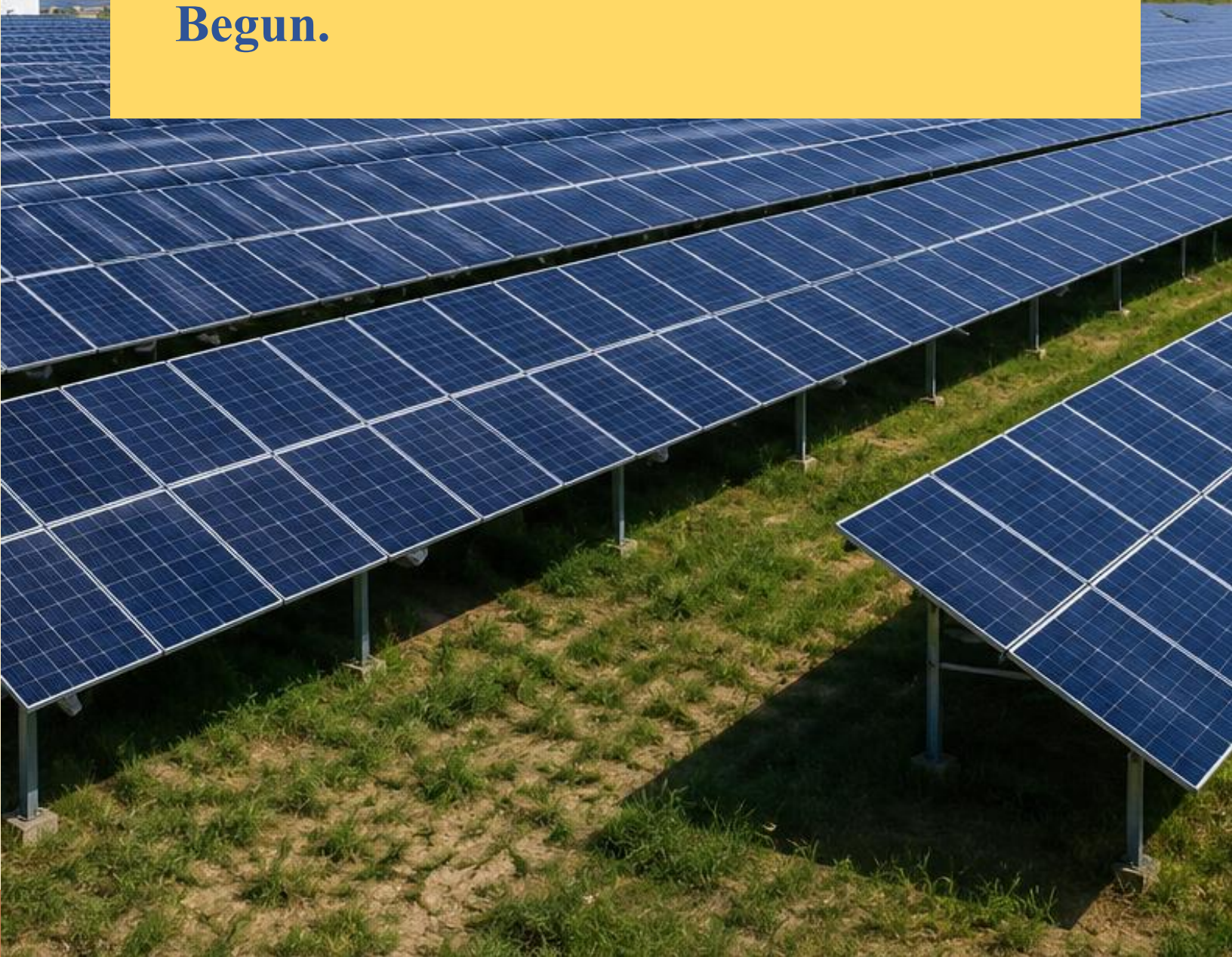




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Pakistan's Solar Super-Cycle Is Sustained. The Battery Cycle Has Begun.



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Disclaimer: This analysis represents our findings based on the most accurate data available at the time of publication. We welcome your feedback regarding any factual inconsistencies. Please direct your observations to research@pakistansolarassociation.org for formal review and reconciliation.

Note on methodology: Solar PV volume (GW) and average USD/Watt pricing figures are derived from Pakistan Customs import records. Import value figures in USD are sourced from Ember's China Cleantech Export Data that is sourced from China bilateral export statistics (HS codes 85414300, 85414200 and 38180019 for solar panels, 850760 for lithium-ion batteries). A 2–3-month lag exists between China export records and Pakistan customs clearance. The fiscal year 2025 figure (~18 GW) covers July 2024–June 2025; the calendar year 2025 figure (21.44 GW) covers January–December 2025.

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List of Abbreviations

Abbreviation	Full Form
PV	Photovoltaic
GW	Gigawatt
GST	General Sales Tax
NEPRA	National Electric Power Regulatory Authority
H1	First Half of the Year
H2	Second Half of the Year
Q1	First Quarter
Q2	Second Quarter
C&I	Commercial and Industrial
kW	Kilowatt
kWh	Kilowatt-hour
Li-ion	Lithium-ion
LiFePO ₄	Lithium Iron Phosphate
TOPCon	Tunnel Oxide Passivated Contact
HJT	Heterojunction Technology
ESG	Environmental, Social, and Governance
VRLA	Valve-Regulated Lead-Acid
HS Code	Harmonized System Code
MoM	Month-over-Month
VAT	Value Added Tax

Executive Summary

Pakistan's solar import market underwent one of the most dramatic boom-bust cycles in emerging market energy history during 2025, importing a record 21.44 GW of solar panels before collapsing 97.5% from its April peak by December. Yet the headline contraction obscures a more consequential story: the simultaneous emergence of lithium-ion battery imports as Pakistan's next primary energy technology cycle.

The 2025 solar correction was policy-driven, not a signal of market exhaustion. Five overlapping forces shaped the curve, 1) a front-loaded inventory surge ahead of regulatory changes, 2) the imposition of 10% GST, 3) NEPRA's decisive net billing revision which dismantled the 3–4-year residential payback arithmetic, 4) urban market saturation, and 5) the cascade exit of informal dealers that contracted the distribution network by 95.7%.

The market that survived this correction is smaller, more sophisticated, and structurally more durable. Q1 2026 Pakistan custom data confirm a reset: import volumes rebounded 168% within the quarter, while average pricing reached \$0.138/Watt, the highest in 15 months, as premium N-type TOPCon and HJT module procurement by commercial and industrial buyers adding aggressively in the mass residential trade. Solar import volumes for 2026 are projected in the range of 12–16 GW, a structurally supported floor.

The battery cycle is the defining signal. Full-year 2025 Li-ion battery imports totalled \$294.3M, a 100% year-on-year increase, with a historic November crossover where batteries exceeded solar in import value for the first time. The battery-to-solar value ratio, which averaged 1:7.8 in H1 2025, had already compressed to 1:3.0 by March 2026. Annual battery import value is projected to reach \$350–450M in 2026 and approach \$500–600M by 2027, driven by hybrid residential retrofits across an installed base of 8–12 million households and accelerating commercial and industrial adoption in textiles, cold chain, healthcare, and telecom.

For policymakers, a rational recalibration of the net billing framework, balancing grid financial sustainability against the strong consumer case for distributed energy, remains the primary lever to unlock latent residential demand. The C&I and battery markets will grow regardless. The only policy question is how efficiently, and equitably, the next phase unfolds.

*The 21 GW installed across Pakistan in 2025 is not the endpoint of the energy transition.
It is the foundation on which the battery market is now being built.*

POLICY ANALYSIS · ENERGY & TRADE

Pakistan imported 21.44 GW of solar panels in calendar year 2025, a volume unmatched in the country's history. By year-end, monthly imports had collapsed 97.5% from peak. Yet within that collapse, a counter-signal emerged: lithium-ion battery imports grew, crossed solar in value, and surged to a 3.7× high by March 2026. The market is not in retreat. It is in transition.

Research & Publication Division PSA | Based on Pakistan Customs Import Data & China Export Statistics, January 2025 – March 2026

The Scale of 2025, And Why the Numbers Require Context

Government trade commentary routinely references Pakistan's fiscal year solar import figure of approximately 18 GW, a July 2024 to June 2025 accounting window. That figure is accurate within its period but structurally misleading for market analysis. China's export records, which upstream-date Pakistan's arrivals by two to three months due to shipment and customs clearance lags, reveal that the true calendar year 2025 total reached 21.44 GW, equivalent in scale to the installed solar capacity of entire mid-sized economies. To contextualize the trajectory: Pakistan's annual solar imports grew from \$321M in 2018 to \$1.99 billion in 2024, then contracted to \$1.61 billion in 2025, as the second half's regulatory shock erased what had been the strongest H1 on record (\$1.23 billion). The boom, in other words, was real, and so was the correction.

Analyzing the data on a month-on-month basis, using Pakistan's own customs import records for volume (GW) and average USD/Watt pricing, cross-referenced against China's bilateral export data for absolute dollar values, reveals not one story but five overlapping forces that shaped 2025. Understanding each is necessary to read what 2026's early data is now signaling.

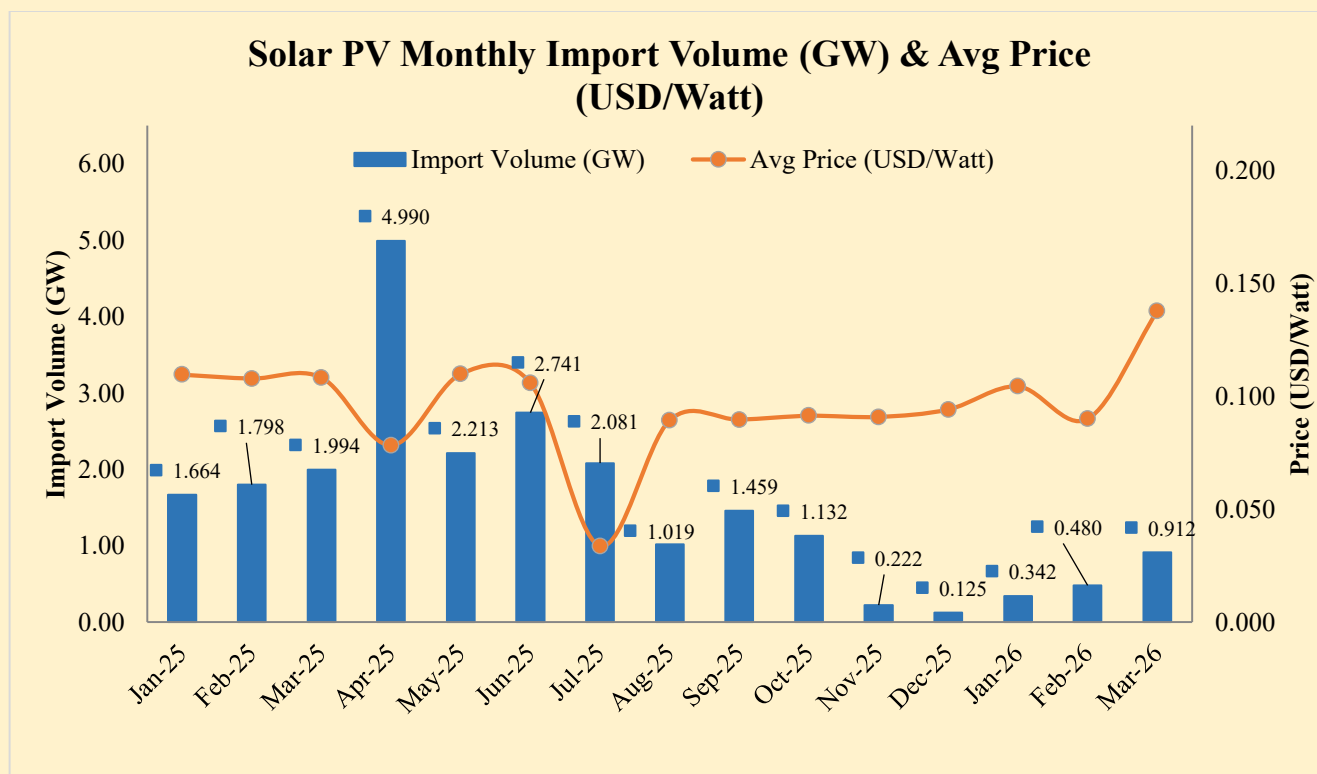


Figure 1: Monthly solar PV import volume (GW) and average price (USD/Watt) (Pakistan Import)

A Market Shaped by Five Converging Forces

The 2025 import curve, visible in Figure 1's shaded phases, was not driven by a single event but by a sequence of overlapping pressures, each compounding the one before.

I. Summer Demand and Net Metering Momentum (January–April 2025)

The year opened from a position of strength. January through March recorded steady growth, 1.66 GW, 1.80 GW, and 1.99 GW respectively, as the approaching summer season activated residential demand and households rushed to sign net metering agreements before anticipated regulatory changes. Prices held in a tight band around \$0.108–\$0.110/Watt, reflecting stable, competitive supply from Chinese Tier-1 manufacturers. April then produced a record-breaking 4.99 GW in a single month, 1,657 import shipments, more than double the prior average, as traders and distributors front-loaded inventory with foreknowledge of impending policy changes. China export data confirms \$233.6M in solar exports to Pakistan that month, against just \$32.4M in Li-ion batteries. The solar-to-battery import ratio stood at 7.2:1. This was not organic demand peak, it was a rational, market-wide hedge.

II. GST, Seasonality, and the First Demand Brake (May–June 2025)

The government's imposition of a 10% GST on solar equipment introduced the first major structural cost shock to the market, raising end-consumer system prices at a time when demand momentum was

already beginning to soften. Pakistan's solar market follows a distinct seasonal cycle: while electricity generation peaks during the extended summer period, installation activity and dealer expansion typically begin slowing toward the end of summer, particularly from late September into October, as consumers defer purchasing decisions ahead of winter and amid uncertainty around pricing and policy direction.

This seasonal slowdown became significantly more pronounced in 2025 due to the combined impact of GST-related price increases and emerging regulatory uncertainty surrounding net billing reforms. The effect is visible in import data, where volumes fell sharply from 1.13 GW in October to just 0.22 GW in November. Although May and June import volumes remained elevated at 2.21 GW and 2.74 GW respectively, these figures largely reflected the clearance of inventory accumulated during April's exceptional import surge rather than sustained end-user demand. Beneath the surface, fresh order placement had already begun contracting. Solar import value declined from \$233.6M in April to \$107.5M in June, a 54% drop in dollar terms, while Li-ion battery imports remained comparatively resilient at \$32.5M, their highest level up to that point.

III. NEPRA Net Billing, The Structural Break

The proposed revision to NEPRA's net billing regulation (S.R.O 251(1)/2026)¹ became the defining market shock of H2 2025, despite the regulations not yet being formally implemented. In December 2025, NEPRA initiated stakeholder feedback on the proposed rules, which were later applied retrospectively from 9 February 2026. However, the market reaction began months earlier. Even before formal approval, widespread uncertainty around the proposed reduction in export compensation rates triggered panic across the residential solar ecosystem. Installers, distributors, consumers, and in some cases even DISCOs began behaving as though the policy had already taken effect, created a premature demand freeze and exposed a major policy communication failure.

The impact on imports was immediate and severe. Import shipments collapsed from 955 in June to 314 in July, a single-month decline of 67%, as the market entered the late-summer slowdown period when installation activity traditionally weakens. Monthly solar import value fell from \$107.5M in June to \$85.5M in July and continued declining through the autumn and early winter months, reaching just \$7.1M in November 2025, a 94% collapse from January levels. Volume bottomed at 0.125 GW in December, during Pakistan's second major seasonal slowdown period. To put this into perspective, Pakistan imported more solar panels in a single week during April 2025 than it did during the entirety of

¹ NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (PROSUMER) REGULATIONS, 2026 [https://www.nepra.org.pk/Legislation/3-Reg/3.35%20NEPRA%20%20Prosumer%20Regulations%202026/NEPRA%20Prosumer%20Regulations%20\(SRO%20251\(1\)2026\)%2009-02-26.PDF](https://www.nepra.org.pk/Legislation/3-Reg/3.35%20NEPRA%20%20Prosumer%20Regulations%202026/NEPRA%20Prosumer%20Regulations%20(SRO%20251(1)2026)%2009-02-26.PDF)

December 2025. The combination of regulatory uncertainty, retrospective policy signaling, and seasonal weakness created a market paralysis with no near-term recovery mechanism.

IV. Market Saturation and the Exit of Pop-Up Vendors

In parallel with the regulatory shock, a structural consolidation was underway that would have happened independent of policy. The 2022–2025 solar boom had attracted thousands of informal, thinly capitalized dealers and opportunistic importers drawn by the margins of a fast-growing market. As demand contracted, inventory accumulated and capital dried up. The cascade of vendor exits is visible in the import shipment data: from a peak of 1,657 shipments in April 2025 to just 72 in December, a 95.7% collapse. The distribution network that had once made residential solar accessible to tens of millions of Pakistanis contracted rapidly to a fraction of its peak scale. Simultaneously, the addressable residential market in tier-1 and tier-2 cities had reached a saturation threshold, a significant share of feasible installations in urban centers had already been completed during the boom years, removing the incremental growth cushion.

V. A New Floor: The Shift to High-Efficiency, Value-Driven Procurement

The Q1 2026 data introduces a materially different signal. Import volumes recovered from 0.34 GW in January to 0.91 GW in March, a 168% sequential rebound within the quarter. The abolition of China's 9% VAT export rebate on solar panels, effective April 1, 2026, will likely cause a significant price hike for solar imports in Pakistan, which currently sources over 90% of its equipment from China. Since manufacturers are expected to pass this tax burden onto international buyers, the cost of panels in the Pakistani market could rise by an estimated 9% to 15%. As a result of this, the average import price climbed to \$0.138/Watt in March 2026, the highest in the entire 15-month period, despite overall volumes remaining well below 2025 peaks. This pricing shift indicates that the market is transitioning toward a broader, more integrated mix of technologies, where high-efficiency N-type TOPCon and HJT modules are finding their place alongside established products. While commercial and industrial buyers are increasingly sourcing premium modules where generation density justifies a per-unit premium, the overall trade continues to reflect a diverse ecosystem. What remains is a more sophisticated, higher-value market where multiple product tiers coexist to meet varied consumer needs, and this multifaceted sector is growing.

Pakistan's solar market was not disrupted by a single shock but reshaped by five converging forces that transformed explosive growth into strategic consolidation.

The Battery Signal: Pakistan's Next Import Cycle Is Already Underway

While the solar narrative of 2025 is one of boom and contraction, the lithium-ion battery data tells a fundamentally different story, one of growth, resilience, and an unmistakable structural inflection. At the start of 2025, Li-ion batteries represented just 7.7% of combined solar-plus-battery import value (\$16.4M against \$197.8M in solar). Through H1 2025, even as solar surged, battery imports grew steadily, rising from \$16.4M in January to \$36.8M in May, reflecting growing residential co-installation demand alongside the solar peak.

The divergence became striking in H2 2025. While solar imports collapsed under uncertainty of NEPRA's revised regulations, Li-ion battery imports proved remarkably resilient, declining only 13.6% from H1 (\$157.9M) to H2 (\$136.4M), compared to a 69.2% collapse in solar. In November 2025, the data recorded a historic crossover: Li-ion battery imports (\$26.6M) exceeded solar PV imports (\$7.1M) for the first time, representing 78.9% of combined import value. This was not a statistical aberration driven by Solar's collapse alone; it reflected genuine and independent battery demand that continued regardless of NEPRA's net metering ruling.

March 2026 confirmed the structural shift with a sharp surge. Li-ion imports reached \$60.3M, a 3.7× increase from January 2025, while solar partially recovered to \$179.1M. The battery-to-solar value ratio, which averaged 1:8 across H1 2025, had compressed to 1:3 by March 2026. The full-year 2025 battery import total of \$294.3M represents a 100% increase from the 2024 figure of \$147.1M and a 240% increase from the 2023 level of \$86.3M. The direction of the market is now unmistakable: Pakistan's energy transition is evolving from a solar-only expansion into a storage-integrated ecosystem where batteries are becoming central to future energy economics.

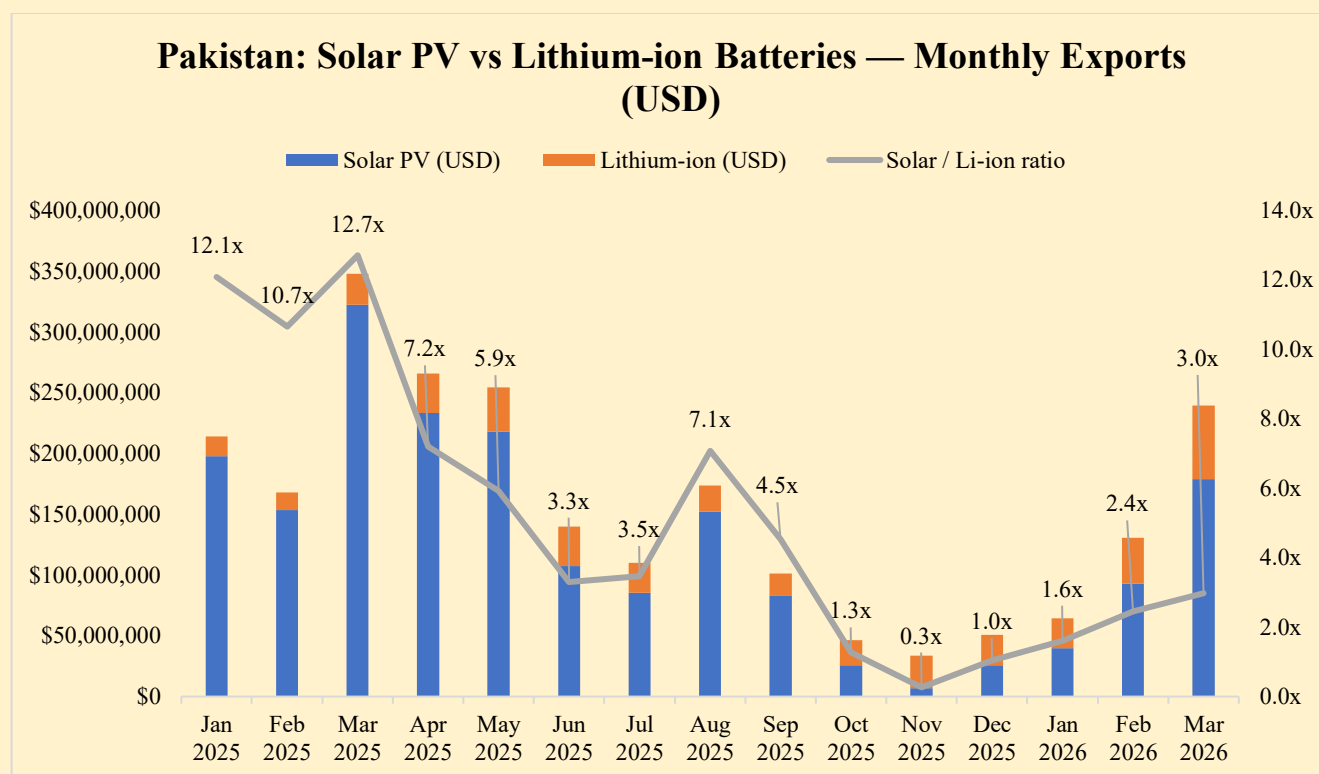


Figure 2: Solar PV vs Li-ion battery import value (USD M), showing the November 2025 crossover and March 2026 surge (Ember)²

What the Transition Means: Hybrid Consumers, C&I Adoption, and Grid Standby

The concurrent patterns, solar stabilizing at a higher-quality floor, batteries accelerating, are not coincidental. They are two expressions of the same underlying shift in how Pakistani consumers and businesses are approaching energy infrastructure.

The Residential Model Pivots: From Grid Prosumer to Energy Independent

Under the old net metering framework, residential solar was fundamentally a grid-interaction product: install panels, export surplus, collect credits, recover capital in 3–4 years. NEPRA's revision made the grid an adversarial counterparty rather than a revenue partner. The rational residential response is not to abandon solar; it is to redesign the system around the grid becoming a standby resource of last resort rather than an active participant. A 3–5 kW solar array paired with 5–10 kWh of LiFePO₄ storage can cover the energy consumption of a typical urban household around the clock, with the grid engaged only during extended low-irradiance periods. This hybrid architecture is entirely independent of net billing

² Ember's China Cleantech Export Data, https://ember-energy.org/data/electricity-data-explorer/?data=capacity&temporal_res=yearly&entity=Pakistan

rates. Its economics rest on displacement of grid electricity at escalating tariff rates, a case that strengthens with every successive NEPRA tariff determination.

This configuration change is the primary driver of the battery import surge. Every hybrid residential retrofit or new installation requires storage; the installed base of grid-tied systems from the 2022–2025 boom, potentially covering 8–12 million households, represents a large addressable retrofit market for storage. Homeowners who previously exported surplus power and received credits now have a direct financial incentive to store and self-consume what was previously sent to the grid.

An additional macro-level catalyst reinforces this trend. Regional geopolitical developments, including Iran-US-Israel tensions affecting energy supply chains and fuel transit routes, have contributed to periodic fuel price spikes and supply uncertainty in Pakistan. This has elevated the perceived value of energy independence beyond pure economics: for an increasing segment of consumers and businesses, off-grid resilience has become a risk management decision. The convergence of regulatory, economic, and geopolitical drivers is unusually powerful.

Solar-Plus-Storage Becomes a Strategic Asset for Pakistan's Industries

The commercial and industrial sector represents the most consequential and structurally durable growth segment for solar and storage in 2026 and beyond. C&I buyers were never materially dependent on net metering export credits. Their solar investment case rests entirely on self-consumption savings against industrial grid tariffs of PKR 60–80/unit, and at current module prices, payback periods remain comfortably within 2.5–4 years regardless of NEPRA's net billing changes.

The sectors most actively transitioning toward solar-plus-storage captive power solutions, and most likely to drive C&I import growth through 2026–2027, include:

- **Textile and export manufacturing:** Pakistan's export competitiveness increasingly depends on energy cost reduction. International buyers, particularly in EU and US markets, are applying ESG pressure for renewable energy certification, adding a compliance dimension to the pure economics case.
- **Cold chain, food processing and agriculture:** High load factors, 24/7 operations, and acute sensitivity to supply interruptions make solar-plus-storage the dominant investment priority. Pakistan's growing cold chain infrastructure for horticulture exports requires reliable, low-cost power.

- **Private healthcare and hospitals:** Backup power reliability and tariff sensitivity intersect. The transition from diesel generator backup to solar-plus-lithium storage systems is already advanced in tier-1 hospitals and is cascading to tier-2 facilities.
- **Shopping malls, commercial plazas and hospitality:** Large south-facing rooftops, high daytime electricity demand, and customer-facing sustainability positioning make these ideal solar-plus-storage candidates. Several major retail chains are already evaluating grid-independence transitions.

For C&I applications, the optimal system architecture increasingly incorporates battery storage not merely as backup but as a load-shifting and grid-arbitrage asset, charging from solar during peak generation and discharging during peak tariff periods. This use case delivers returns independent of net metering policy and drives a higher battery-per-panel procurement ratio than the legacy residential market.

Outlook: Where the Data Points

Pakistan's solar import market in 2026 is expected to settle into a new equilibrium of 12–16 GW annually, reflecting a structurally resilient baseline rather than a market in permanent contraction. Seasonal uplift in Q2 2026 as summer approaches, continued C&I project activity, and the hybrid residential retrofit market will provide support, while the residential grid-tied segment remains suppressed under the current regulatory framework. The critical variable remains NEPRA policy: any meaningful restoration of prosumer economics, whether through legislative, judicial, or regulatory channels, represents the primary upside catalyst for solar volumes.

The battery outlook is considerably more constructive. Annual Li-ion import value is projected to reach \$350–450M in 2026 and approach \$500–600M by 2027, representing compound annual growth of 25–35% and a sustained re-rating of batteries as a primary energy import category. The ratio of battery-to-solar import value, which averaged 1:8 in H1 2025, is forecast to reach 1:2 by end-2026 and potentially approach parity in value terms by 2028. Pakistan's energy import composition is shifting from a panel-dominated profile to an integrated energy storage economy, a transition consistent with the global direction of travel and one for which the structural conditions in Pakistan are unusually favorable: persistent grid unreliability, escalating tariffs, rapidly declining lithium costs, and a consumer base that has already built solar generation capacity and now needs only the storage layer to achieve complete independence.

The 21 GW installed across Pakistan in 2025 is not the endpoint of the energy transition. It is the foundation on which the battery market is now being built.

For policymakers, the data presents a timely opportunity. A rational recalibration of the net billing framework, one that balances grid financial sustainability against the manifestly strong consumer case for distributed energy, would unlock the residential market's latent demand while the C&I and battery sectors continue their independent growth trajectories. The energy transition that millions of Pakistani consumers began when they installed their first solar panel is not reversible. The only policy question is how efficiently, and equitably, the next phase unfolds.