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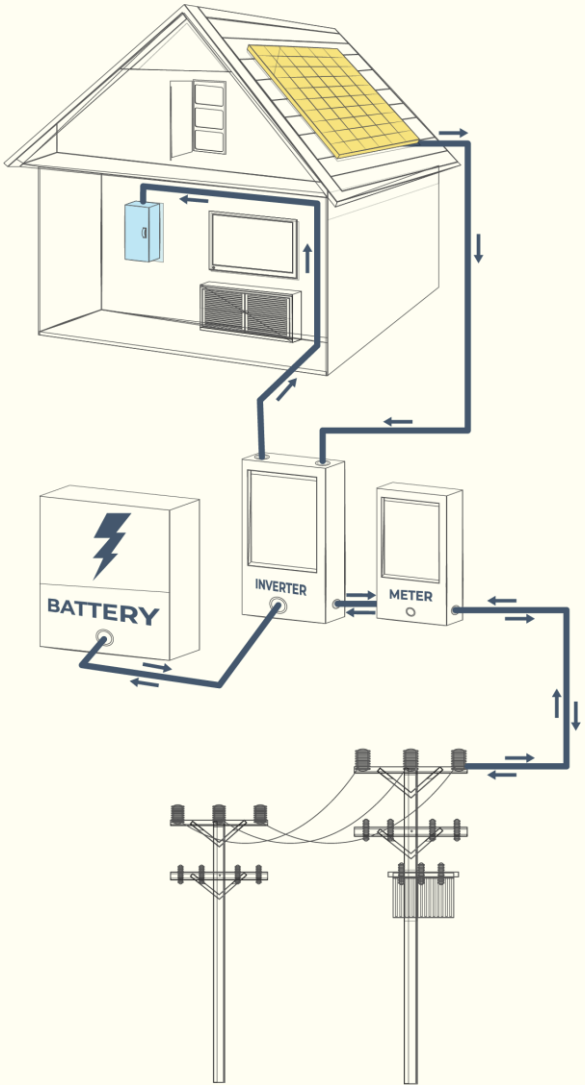

From **Solar Panels** to **Storage**: Pakistan's Battery Boom Begins

A data-driven study of Pakistan's consumer-led shift to battery energy storage.

Energy & Storage Series

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Disclaimer:

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Wherever solar rushes in, batteries follow, and Pakistan is no exception

Global cumulative solar PV capacity reached a record 2,500 GW in 2025, with 600 GW added that year alone. Pakistan's solar story reflects the same momentum, with cumulative solar PV deployed capacity reaching 38 GW by FY25, almost entirely through distributed installations. Millions of households, farms, and businesses invested their own savings in solar PV to reduce reliance on the grid. Favourable net metering policies opened the door to solar adoption, while rising tariffs, prolonged power outages, and falling Chinese solar panel prices accelerated the solar rush across the country. The result: distributed solar generated 51 TWh in FY25, even as national grid supply fell for the third consecutive year, leaving two electricity systems running in parallel, a stagnating centralised grid and a consumer-built solar fleet that official datasets barely capture. The Hormuz disruption in March 2026 exposed the energy security risks of imported fossil fuels used by Pakistan's thermal power fleet and by the industrial segment, while the consumer energy resources (CERs) continued generating uninterrupted electricity.

Battery storage is following the rooftop solar's growth trajectory. Falling Lithium Iron Phosphate (LFP) battery prices, driven by China's manufacturing scale and declining raw material costs, continue to improve the economics of distributed storage. Increasingly, solar owners are investing in Lithium-ion batteries to store surplus solar electricity for evening use and reduce the impact of high tariffs and unfavourable net billing. Lithium-ion battery energy storage system (BESS) imports rose 220% year-on-year (YoY) to 4.6 GWh in calendar year 2025. With distributed solar reshaping Pakistan's electricity sector at pace, battery storage has moved from a niche add-on to a structural necessity. It anchors energy security at the local level while ensuring rooftop solar delivers its full economic and operational value.

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Data highlights: The numbers behind Pakistan’s developing battery rush

1 in 26

Solarized households with battery storage installed

By FY25, **7.3 million households** in Pakistan had solar installed on their rooftops; out of a total 40 million households in the country, that makes nearly 1 in 5 of all Pakistani homes.

With the battery rush gaining pace, around **282,000 solarized households**, roughly **4%**, now have BESS installed at home. That's 1 in every 26 solarized households, a share that is rising fast as storage costs fall.

7.6 GWh

Cumulative BESS imports (2018–2025)

Out of the 7.6 GWh of lithium-ion batteries imported into the country in last eight years, **60% (4.6 GWh)** arrived in 2025 alone, marking a **220% YoY** surge.

This developing battery rush is driven by a convergence of forces: soaring electricity prices in the country, increasing solarized households, falling battery costs globally, and net billing reforms, all accelerating the rise of CERs.

3.1 GWh

Cumulative Residential BESS imports (2018–2025)

Residential consumers account for roughly **40%** of Pakistan's total lithium-ion battery imports, with cumulative residential BESS imports reaching **3.1 GWh out of the 7.6 GWh** imported by the end of 2025.

Initial findings suggest that, much like Pakistan's solar rush, its developing battery rush too is being driven from the bottom up; by households rather than utilities.

Data source: Renewables First’s calculations

CERs are now driving battery boom

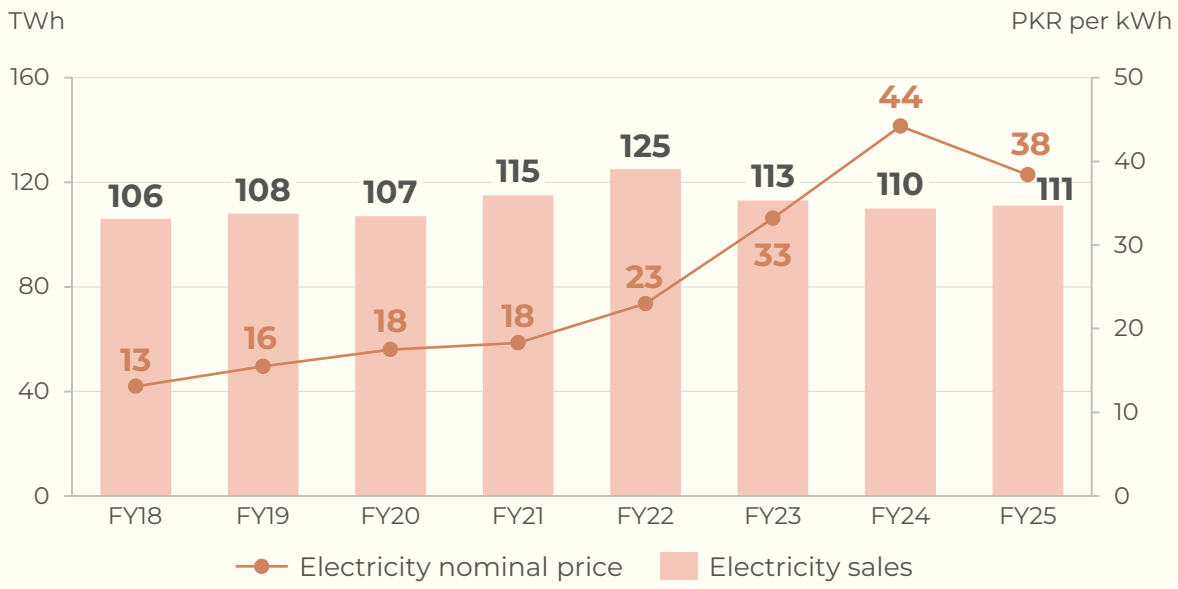
Pakistan's electricity crisis created the conditions for a solar revolution

Soaring electricity prices triggered the largest consumer-led energy transition in the country's history, fundamentally reshaping electricity demand patterns and accelerating the move away from the grid.

155%
Increase in tariff FY20 – FY24

13 cents per kWh
Highest tariff among neighboring countries

11%
Drop in grid sales for three consecutive years



Electricity sales and nominal electricity price, FY18 – FY25

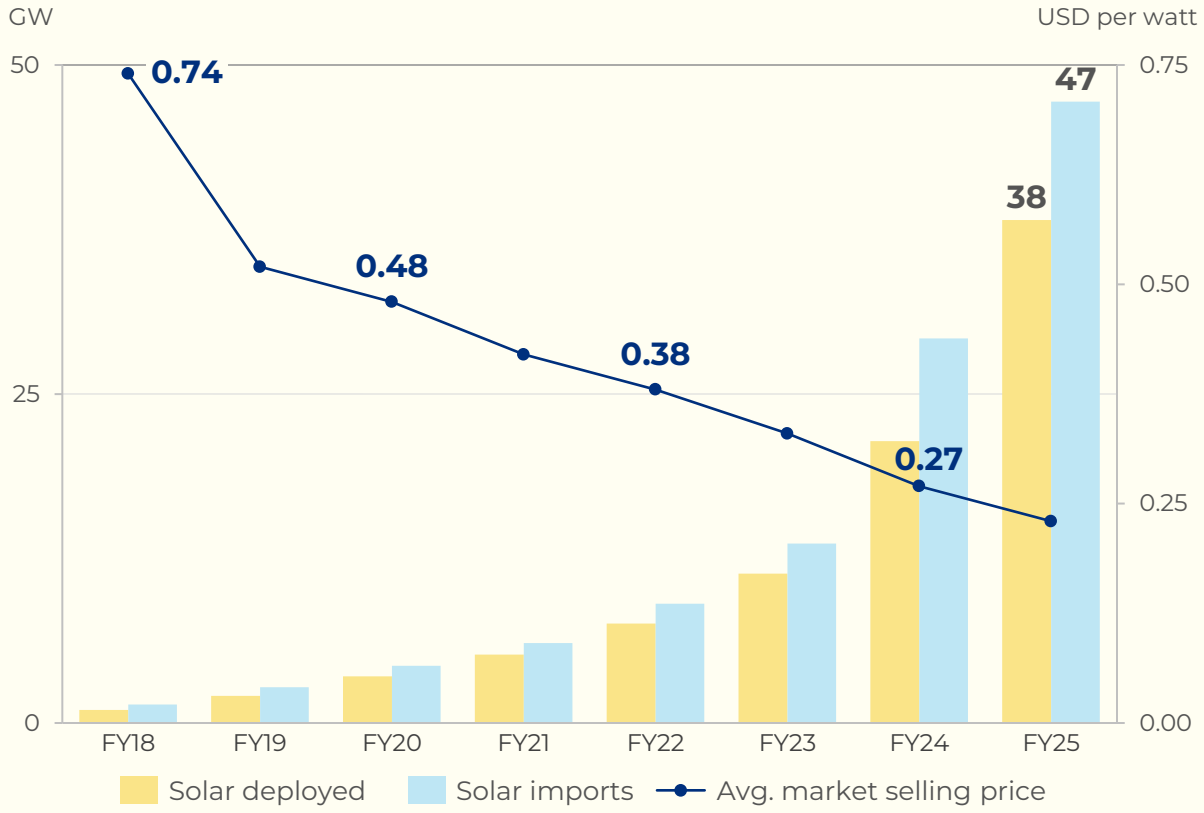
- Between FY20 and FY24, electricity tariffs surged by 155%, pushing the average tariff to almost PKR 44 per kWh and placing unprecedented financial pressure on households and businesses.
- Pakistan's electricity prices are among the highest in the region, at 13 cents per unit, compared to India and Bangladesh, where tariffs are nearly 50% lower. Grid electricity, already unaffordable for many, is becoming increasingly out of reach, further eroding the competitiveness of businesses.
- At the same time, persistent load shedding and unreliable power supply have further undermined confidence in the grid, disrupting industrial and commercial activity and increasing the cost of doing business.
- As tariffs climbed and reliability concerns intensified, electricity demand growth collapsed by a record 10% in FY23 and has remained largely stagnant since, despite population growth and the addition of new electricity consumers.

The combination of high tariffs and unreliable electricity supply triggered a structural shift in consumer behaviour, accelerating the move toward rooftop solar and now, increasingly, battery storage.

Data source: NEPRA State of Industry reports & Renewables First's calculations

Every kilowatt of rooftop solar is quietly building demand for storage

As rooftop solar adoption accelerates, battery storage is emerging as the logical next step in Pakistan's energy transition story, letting consumers capture surplus daytime generation and deploy it during evening peak-tariff hours.



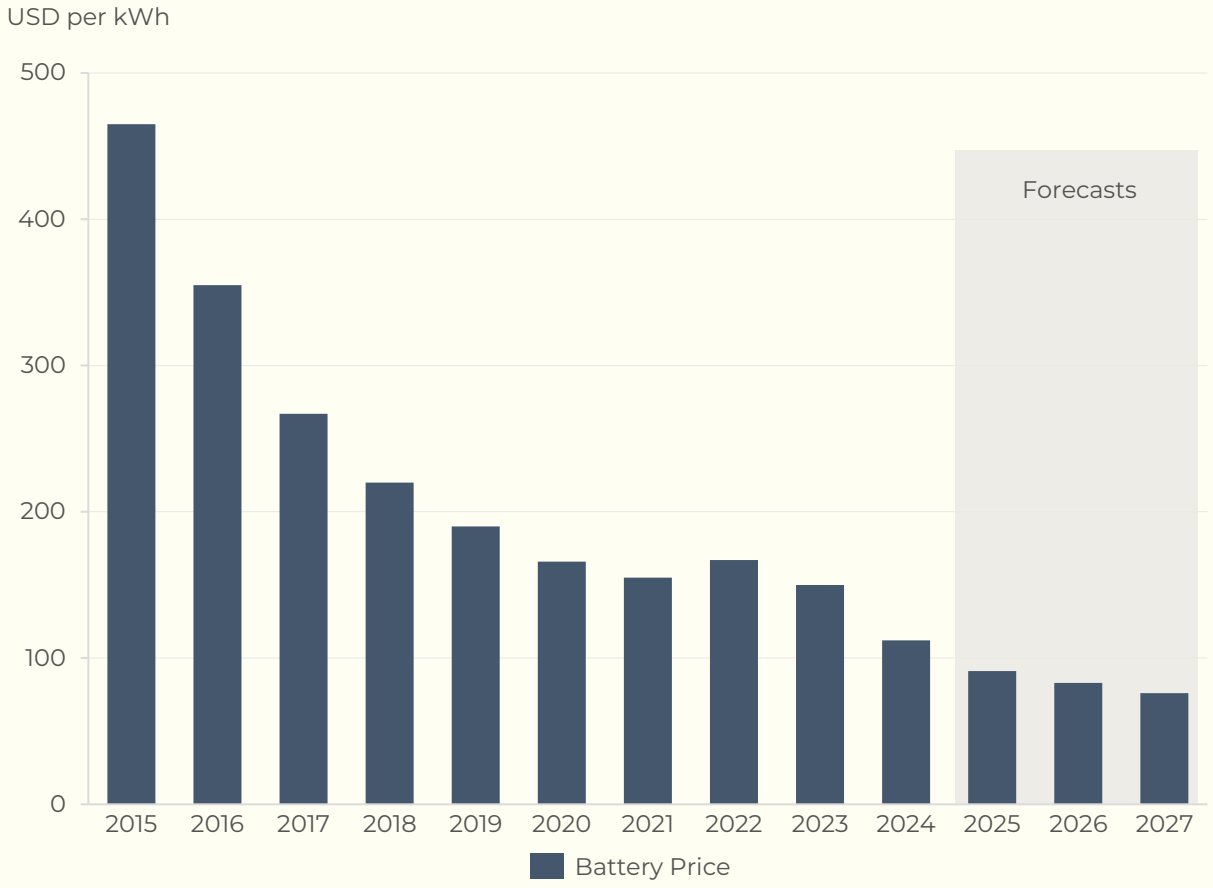
Solar panels imported and deployed, and avg. market selling price, FY18 – FY25

- Consumers responded to the electricity crisis by rapidly adopting rooftop solar as global PV prices dropped, thus reducing their dependence on the grid and protecting themselves from rising electricity costs.
- Dramatic decline of solar panel prices improved solar economics, triggering an unprecedented rooftop solar boom in the country.
- Consequently, cumulative solar panel imports reached nearly **55 GW** by Mar-26, while installed solar capacity is estimated at **38 GW** by Jun-25.
- However, as solar penetration increased, a new challenge emerged as surplus electricity generated during the day cannot be consumed immediately.

With net billing reducing the value of exports to the grid, storing surplus solar energy is becoming increasingly attractive, setting the stage for a **battery rush.**

Data source: Chinese customs, import data & Renewables First's calculations

Falling battery prices are gearing up Pakistan's battery storage market



Plummeting battery prices over the past decade, 2015 - 2027

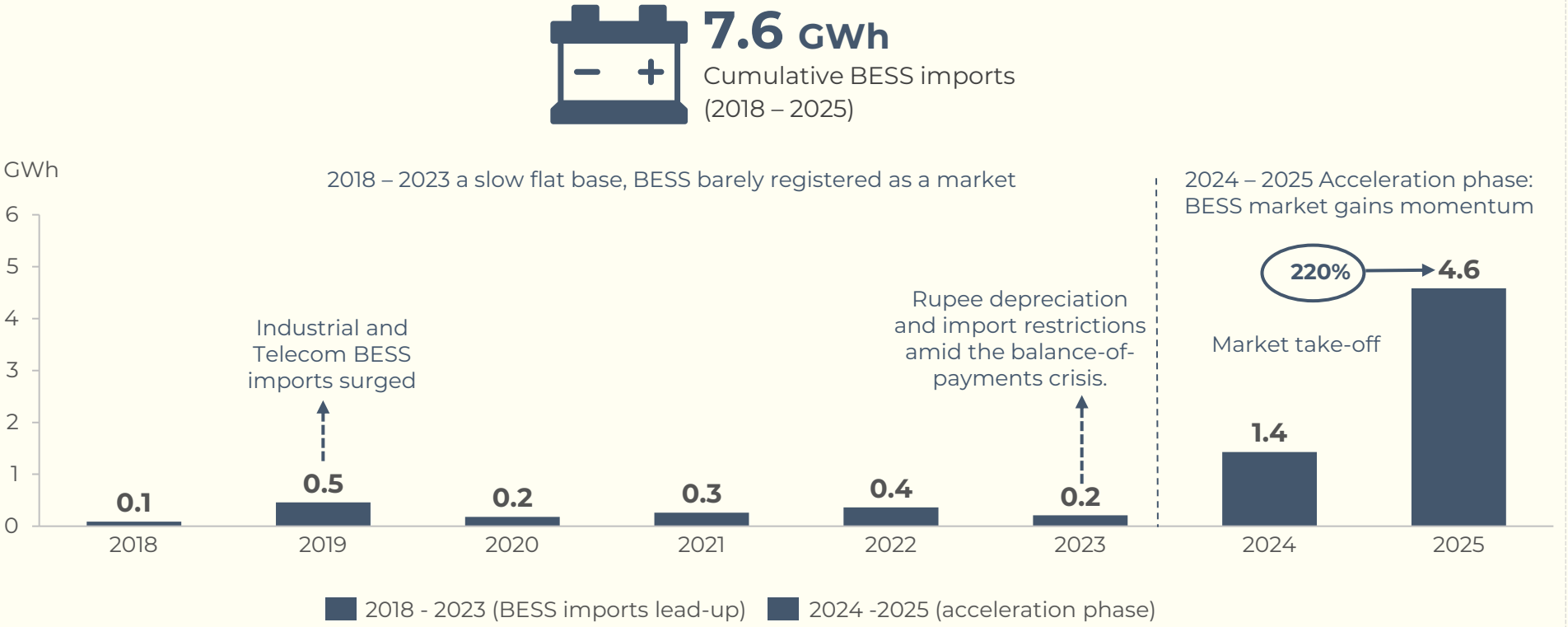
- Battery prices have fallen roughly 75% over the past decade, from over USD 460 per kWh in 2015 to approx. USD 110 per kWh in 2024, with forecasts pointing to further declines through 2027.
- This global decline is reaching the Pakistani market already primed to absorb it. Economical Chinese battery systems are arriving in Pakistan just as high grid tariffs and the rooftop solar boom have created ready demand for storage.
- If the price trajectory holds, BESS imports are likely to accelerate. Sustained cost declines would drive wider battery uptake across residential, commercial, and industrial segments, extending the momentum already visible in the data.

Data source: Bloomberg NEF & Goldman Sachs, 2024-2027 outlook

Tracking BESS import numbers

Pakistan's cumulative lithium-ion BESS imports hit 7.6 GWh by the end of 2025

Of the cumulative 7.6 GWh of BESS imported, 4.6 GWh was added in 2025 alone. The 2025 surge reflects growing co-deployment of rooftop solar with BESS. This represents a fundamental shift in consumer behaviours, as consumers seek to manage energy arbitrage and to avoid higher tariffs during peak timings.



Lithium-ion battery energy storage system volume imported, 2018 - 2025

Data source: Chinese customs, import data & Renewables First's calculations

Battery storage adoption is gaining momentum across the consumer market

Consumer BESS imports increased from 1.25 GWh in 2024 to 4.34 GWh in 2025, a 247% YoY increase. Residential consumers accounted for 58% of total imports, making households the dominant driver of battery storage demand. As BESS adoption accelerates, the residential segment is expected to remain the cornerstone of Pakistan's distributed energy transition.

Sectoral breakdown	Year 2024 GWh	Year 2025 GWh
Residential	0.62	2.45
Commercial	0.09	0.98
Industrial	0.54	0.91
Consumers BESS imports	**1.25***	**4.34***
Telecom	0.18	0.25
Total BESS imports	**1.43**	**4.59**

***Note:** Comparable figures for consumer BESS were also mentioned in IEEFA's battery study; however, this analysis goes further by including telecom BESS imports, capturing all BESS-reliant sectors in the country.

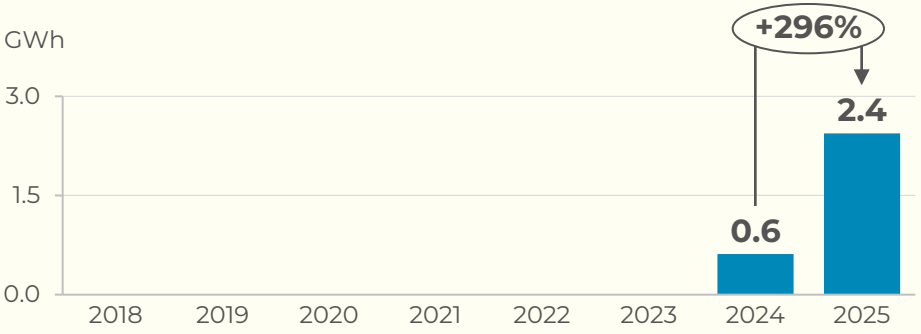
Sectoral breakdown of BESS import volume, 2024 vs 2025

Data source: Chinese customs, import data & Renewables First's calculations

CER uptake drives residential BESS imports to 2.4 GWh in 2025, capturing the largest market share

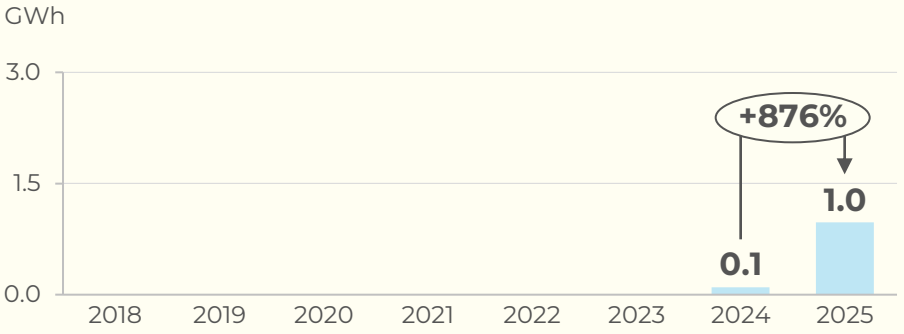
Residential BESS imports, 2018 - 2025

Residential BESS imports reached a cumulative **3.1 GWh** by the end of 2025, with 2.44 GWh (over 80% of that total) arriving in 2025 alone, as consumers increasingly pair rooftop solar with storage to reduce grid reliance.



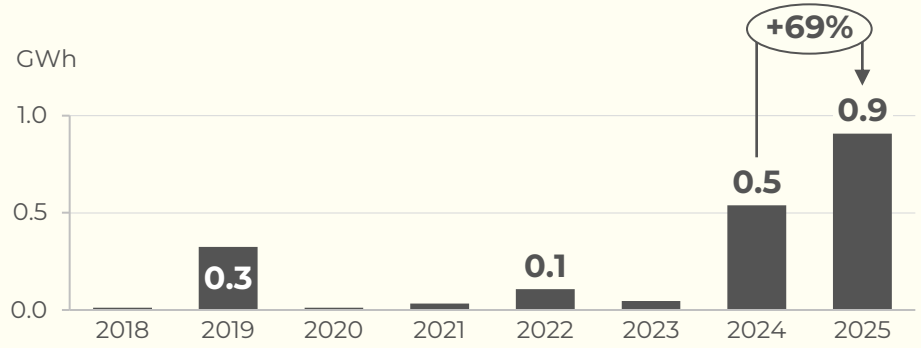
Commercial BESS imports, 2018 - 2025

Commercial BESS imports reached **1.0 GWh** by the end of 2025, driven by growing SME energy needs and solar integration across commercial facilities.



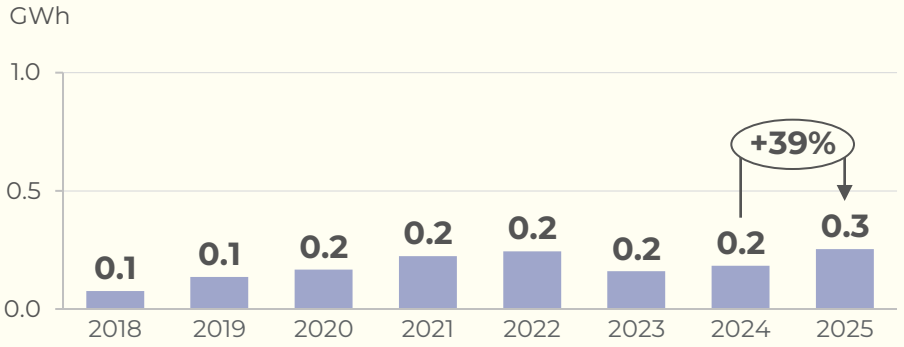
Industrial BESS imports, 2018 - 2025

Industrial BESS reached **2.0 GWh** by the end of 2025, driven by high-load energy optimization needs, process continuity requirements, and growing solar adoption across industrial facilities.



Telecom BESS imports, 2018 - 2025

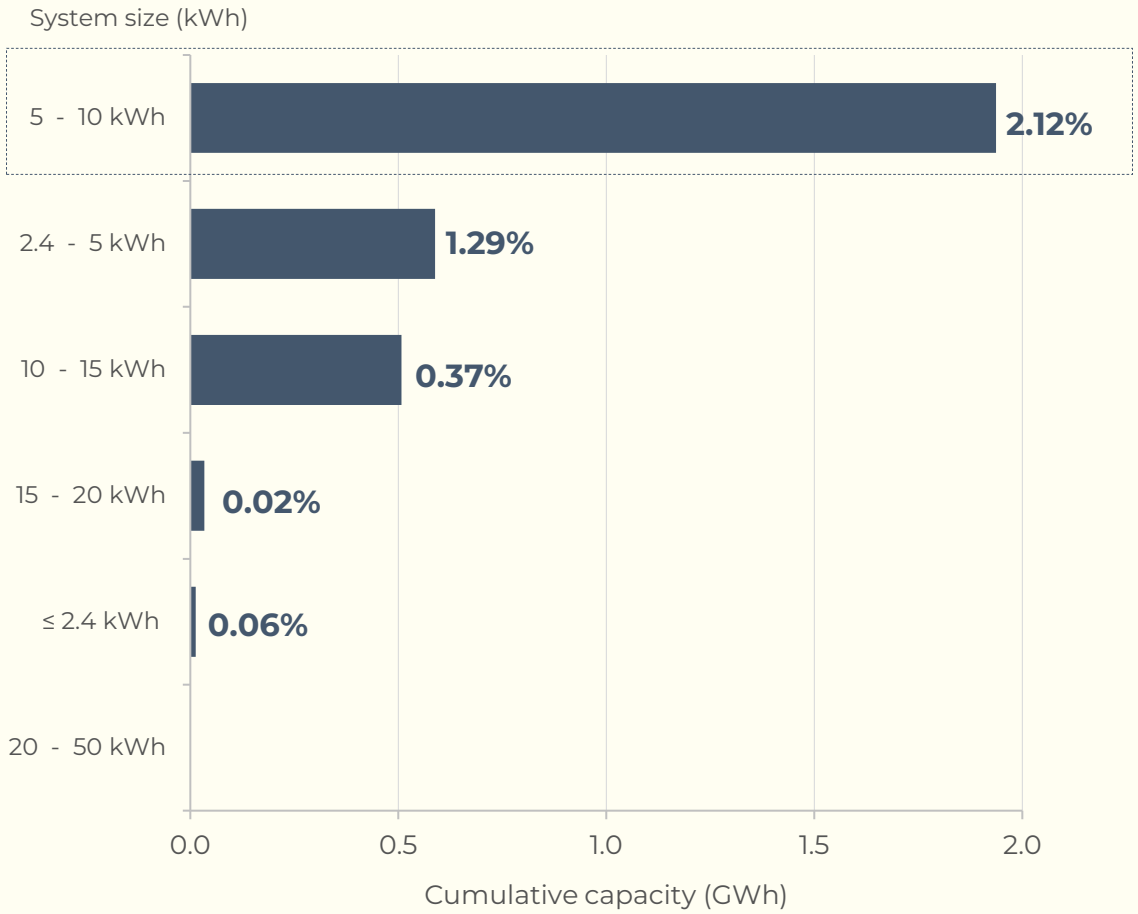
Telecom BESS reached **1.4 GWh** by the end of 2025, driven by tower backup needs, off-grid connectivity, and the gradual displacement of diesel generators across base station networks.



Data source: Chinese customs, import data & Renewables First's calculations

1 in 26 solarized households and counting

Lithium ion battery storage reaches 1 in 26 solarized households as Pakistan's BESS market accelerates



Residential BESS cumulative capacity by battery size segment, 2018 - 2025

- Pakistan's residential rooftop solar market reached an estimated **16 GW** in FY25. The number of solarized households increased by **147%**, rising from 3.0 million in 2023 to **7.3 million** in 2025.
- Residential lithium-ion BESS imports reached **3.1 GWh** by 2025, equipping an estimated **282,000 households**. The **5–10 kWh** segment dominates, striking the best balance between affordability, backup duration, and household energy needs.
- Despite rapid solar adoption, only **4% (1 in 26)** solarized households currently have lithium-ion battery storage, highlighting the significant untapped potential for residential BESS deployment.

Note: Bar = Cumulative capacity (GWh),
Percentage = share of solarized households at that size

Data source: Chinese customs, import data , CORE Financing study & Renewables First's calculations

Data notes and assumptions

Annex I: C&I and Telecom BESS classification methodology

Commercial, industrial, and telecom BESS units were identified by checking key details like capacity, battery type, product description, and brand or model to confirm they were genuinely stationary storage systems. Factors such as sanctioned load, solar system size, grid connection, and intended use were then applied as standard sector assumptions to estimate how the imported BESS capacity is likely being used.

Sector	BESS size used in classification	Use case description
Commercial BESS	50 kW upto 1 MW	Beyond peak shaving, commercial storage supports TOU arbitrage, power factor correction, backup power for critical operations, solar self-consumption and smoothing, and, where markets allow, frequency regulation and demand response
Industrial BESS	1 MW and above	Beyond peak shaving, industrial storage supports TOU arbitrage, power factor correction, backup power for critical operations, uninterrupted power supply during outages for sectors like textiles and petrochemicals, solar self-consumption and smoothing, and, where markets allow, frequency regulation and demand response.
Telecom BESS	1 KW to 60 KW, (specified brands & importers)	Beyond peak shaving, telecom storage supports TOU arbitrage, power factor correction, backup power for critical operations, uninterrupted power supply during outages for tower sites and network infrastructure, solar self-consumption and smoothing, and, where markets allow, frequency regulation and demand response.

Data source: Chinese customs, import data & Renewables First's calculations

Annex II: Residential BESS classification methodology

Residential BESS units were identified by checking capacity and other key details. Only battery units with a per-unit capacity between 2.4 and 50 kWh were included. These capacities were confirmed using product descriptions, brand and model information, with checks in place to exclude irrelevant or non-residential entries.

The confirmed residential battery imports were then grouped into four household storage segments, based on battery capacity, typical household electricity use, and common rooftop solar setups. These segments are meant as an analytical framework for understanding deployment patterns, not as fixed technical standards.

Residential Segment	Sanction Load	Solar PV system (kW)	Battery Capacity (kWh)	Use case description
Small household	Up to 5 kW	Upto 5	2.4–5	Entry point for residential solar-storage adoption, sized to cover critical loads like lighting, fans, and refrigeration during outages.
Medium large household	5–10 kW	5–15	5–20	The mainstream residential segment, typically running one to two battery modules to balance evening demand with daytime solar generation.
Large household	10 kW+	10+	20–50	The upper end of the residential market, where extended backup and near-total solar utilization are prioritized; retained only where deployment evidence was strong.

Data source: Chinese customs, import data & Renewables First's calculations

What to expect next?

Mapping where Pakistan's battery market goes from here

Building on these datasets, our next step is to model how BESS imports and deployment trends could evolve over the coming decade if current growth rates hold. This forecasting exercise aims to give policymakers, DISCOs, and market participants an early, data grounded view of where Pakistan's battery storage market is headed, and what infrastructure, regulatory, and grid planning decisions need to happen now to keep pace with it.

We see this as a collective effort. As we refine these projections, we welcome input, data, and on-the-ground perspectives from partners across the sector, because tracking Pakistan's energy transition is stronger when it's done together.

Renewables First (RF) is a think and do tank for energy and environment. Our work addresses critical energy and natural resource issues with the aim to make energy and climate transitions fair and inclusive.

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