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The Standalone Energy Storage Market in India

Examining Evolution, Trends and Future Prospects for Industry

Prabhakar Sharma, Senior Consultant, JMK Research & Analytics
Pulkit Moudgil, Research Associate, JMK Research & Analytics
Aman Gupta, Research Associate, JMK Research & Analytics

Contributing Authors
Vibhuti Garg, Director-South Asia, IEEFA
Charith Konda, Energy Specialist, India Mobility and New Energy, IEEFA
Labanya Prakash Jena, Consultant - Sustainable Finance, IEEFA

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Key Findings

Standalone Energy Storage Systems (ESS) are rapidly emerging as a key market, with 6.1 gigawatts of tenders issued in the first quarter of 2025 alone, accounting for 64% of the total utility-scale energy storage tendering activity.

Tenders supported by Viability Gap Funding (VGF) demonstrate significantly improved viability, with tariffs approximately 40% lower than non-VGF projects for two-hour storage durations.

The Standalone ESS industry continues to face persistent challenges such as project cancellations, supply-chain constraints, weak domestic manufacturing and power purchase agreement delays.

Players such as IndiGrid and HG Infra Engineering are focused on Battery + ESS (BESS). In contrast, Greenko is solely concentrated on Pumped Hydro Storage (PHS), while JSW Energy has a presence across both BESS and PHS segments.

Executive Summary

India's ambitious clean energy transition demands a parallel development in energy storage infrastructure, with Standalone Energy Storage Systems (Standalone ESS) emerging as a key enabler. As the country rapidly scales up variable renewable energy (VRE), Standalone ESS offers a dispatchable solution to address the intermittency of renewables, support grid stability, and optimise energy usage.

Unlike VRE-paired ESS, which is typically owned or contracted by renewable energy developers to store and dispatch power to smoothen renewable integration, Standalone ESS functions as an independent asset. Utilities, grid operators or third-party entities can own and deploy it flexibly to provide grid balancing, peak shaving and ancillary services, enabling storage to operate based on grid requirements rather than generator constraints. Additionally, emerging business models such as Energy Storage as a Service (ESaaS) offer storage as a service rather than an owned asset, lowering the entry barrier for users through subscription-based or pay-per-use arrangements.

In the first quarter of 2025, Standalone ESS tenders reached 6.1 gigawatts (GW), which accounted for 64% of all utility-scale energy storage tenders, which included all other use cases of ESS such as Standalone ESS, renewable energy + ESS, and Firm and Dispatchable Renewable Energy (FDRE). This capacity, issued across 11 tenders in just three months has already surpassed the total issuance in 2024. The Viability Gap Funding (VGF) scheme, which offers up to 30% support for capital expenditure of standalone Battery ESS (BESS) projects, has primarily driven this acceleration. This initiative has addressed declining battery costs while enhancing project viability.

The VGF framework has also made projects more economically viable. In recent auctions, BESS tenders in Maharashtra (August 2024, 300 megawatts (MW)) and Rajasthan (November 2024, 500MW) secured monthly tariffs as low as Rs219,001-221,100/MW (US$2,561-$2,586/MW/month), representing almost a 40% reduction compared to non-VGF projects with similar specifications.

Central and state agencies continue to play a crucial role in scaling deployment. NTPC leads the way, having issued six BESS tenders totalling 5.75GW since 2022. At the state level, Gujarat Urja Vikas Nigam Limited (GUVNL) and Maharashtra State Electricity Distribution Company Limited (MSEDCL) have further advanced adoption by issuing large-scale tenders tailored to their grid and reliability requirements.

India's grid-scale Standalone ESS market is also witnessing a diversification of players, with both established power sector giants and new entrants actively participating. Large independent power producers (IPPs) such as JSW Energy, Greenko, and Torrent Power are leveraging their experience to lead deployments. JSW Energy, for instance, has emerged as the market leader with nearly 2GW of awarded capacity. At the same time, newer entrants such as Pace Digitek, Oriana Power, Kintech Synergy and Bondada Engineering are gaining ground in BESS-based tenders, expanding the market beyond traditional players.

Despite growing policy momentum and market activity, India's Standalone ESS sector remains nascent, primarily due to persistent execution and commercial bottlenecks. A key barrier has been the delay or cancellation of power sale and storage agreements, often triggered by offtakers anticipating further tariff reductions due to falling battery prices. These uncertainties have already led to the cancellation of 6.4GW of awarded capacity.

Beyond contracting delays, the sector faces structural hurdles related to supply chains, manufacturing and financing. India's installed BESS capacity remains limited, with most utility-scale projects relying on a small pool of vendors, many of whom operate through international joint ventures. A lack of domestic battery cell manufacturing, compounded by heavy dependence on critical mineral imports such as lithium and cobalt, further exposes the market to global price volatility and geopolitical risks. While recent mineral discoveries in India offer long-term promise, delays in refining infrastructure and commercialisation timelines limit their short- to medium-term impact. Meanwhile, access to affordable project financing remains challenging, especially for smaller developers, as investors remain cautious of the sector's early-stage risks and long payback periods.

Looking ahead, India's Standalone ESS market stands at a critical inflection point. With the right mix of sustained policy support, streamlined regulatory processes, and targeted investments in domestic manufacturing and supply chains, the sector can overcome early-stage barriers and unlock its full potential. As energy storage becomes integral to renewable integration and grid resilience, Standalone ESS will play a defining role in shaping a reliable and flexible energy system.

Introduction

Energy Storage Systems (ESS) capture surplus energy for later use, securing a reliable and efficient power supply when required. Energy storage systems such as pumped hydro storage (PHS) and flywheels have traditionally supported grid operations through ancillary services such as frequency regulation and load balancing. However, with the growing share of variable renewable energy (VRE), its role is evolving to ensure grid reliability and uninterrupted power supply.

A significant shift in the ESS landscape is the growing prominence of Standalone Energy Storage Systems (Standalone ESS), which function as independent assets rather than being paired with VRE generation sources. Typically, renewable energy developers own or contract VRE-paired ESS, which they primarily use to store and dispatch power, ensuring smoother renewable integration. In contrast, independent entities, utilities or grid operators can own Standalone ESS and deploy it flexibly for grid balancing, peak shaving and ancillary services.

Standalone ESS is transforming energy storage deployment by shifting to a service-based approach, also known as Energy Storage as a Service (ESaaS). This model enables third-party providers to own, operate and maintain energy storage systems, offering them through subscription or pay-per-use structures. This approach enhances cost-effectiveness, promotes efficient energy use, and provides consumers with greater flexibility by enabling on-demand access to ESS.

With a growing emphasis on large-scale VRE integration, the Indian government has introduced incentives such as Production-linked Incentives and Viability Gap Funding for battery energy storage systems (BESS), and regulatory frameworks such as national energy storage policy, energy storage obligation (ESO), to accelerate ESS adoption. Recognising the role of storage in grid stability and renewable energy integration, India's National Transmission Plan (October 2024) projects an ESS capacity of approximately 83 gigawatts (GW) by 2032, comprising 47GW of BESS and nearly 36GW of PHS.[1] As energy markets evolve, Standalone ESS will likely play a key role in accelerating storage adoption and optimising energy management across sectors.

Despite India's ambitious energy storage targets, the deployment of Standalone ESS faces several challenges, including delays and cancellations in power agreement signings, high upfront costs, and limited domestic manufacturing. This report examines the role of Standalone ESS in India's energy transition, analysing trends in the tendering landscape, exploring key barriers to deployment and identifying the path ahead to accelerate its adoption.

Standalone ESS Applications

As India scales up renewable energy, Standalone ESS is becoming essential for managing intermittency, stabilising the grid and optimising energy distribution. By storing excess generation

[1] Central Electricity Authority (CEA). National Electricity Plan Volume II. October 2024. Page 95.

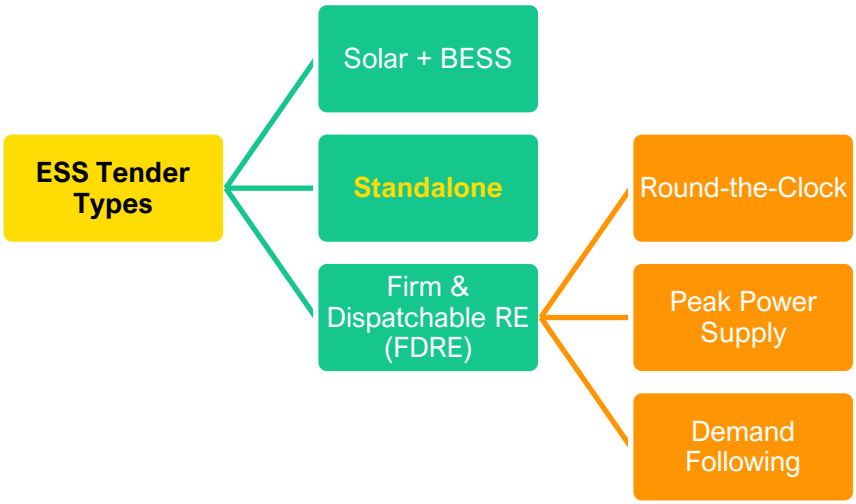
and discharging when needed, ESS enhances efficiency, reduces curtailment and defers costly grid upgrades. It enables better utilisation of transmission infrastructure while minimising dependence on conventional power sources. As the share of renewable energy in total energy generation increases, ESS will be key to balancing supply and demand, ensuring reliability, and supporting long-term sustainability. The following are the major applications of ESS (including Standalone ESS):

1. **Grid Stability and Flexibility:** With increasing renewable penetration, traditional grids face frequency fluctuations and voltage imbalances, which can lead to power outages or inefficiencies. Standalone ESS provides frequency regulation and voltage support, ensuring a more resilient and reliable grid. These functions collectively improve grid efficiency, reducing reliance on fossil-fuel-based backup generation and lowering overall carbon emissions.
2. **Electricity Cost Savings:** Time-of-use optimisation allows Standalone ESS to store electricity when prices are low and discharge it when prices rise, enabling cost-effective energy management for industries, commercial consumers and utilities. This is particularly beneficial for power distribution companies (DISCOMs), which face financial burdens due to expensive peak-hour procurement costs and power purchase agreements (PPAs) with high variability.
3. **Peak shaving:** In India, where daily peak demand surges in the evening when solar generation drops, utilities and consumers face significant cost pressures due to the high price of power procurement during these hours. Standalone ESS helps reduce reliance on costly peak-hour power generation by storing energy during off-peak periods and discharging it when demand surges. For commercial and industrial (C&I) consumers, behind-the-meter storage lowers demand charges by preventing peak consumption spikes. As India expands renewable energy, peak shaving will be essential for grid stability, cost optimisation and reducing fossil-fuel dependence, making Standalone ESS a key enabler of a more resilient and sustainable power sector.
4. **Ancillary services:** The deployment of Standalone ESS is crucial in enhancing grid stability and reliability by providing essential grid services such as grid congestion mitigation, frequency regulation, voltage support, ramping and other ancillary services. As renewable energy penetration increases, maintaining grid balance becomes more challenging due to fluctuations in generation. Standalone ESS mitigates these challenges by responding rapidly to frequency deviations, stabilising voltage levels, and managing sudden demand-supply mismatches.
5. **Other applications:** Standalone ESS enables black start capability, allowing grids to recover quickly from total blackouts by supplying essential power to critical infrastructure. Additionally, storing and releasing energy strategically mitigates grid congestion, enhances transmission efficiency, and reduces strain on power lines. Another key function is damping oscillations, where Standalone ESS stabilises frequency fluctuations in the network, preventing instability and minimising the risk of widespread outages. These applications highlight the expanding role of Standalone ESS in ensuring a resilient and efficient electricity grid.

Evolution of Standalone Storage Tenders

Standalone ESS tenders are gaining momentum, with 6.1GW issued in the first quarter of 2025 alone, making up 64% of the total utility-scale energy storage tendering market. This surge highlights a shift toward independent storage solutions for grid stability and renewable energy integration. The increasing recognition of storage as a crucial element in India's energy transition, coupled with policy interventions that have eased financial and technical barriers, is driving this trend.

Figure 1: ESS Tender Types Under Utility-scale Applications

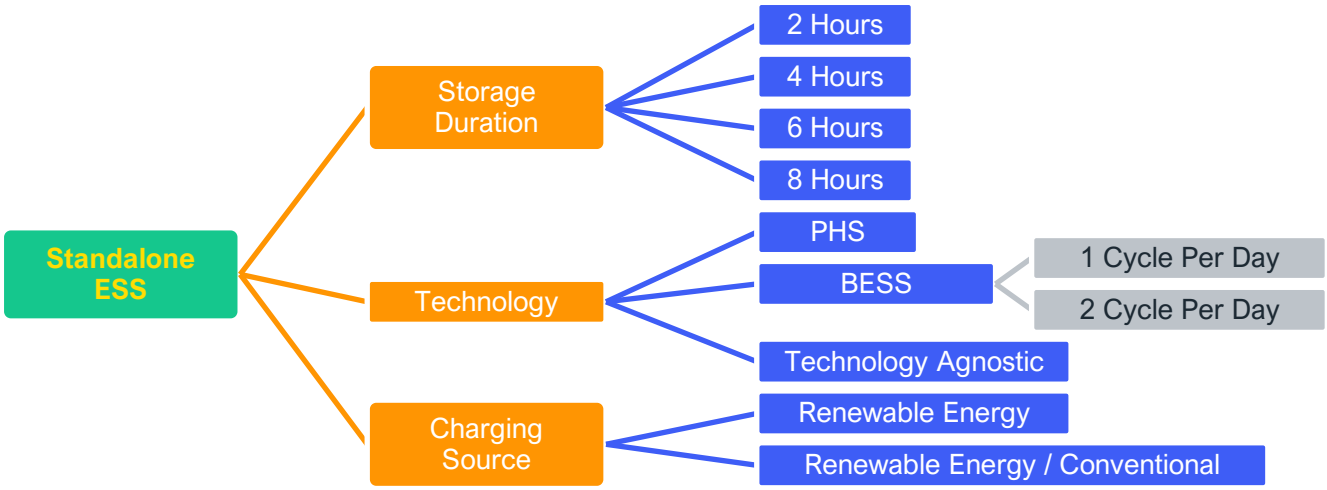


Source: JMK Research

While Solar + BESS and Firm and Dispatchable Renewable Energy (FDRE) tenders allow a combination of renewable energy and ESS project components, Standalone ESS projects only focus on energy storage systems.[2] Key enablers for the surge in Standalone ESS issuance include the introduction of Viability Gap Funding (VGF) to offset capital costs, relaxed financial obligations such as Earnest Money Deposit (EMD) and Performance Bank Guarantee (PBG) criteria, and reduced net worth criteria. These measures make it easier for more developers to participate in the market.

[2] Solar + BESS: Combines solar power generation with battery energy storage systems to store excess solar energy for later use. FDRE: These tenders are designed to procure renewable energy power with enhanced reliability and dispatchability, often necessitating the incorporation of energy storage systems.

Figure 2: Standalone ESS Tender Specifications Issued in India



Source: JMK Research

The structure of Standalone ESS tenders varies around storage durations, with BESS typically designed for two to four hours and PHS for longer durations of six to eight hours, reflecting their respective technological capabilities. These tenders can be categorised based on technology – BESS, PHS or technology-agnostic models that permit any ESS type.

Additionally, while most Standalone ESS tenders issued mandate charging from renewable sources to align with clean energy goals, some allow charging from conventional sources, offering greater flexibility in energy management. Also, while some tenders specify a single operational cycle (one full charge-discharge cycle), others define two operational cycles daily. This evolving framework highlights the growing role of Standalone ESS in grid stability and energy transition. Table 1 highlights key differences between BESS and PHS in India's Standalone ESS landscape.

Table 1: BESS vs PHS Standalone Storage Tenders

Parameters	BESS	PHS
Tendered capacity (to Mar 2025)	9.33GW	19.9GW
No. of tenders issued (to Mar 2025)	20	3
Energy storage technology	Battery	Pumped hydro
Energy storage duration	2-4 hours	6-8 hours
Operation cycle per day	1-2	-
Gestation period	6-12 months	6-8 years
VGF support	Yes	No
Operational capacity (to Mar 2025)	0.13GW	4.7GW
Pipeline capacity (Mar 2025)	3.1GW	3.5GW
PPA period	8-12 years	25-40 years

Source: JMK Research

PHS has traditionally dominated the storage landscape due to its large-scale and long-duration storage capabilities. However, the surge in renewable energy adoption has driven a rapid shift towards BESS. As India moves toward its 2030 storage targets of 42GW for BESS and 19GW for PHS, the evolving tender framework underscores the complementary nature of both technologies in ensuring grid reliability and supporting the clean energy transition. Overall, while PHS remains critical for long-duration storage, its higher costs and longer execution timelines make it less competitive than BESS in the near term.

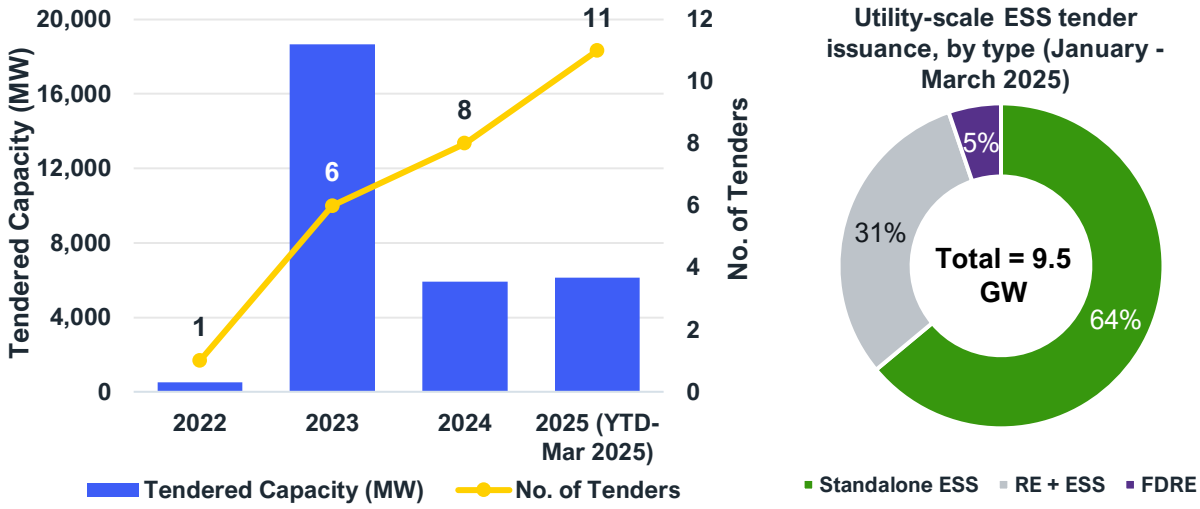
Standalone ESS Tenders Issuance Trends

There has been an exponential rise in the issuance of Standalone ESS tenders in India since 2022. From just 0.5GW across one tender in 2022, the total tendered capacity surged more than 50 times to 31.2GW by March 2025 in terms of cumulative capacity (Figure 3). The offtakers (DISCOMs) have the flexibility to determine end-use applications, allowing them to optimise energy storage based on their specific needs. Developers face lower risks since they also handle charging and discharging, making Standalone ESS attractive to both parties. Policy interventions, especially the VGF scheme, have further strengthened the financial viability of these projects.[3]

In the first three months of 2025, 11 new Standalone ESS tenders were issued, totalling 6.125GW, exceeding the entire Standalone ESS capacity issued in 2024. The VGF scheme, which offers up to 30% capital cost subsidy with a limit of Rs4.6 million per megawatt-hour (MWh) or US$53,801/MWh (market component under Tranche-1), is primarily driving this surge. Nine of the 11 tenders utilised this support. The incentives have significantly lowered financial barriers, making standalone storage more viable for developers and utilities.

[3] Press Information Bureau (PIB). Cabinet approves the Viability Gap Funding Scheme for development of Battery Energy Storage Systems. 6 September 2023; PIB. Viability Gap Funding for Battery Energy Storage Systems. 3 April 2025.

Figure 3: Standalone ESS Tendering Activity (2022-March 2025)



Source: JMK Research

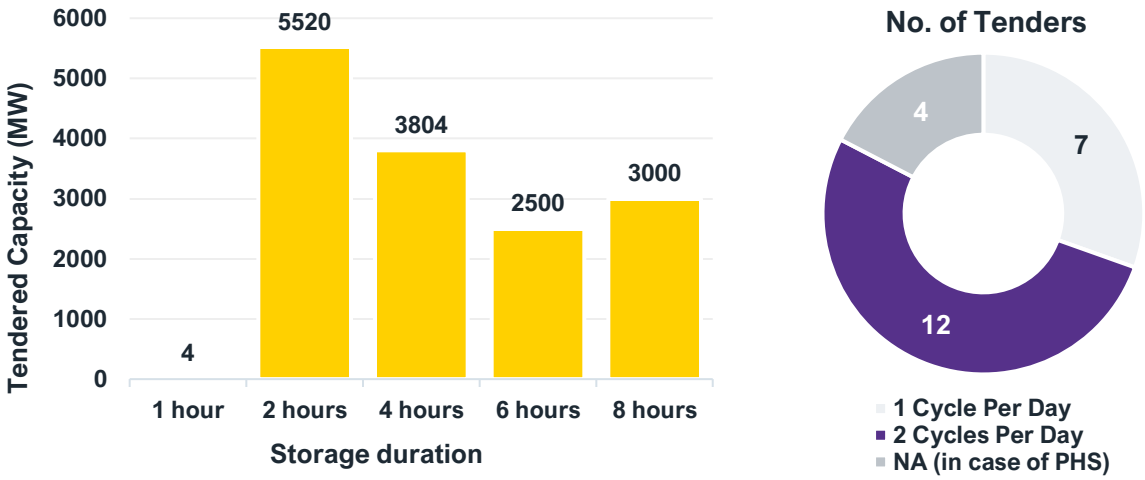
Within the Standalone ESS market, although BESS comprised just 28.7% (cumulative capacity) of the total 31.2GW issued until March 2025, they accounted for 21 of 26 tenders. This reflects a preference for scalable and flexible battery storage solutions over large-scale PHS projects.

The highest Standalone ESS capacity tendered in 2023 was a 16.4GW standalone PHS tender by Rewa Ultra Mega Solar Limited (RUMSL) in Madhya Pradesh. However, this tender has been suspended due to challenges related to site identification and land acquisition. It may be revised and reissued once these challenges are addressed.

Standalone BESS tenders predominantly specify a storage duration of two hours, representing 56.9% of the total tendered capacity (Figure 4). In contrast, standalone PHS tenders typically require six to eight hours of storage, aligning with their suitability for long-duration energy shifting.

Regarding operational cycles, most BESS tenders favour higher utilisation, with 10 tenders (3,770MW) mandating two cycles per day, while seven tenders (1,600MW) require only one cycle per day. This preference for shorter-duration, high-cycle BESS highlights its role in providing fast-response grid services, while PHS remains the preferred choice for long-duration storage needs.

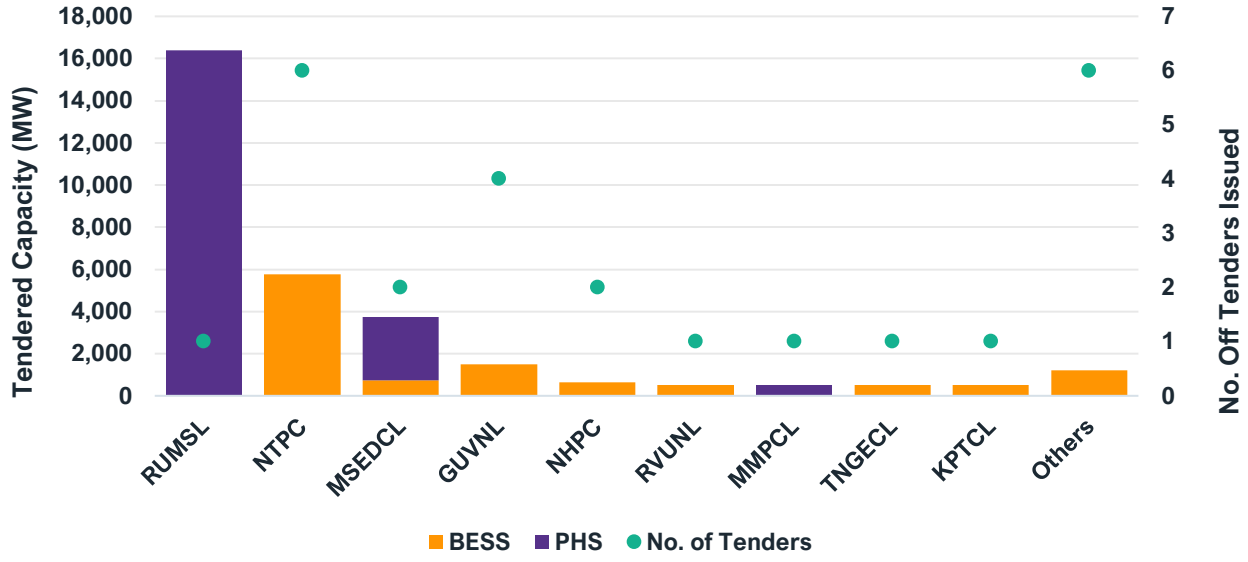
Figure 4: Standalone ESS Tenders by Storage Duration and Operational Cycles (2022-March 2025)



Source: JMK Research. Note: For RUMSL 16.4GW PHS tender, information on storage duration is not available. Operational cycles per day are not given in PHS tenders.

The landscape of Standalone ESS tenders in India highlights the growing interest of both central and state agencies in capacity allocation and tender issuance (Figure 5). NTPC emerged as the most active agency in BESS tenders, issuing six tenders amounting to 5.75GW since 2022. State-level entities such as Gujarat Urja Vikas Nigam Limited (GUVNL) (five tenders, 2GW) and Maharashtra State Electricity Distribution Company Limited (MSEDCL) (two tenders, 3.8GW) have also significantly advanced Standalone ESS adoption. This trend indicates that while state agencies drive region-specific energy security efforts, central agencies remain key enablers of large-scale deployment.

Figure 5: Standalone ESS Tender Landscape by Implementing Agencies (2022-March 2025)



Source: JMK Research. Note: Others include UPPCL, TGGENCO, TNGECL, SECI, BSPGCL and TERI.

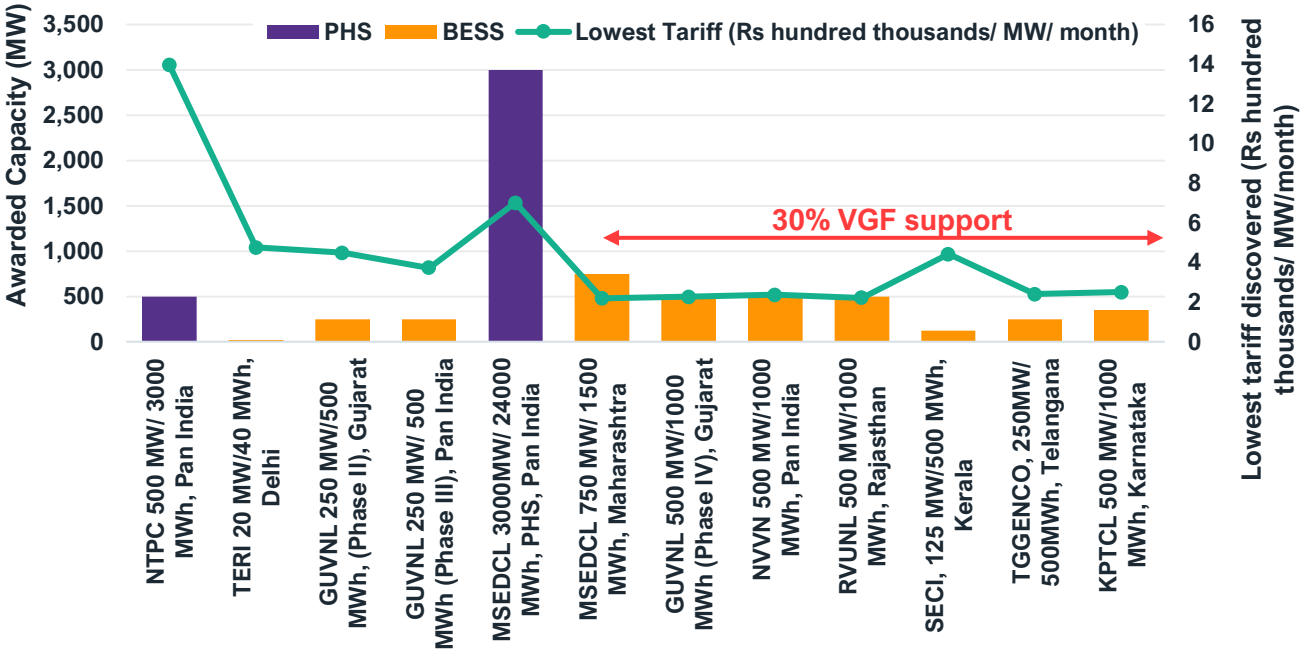
The predominance of PAN India tenders, which account for 8.75GW of total Standalone ESS capacity issued, allows developers to choose sites based on grid infrastructure availability. In contrast, state-issued tenders from GUVNL and MSEDCL are more localised and designed to address immediate grid-balancing needs within specific regions. Since the June 2023 release of the Resource Adequacy Planning Framework, multiple states have outlined their energy storage requirements, driving both central and state-level energy storage initiatives.[4]

Standalone ESS Auction Analysis

Since January 2022, approximately 7GW of standalone ESS capacity has been awarded across 12 tenders. The auction trends for Standalone ESS tenders highlight the evolving cost dynamics and deployment challenges in India's energy storage sector.

[4] PIB. Guideline for Resource Adequacy Planning Framework for India. 28 June 2023.

Figure 6: Standalone Storage Tenders Auction Results (2022-March 2025)



Source: JMK Research

The NTPC PHS tender (500MW/3000MWh) in 2022 closed at Rs1.4 million/MW a month (US$16,374/MW/month). However, the latest PHS tender by MSEDCL (3,000MW/24,000MWh) in March 2024 had a tariff of Rs705,511/MW/month (US$8,25/MW/month). This drop was due to the higher project capacity and the eight-hour storage requirement, which aligns better with the optimal discharge duration for PHS technology.

BESS tariffs have also been in a sharp and consistent decline, primarily driven by falling battery prices. The Energy and Resource Institute (TERI)'s BESS auction in 2023 (Delhi, 20MW) closed at Rs479,968/MW/month (US$5,614/MW/month), while the GUVNL Phase III auction in March 2024 (250MW, PAN India) dropped to Rs372,978/MW/month (US$4,362/MW/month) even without VGF support. The introduction of VGF in September 2023, offering up to 40% capital expenditure (capex) support, has further accelerated cost reductions for BESS projects. For tranche-I (1000 MWh), the VGF was later revised to offer financial support up to 30% of capex or Rs4.6 million/MWh (US$53,801/MWh), whichever is lower due to reduced battery costs.[5] For subsequent tranches of VGF as well as for the standalone BESS tenders issued by states and other Central Public Sector Undertaking (CPSU) entities, the upper limit of VGF incentive is capped at Rs2.7 million/MWh.[6]

Auctions conducted under the VGF framework, such as MSEDCL (August 2024, Maharashtra, 300MW) and Rajasthan's RVUNL (November 2024, Rajasthan, 500MW), achieved tariffs as low as

[5] PIB. Viability Gap Funding for Battery Energy Storage Systems. 3 April 2025.
[6] Economic Times. Battery storage target triples to 13,200 MWh under VGF, up from 4,000 MWh amid cost drop. March 2025

Rs219,001-Rs221,100/MW/month (US$2,561-$2,586/MW/month), a 40% reduction compared with non-VGF projects for two-hour storage projects.[7] This steep decline is further supported by a 31% drop in battery prices between 2022 and 2024, making BESS increasingly cost-effective.[8]

The recent standalone BESS tender from the Solar Energy Corporation of India (SECI, 125MW/500MWh, 2024), was awarded twice the tariff of the last standalone BESS tender due to its four-hour energy storage duration, highlighting the cost implications of extended-duration storage. It is the only four-hour BESS tender under execution. Additionally, authorities have issued six other tenders in the four-hour storage category, totalling 3.675GW, further reinforcing the shift towards high-capacity energy storage solutions.

The cost gap between PHS and BESS is widening, with BESS benefiting from faster deployment (18-24 months), flexibility in site selection, and strong policy incentives. With continued battery price declines and government support, BESS will likely dominate future Standalone ESS tenders, ensuring faster and more cost-effective energy storage deployment in India's evolving renewable energy landscape.

Viability Gap Funding to develop Battery Energy Storage Systems

Objective: The VGF scheme aims to accelerate the deployment of 13,200MWh (revised recently from 4,000MWh) of BESS projects by the 2027-28 fiscal year by providing financial support of up to 40% of the capital cost, capped at Rs9.6 million/MWh (US$112,281/MWh). For tranche-I (1000 MWh), the VGF was later revised to offer financial support up to 30% of capex or Rs4.6 million/MWh (US$53,801/MWh), whichever is lower due to reduced battery costs. For subsequent tranches of VGF as well as for the standalone BESS tenders issued by states and other Central Public Sector Undertaking (CPSU) entities, the upper limit of VGF incentive is capped at Rs2.7 million/MWh. This initiative seeks to enhance the affordability and viability of battery storage systems, enabling better integration of renewable energy sources such as solar and wind into the grid.

Selection of BESS developers:

Parameters	Criteria
Bidding Process	Through Tariff-Based Competitive Bidding process
Contract Period	10-12 years
Project Developer Capacity Limits	A single developer can secure up to 50% of the capacity in a tranche, with a cumulative cap of 1,000MWh across all tranches. Eligible standalone projects must have a minimum capacity of 100MWh
Project type	Build Own Operate
VGF determination	The Ministry of Power-designated committee will determine the VGF, which will be specified in the RfS document. The committee will determine the VGF for each tranche, considering tariffs from previous BESS bids.

[7] Ministry of Power. Scheme for Viability Gap Funding (VGF) for development of Battery Energy Storage Systems. 15 March 2024.
[8] BloombergNEF. Lithium-Ion Battery Pack Prices See Largest Drop Since 2017, Falling to $115 per Kilowatt-Hour. 10 December 2024.

Proposed outlay: The scheme has an outlay of Rs94 billion, including budgetary support of Rs37.6 billion.
Components: The Ministry of Power has outlined three key components to the VGF:

1. **Market component:**
    a. **Tranche I:** 1,000MWh allocated to NTPC Vidyut Vyapar Nigam (NVVN) with VGF of Rs4.6 million/MWh (US$53,801/MWh), totalling Rs4.6 billion (US$53.8 million).
    b. **Tranche II:** 1,200MWh allocated to SECI with VGF support of Rs2.7 million/MWh (US$31,579/MWh), totalling Rs3.24 billion (US$37.9 million).
2. **State component:** 6,000MWh allocated across eight states: Rajasthan, Tamil Nadu, Karnataka, Gujarat, Maharashtra, Telangana, Bihar and Kerala. Each state will receive VGF of Rs2.7 million/MWh (US$31,579/MWh), with a total funding of Rs16.2 billion (US$189.5 million).
3. **CPSU component:** 5,000MWh assigned to NVVN and state-run hydro utilities NHPC and SJVN with VGF support of Rs2.7 million/MWh (US$31,579/MWh), amounting to Rs13.5 billion (US$157.9 million).

Disbursement schedule: The VGF amount to the eligible projects shall be disbursed in five tranches:

Milestone	% VGF disbursed
On financial closure subject to submission of bank guarantee and possession of 90% of the total land required for the project by the developer	10
On Commercial Operation Date (COD)	45
Completion of 1st year from COD	15
Completion of 2nd year from COD	15
Completion of 3rd year from COD	15
Total	**100**

Balancing Fund Management: The BESS Balancing Pool (BBP), established to operate the scheme, manages revenue surpluses and shortfalls in BESS operations across all tranches. If energy sales revenue exceeds the costs covering the BESS developer's fixed charges and the BESS Implementing Agency's trading margin, the surplus is deposited into the BBP. In case of a revenue shortfall, the fund compensates the deficit. Transactions to and from the BBP will occur monthly.

The BBP is a critical financial mechanism to stabilise revenue fluctuations in BESS projects, ensuring long-term viability and investor confidence. The BBP mitigates financial risks associated with variable energy market conditions by systematically managing surpluses and deficits.

Source: Ministry of Power

Case Study: TERI-BSES Rajdhani Standalone BESS

Project Overview: In June 2023, the Energy and Resources Institute (TERI) invited bids to implement a 20MW/40MWh BESS in Delhi on behalf of BSES Rajdhani Power Limited (BRPL). The project is India's first commercial Standalone model at the distribution level to receive regulatory approval for its tariff. Developed in collaboration with the Global Energy Alliance for People and Planet (GEAPP), IndiGrid and AmpereHour Energy, it aims to enhance grid stability and support the integration of renewable energy in South Delhi. The project represents innovative advancements in grid modernisation, with GEAPP providing a concessional loan covering 70% of the project cost.

Table 2: Project Details

Parameter	Details
Location	Kilokari, New Delhi, India
BESS capacity	20MW/40MWh
Auction winner	IndiGrid & AmpereHour Energy
Levellised annual tariff	Rs5.8 million/MW/year (US$67,364/MW/year)
Power offtaker	BSES Rajdhani Power Limited
Financing	GEAPP's concessional loan covers 70% of the project cost
Commissioning date[9]	April 2025 (16 months from the date of award)
Project lifespan	12 years
Operational Cycles	2 cycles per day
Minimum annual availability	95%
Round trip efficiency	85% in year 1 to 82% in year 12

Source: National Renewable Energy Laboratory (NREL), JMK Research

Purpose: BRPL aims to enhance grid reliability and reduce reliance on costly peak power purchases. The Standalone ESS model will help manage load fluctuations, integrate more renewable energy, and maintain high power quality at a substation experiencing high demand.

Status: Commissioned in April 2025.

Importance: A key objective of this pilot project is to demonstrate the benefits of BESS services for DISCOMs by improving power reliability, optimising operational efficiency, and lowering costs. Located at a high-demand substation, the project is expected to enhance power quality and ensure 24/7 reliable electricity for more than 100,000 low-income consumers. Additionally, concessional financing provided by GEAPP has ensued affordability.

A critical insight from the project is the importance of value-stacking through multiple revenue streams, including energy arbitrage, ancillary services and capital expenditure deferral. Early regulatory engagement can further streamline approvals and align projects with evolving policy

[9] PV Magazine. IndiGrid commissions India's first regulated utility-scale standalone BESS in Delhi. 5 April 2025.

frameworks. Additionally, India's VGF scheme is essential to derisk investments and catalyse large-scale BESS deployment.

BRPL and GEAPP will share key insights from the BESS pilot project with DISCOMs, state regulators and power sector stakeholders to support knowledge-sharing, capacity-building and wider adoption. As the first BESS project in India to secure regulatory approval, it sets a precedent for future projects and informs policy development. Additionally, the project contributes to the global BESS Consortium, led by the GEAPP Leadership Council, helping low- and middle-income countries scale up energy storage solutions.

Key Players in the Standalone ESS Market

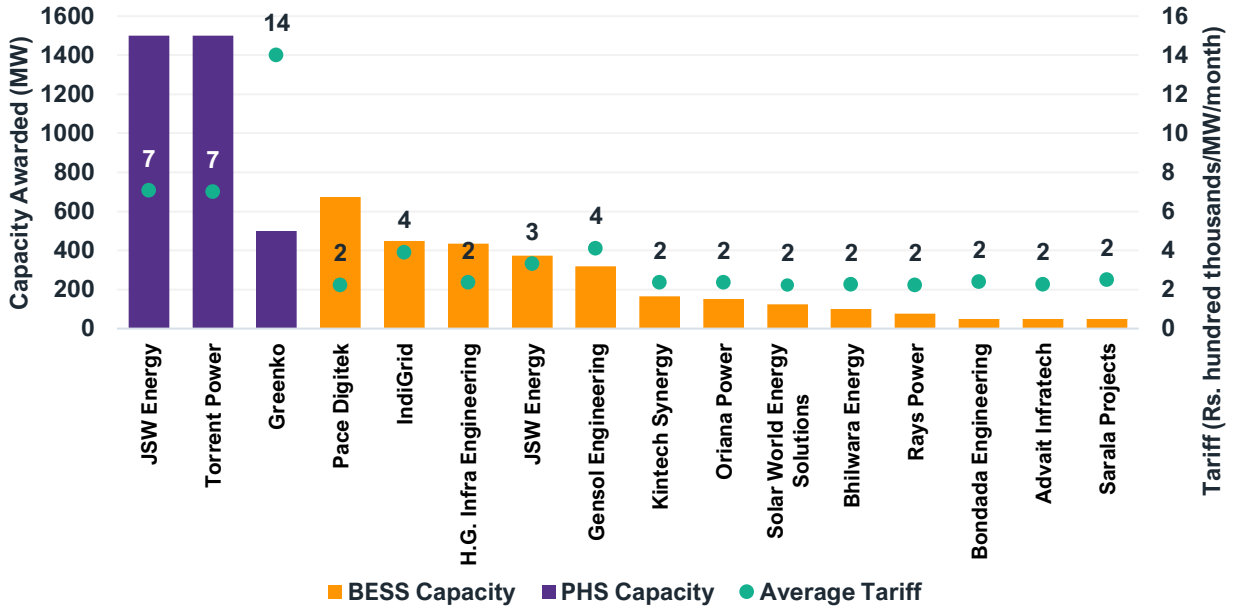
India's grid-scale standalone storage market is still in its early stages. While policy initiatives have gained momentum, large-scale participation has remained limited. However, 2024 marked a pivotal moment, with record-breaking involvement from key developers, reshaping the competitive landscape and signalling a more dynamic phase of market evolution.

India's grid-scale Standalone ESS market is rapidly expanding, with increasing participation from established energy giants and new entrants (Figure 7). Large Independent Power Producers (IPPs) such as JSW Energy, Greenko and Torrent Power are leveraging their existing power sector experience to integrate storage solutions. Several engineering, procurement and construction (EPC) firms and technology providers, such as Pace Digitek, Bondada Engineering and Advait Infratech, are also entering the space.

JSW Energy has established itself as the leader in the grid-scale Standalone ESS market, having secured nearly 2GW of awarded capacity. Other major players, such as IndiGrid, HG Infra Engineering and Gensol Engineering, have each secured over 300MW.

An analysis of the technology focus reveals a clear distinction in developer participation. PHS continues to dominate capacity allocations, with JSW Energy, Torrent Power and Greenko at the forefront of this segment. While other companies are diversifying into various storage technologies, Greenko focuses solely on PHS, leveraging its expertise in large-scale hydro-based storage solutions.

Figure 7: Grid-scale Standalone ESS Market Leaders by Capacity Awarded (January 2022-March 2025)



Source: JMK Research

Newer players have also entered the market. Companies such as Pace Digitek, Bondada Engineering, Kintech Synergy, Oriana Power and Solarworld Energy Solutions have secured BESS capacities, expanding the industry's landscape beyond established players.

Large energy companies will likely dominate large-scale BESS deployments, leveraging their financial strength, project execution experience, and ability to secure long-term PPAs. Original equipment manufacturers (OEM) for grid-scale ESS are almost all based outside India. Samsung and LG Chem are the leading lithium-ion battery manufacturers in the world. Indian battery manufacturers, such as Exide and Exicom, only assemble the battery packs after importing the battery cells, primarily from China.

With increasing tender activity, competition will likely intensify among independent power producers (IPPs), EPCs and global technology providers. As tenders scale up, price competition will increase, favouring players with economies of scale and efficient project execution capabilities.

Key Challenges

Despite the first tender being issued in 2022, the Standalone ESS market remains nascent. Developers have yet to commission any large utility-scale Standalone ESS tender awarded since then. The Standalone ESS market is still reeling with challenges it needs to overcome to kickstart wide-scale implementation in India.

Power Agreement Signing Delays and Cancellations

As discussed in the Auction Analysis section of this report, the prices discovered in the utility-scale standalone tenders have continuously fallen since the first auction in August 2022. The expectation of continuously falling tariffs makes the energy offtakers hesitant to enter into long-term power sales agreements (PSAs). The delays in signing PSAs post letter of award led to regulatory energy commissions rejecting the tariffs, nullifying the entire auction process and cancelling the tender.[10]

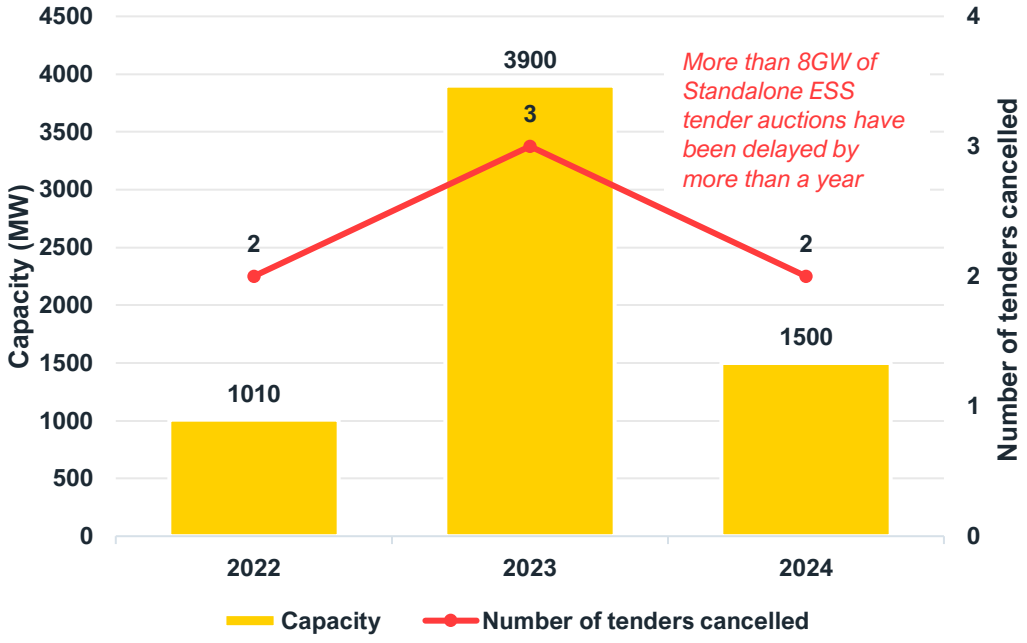
By 2024, 30.8GW of capacity has been issued through utility-scale Standalone ESS tenders. However, delays in finalising PPAs have led to significant cancellations, with approximately 6.4GW of awarded capacity ultimately being nullified (Figure 8). The primary reasons for these cancellations are delays in signing PSAs and PPAs. Of the 6.4GW capacity cancelled, 3.9GW was from PHS projects, 2.01GW was BESS and 500MW was from technology-agnostic capacity sources.

With the recent surfacing of accusations levied against Gensol Engineering, the 320 MW of capacity awarded to them will also likely remain in limbo, with potential delays and cancellation on the horizon.

Following recent allegations of financial misconduct levied against Gensol Engineering by Securities and Exchange Board of India (SEBI), the 320 MW cumulative capacity awarded to them under standalone ESS tenders is now uncertain, with potential delays or even cancellation looming.[11]

[10] Central Electricity Regulation Commission (CERC). Petition for adoption of tariff for Pilot Projects of 500MW/1000MWh Standalone BESS. 2 January 2025.
[11] Economic Times. Gensol Engineering shares tumble 5%; hit another lower circuit limit. April 2025

Figure 8: Cancellation of Standalone ESS Tenders (2022-February 2025)



Source: JMK Research

Project Execution Challenges

India's Standalone ESS market also faces challenges of limited vendor availability and inadequate domestic manufacturing. Reliance on imports for battery components persists, and while local production initiatives exist, they fall short of demand. The market also grapples with securing critical minerals, essential for batteries, which are predominantly sourced from a few countries. This sub-section elaborates on these challenges.

Limited Vendor Availability

The cumulative installed BESS capacity in India is just over 360MWh. Several of the Standalone ESS projects under execution are gigawatt-hours (GWh)-scale and face supply-chain issues with only a handful of vendors available to supply and execute projects at that scale.

There is a limited availability of high-quality EPC players operating at the GWh scale. Most of the Standalone ESS project executing vendors operating in India are either based overseas, such as Jinko (China), or operate through a joint venture (JV) with an Indian brand. For example, TACO Gotion is a JV between Tata AutoComp and Chinese battery manufacturer Gotion, while Fluence India ReNew is a JV backed by multinationals Siemens, AES and ReNew.

Inadequate Domestic Manufacturing

Akin to solar, most of the original equipment manufacturers in battery cell manufacturing are based in China, leading to a heavy reliance on imports for key energy storage components. While initiatives such as the Production Linked Incentive (PLI) scheme aim to boost local production, India still lacks large-scale refining and processing infrastructure, making establishing an end-to-end domestic supply chain difficult. As of 2023, only 6.7GWh of lithium-ion battery manufacturing capacity had been commissioned in India, far below the growing demand. While there are announcements for 246GWh of additional nameplate manufacturing capacity by 2035, delays in plant commissioning and market uncertainties pose a risk to achieving these targets.[12]

Critical Minerals Availability Crunch

Additionally, India's Standalone ESS market faces a significant challenge in securing a stable and affordable supply of critical minerals such as lithium, cobalt and nickel, which are essential for battery storage technologies. More than 80% of the global supply of refined lithium and cobalt is concentrated in a few countries, particularly China, leaving India exposed to supply-chain disruptions, price volatility and geopolitical risks.[13] This dependency increases project costs and poses a barrier to large-scale domestic ESS deployment.

Recent lithium discoveries in Jammu & Kashmir and Rajasthan have sparked optimism about reducing import dependence.[14] However, the absence of domestic refining and processing infrastructure continues to hinder progress. This issue was highlighted when the lithium block auction in Jammu & Kashmir failed for the second time, as concerns about the quality of the deposits and their commercial viability deterred potential participation in an auction.[15] Given that mining projects typically take more than 16 years from discovery to production, domestic output is unlikely to meet short- to mid-term demand, which is likely to more than double by 2030.[16]

A robust domestic BESS manufacturing ecosystem could strengthen the supply chain and make it potentially easier for the developers to procure and execute Standalone ESS projects due to the lower import duties and absence of other tariff and non-tariff barriers. Moreover, targeted government support, such as VGF and technology development, will be key to fostering industry participation.

[12] PV Magazine. India's battery boom: Poised to dominate the global EV revolution. 4 October 2024.
[13] Hindustan Times. China's hold on exports and supply chains key challenge. 1 February 2025.
[14] The Economic Times. Lithium reserves found in Rajasthan's Nagaur, higher capacity than J&K reserves. 9 May 2023.
[15] The Indian Express. Why investors did not pick up Jammu and Kashmir lithium block in auction. 31 July 2024.
[16] IEEFA. India's Hunt for Critical Minerals. October 2024.

Financing Roadblocks

As highlighted in the Climate Investment Funds (CIF) Renewable Energy Integration (REI) plan released in October 2024, investors are still wary of investing in standalone BESS solutions.[17] The hesitation stems from the high initial capital expenditure, longer payback periods, and the nascent stage of the Indian ESS market. These factors lead to stringent payment terms for higher loan rates and shorter tenures, making the market less accessible for smaller developers. Concessional financing and parent company guarantee (where applicable) can significantly address these roadblocks and unlock wider market participation.

Investors also face challenges in assessing alternative BESS technologies, as multiple chemistries, such as sodium-ion, flow batteries and solid-state batteries, are in various stages of development, creating ambiguity around which technology will achieve commercial viability. Furthermore, aggressive bid prices in recent tenders, driven by expectations of falling battery costs, have raised concerns about project feasibility. If battery prices do not decline as projected, there is a risk that some of these projects may fail to materialise.

PHS-specific Inhibitors

PHS projects have a long gestation period of up to 10 years. This is due to a wide array of regulatory clearances, extensive construction work and the high capex required. In contrast, most PHS-focused and ESS-technology-agnostic tenders only specify a timeline of two to three years. This timeline is significantly shorter than the gestation period needed for PHS projects, making it difficult for PHS-based projects to qualify. Consequently, most PHS-based utility-scale Standalone ESS tenders awarded have been cancelled before construction. Additionally, site identification and land acquisition challenges have led to the suspension of others, such as Madhya Pradesh's PHS tender.

Lack of Support for Alternative Storage Technologies

While lithium-based BESS dominates the market, alternative technologies such as sodium-ion and flow batteries are emerging as viable options. These alternatives offer key advantages to sodium-ion batteries; for instance, they leverage India's abundant sodium resources, reducing dependency on imported lithium. They also perform better under extreme temperatures, making them suitable for India's diverse climatic conditions. Similarly, flow batteries provide long-duration storage capabilities, which could be helpful for grid applications.

However, the absence of dedicated policy incentives and funding for these alternative storage technologies has hindered their large-scale adoption. While the PLI and VGF schemes are designed to be technology agnostic, lithium-ion has emerged as the dominant beneficiary due to its market

[17] Climate Investment Funds. Climate Investment Funds (CIF) Renewable Energy Integration (REI) Program. October 2024.

maturity. Emerging technologies such as sodium-ion and flow battery technologies have yet to gain comparable levels of support, which has slowed their commercialisation. Encouraging research, pilot projects and manufacturing incentives for these emerging technologies would help diversify India's energy storage sector, reducing over-reliance on lithium-based BESS.

The Way Forward

India's ESS market is poised for unprecedented expansion, driven by the country's ambitious renewable energy targets and the need for grid stability as large-scale VRE capacities are commissioned. The CEA estimates a storage requirement of 320GW/2380GWh (BESS + PHS) by 2047, highlighting the crucial role of storage in the country's energy transition. India's standalone ESS capacity pipeline is 5.9GW, with BESS contributing approximately 2.4GW and PHS projects 3.5GW. If execution proceeds as planned, this capacity could be commissioned by 2027, further strengthening India's energy storage landscape.

Strengthening the Policy Framework

Several states in India, such as Rajasthan, Andhra Pradesh and Madhya Pradesh, have incorporated storage targets into their renewable energy policies. Rajasthan's Clean Energy Policy, for instance, targets 10GW of storage by FY2030 and offers incentives such as exemptions from transmission and wheeling charges during non-solar hours for seven years.[18] Similarly, Andhra Pradesh and Madhya Pradesh have mandated storage targets as part of their broader renewable energy policies. However, broader adoption of storage solutions at the state level is necessary to meet CEA's energy storage requirements for 2048.

The VGF scheme, capped at 13.2GWh, has reduced investment risk to an extent in energy storage. This support has led to a noticeable rise in the issuance of standalone storage tenders, driven by the momentum created through VGF-backed tenders. However, its limited scope prevents broader market participation since it applies only to tenders involving intermediary agencies.[19] Expanding VGF support to include tenders initiated by offtakers such as DISCOMs and industrial consumers would enhance market access and attract larger investments. As the scheme approaches its 13.2GWh capacity, industry stakeholders anticipate a renewed focus on Firm and Dispatchable Renewable Energy (FDRE) tenders by the second half of 2025. Extending the scheme beyond FY2028 is crucial to ensure the financial viability of the storage sector.

As exemplified by SECI's 500MW/1,000MWh standalone BESS project, regulatory challenges highlight the complexities of India's storage sector. The project was awarded to JSW Energy in April 2022 through competitive bidding. However, delays in signing the Battery Energy Storage Purchase Agreement (BESPA) stalled its progress. In January 2025, CERC declined to adopt the discovered

[18] Government of Rajasthan. Integrated Clean Energy Policy. 2024.
[19] VGF component applies only for tendering agencies of six states such as Gujarat, Karnataka, Maharashtra, Rajasthan, Tamil Nadu and Telangana, and tender from NTPC, SJVN and NHPC.

tariff, stating that the price was no longer aligned with market conditions. Consequently, the project was cancelled. This case underscores the importance of timely contractual closure, transparent price benchmarking and a stable regulatory framework to support large-scale BESS deployment in India.[20]

Unlocking Additional Revenue Streams

To enhance the economic viability of BESS projects, it is essential to enable participation across multiple market segments, a concept known as "value stacking". In simple terms, value stacking allows a single BESS asset to provide various services throughout the day rather than being limited to just one function. For example, a BESS can store excess solar power during the day (energy arbitrage), discharge during evening peak demand (peak shaving), and offer real-time grid support such as frequency regulation (ancillary services). By layering (stacking) these use cases, project developers can unlock multiple revenue streams from the same asset, significantly improving returns and making storage deployments more financially sustainable.

Among India's most promising stacked services is participation in Primary Reserve Ancillary Services (PRAS). Given their near-instantaneous response time, BESS assets are ideally suited to maintain grid frequency and system stability. Recognising this potential, SECI initiated a pilot project to explore the operational viability of BESS in the ancillary market. The National Load Dispatch Centre had planned a pilot project involving a 150MW/300MWh segment of SECI's 500MW/1000MWh standalone BESS project. However, as highlighted above, this project is cancelled. The cancellation of this pilot reinforces the urgent need to establish timely execution mechanisms to enable BESS to contribute effectively to grid stability through ancillary services.

Optimising Power Exchanges

In August 2022, the Ministry of Power mandated that Indian power exchanges introduce the High Price-Day Ahead Market (HP-DAM) to ensure greater power availability during the peak demand season. HP-DAM caters to high-cost power from sources such as BESS, imported coal, and gas-based power plants. All power exchanges – Indian Energy Exchange, Power Exchange India Limited and Hindustan Power Exchange – had adopted HP-DAM by July 2023.

For FY2025, the HP-DAM segment recorded a total transacted volume of 3,344MWh, marking a 90% decline on the previous financial year.[21] Despite the introduction of HP-DAM, its limited uptake raises concerns about its effectiveness in incentivising storage. To enhance the viability of this market segment, it will be crucial to refine pricing mechanisms and improve overall market participation.

[20] CERC Petition. Adoption of tariff for Pilot Projects of 500 MW/1000MWh Standalone Battery Energy Storage Systems in India. January 2025.
[21] Indian Energy Exchange (IEX). High Price Day Ahead Market. Accessed April 2025.

Additionally, integrating ESS into capacity markets can provide a stable revenue stream while enhancing grid reliability. Offtaker-led tenders are gaining traction, but scaling them effectively will require more substantial financial backing, risk-sharing mechanisms and standardised contracts.

Enhancing Financial Support

Access to concessional financing is critical to accelerating ESS deployment, particularly as the sector scales up and finds multiple applications. IndiGrid's 180MW/360MWh project, backed by the International Finance Corporation (IFC) and supported by concessional funding from CIF, demonstrates how blended finance can reduce capital costs and improve project viability. Expanding concessional financing via multilateral institutions and leveraging green bonds to attract additional capital will be essential to make the market more accessible and attractive.

Strengthening the Domestic ESS Supply Chain

India's Standalone ESS market heavily relies on imported battery materials such as lithium, cobalt and nickel, making it highly vulnerable to supply chain disruptions. This dependency increases project costs and poses challenges for large-scale domestic deployment. The National Critical Mineral Mission (NCMM), launched in January 2025 with an outlay of Rs343 billion (US$4 billion), is a significant step toward securing a stable domestic supply of these essential minerals.[22] By covering all stages of the value chain, from exploration and mining to processing and recycling, the mission aims to reduce import dependency and enhance India's self-sufficiency in energy storage technologies.

The NCMM aims to accelerate domestic mineral exploration, establish a fast-track regulatory approval process, and promote the recovery of critical minerals from mining waste. Additionally, it encourages Indian Public Sector Undertakings (PSUs) and private companies to acquire mineral assets abroad while developing a national stockpile of essential materials. However, India still lacks large-scale refining capacity, and building a resilient supply chain will require sustained policy support, infrastructure development and investment in domestic processing capabilities. Strengthening synergies between the NCMM and energy storage policies will be key to reducing import dependency and enabling cost-effective, large-scale ESS deployment.

Conclusion

India's push towards a renewable energy-driven future cannot succeed without robust energy storage solutions. The increasing importance given to standalone ESS marks a significant step in treating storage as an independent asset class. Consequently, the proliferation of utility-scale

[22] The Hindu. Government approves National Critical Minerals Mission with outlay of ₹34,300 crore in 7 years. 29 January 2025.

Standalone ESS tenders will dictate the evolution of a capacity-based power market in India alongside the energy-based one.

In the near term, BESS and PHS will continue to dominate the ESS landscape in India, with storage duration determining their applicability in a particular scenario. However, ongoing research and development efforts in various BESS chemistries, such as sodium-ion and redox flow, aim to extend its viable backup storage duration to eight hours. Therefore, in the long term, BESS will likely attain competitiveness with PHS even at a higher storage duration.

The development of Standalone ESS will likely be led by large companies due to the substantial capital investment, financial structuring capabilities and technical expertise required. While reduced financial thresholds have opened the door for new entrants, the scale and complexity of Standalone ESS projects will likely lead to industry consolidation, with a few key players dominating the market.

Unlike five to 10 years ago, energy resource planning at both central and state levels incorporates ESS as a vital component. States such as Karnataka and Andhra Pradesh have already identified ESS as a critical element in their renewable energy policies. Other states will likely establish similar guidelines, including specific targets for Standalone ESS.

As the Standalone ESS sector matures, the focus must shift from early-stage adoption to long-term sustainability. With several Standalone ESS projects nearing completion, maintenance and ancillary spare market for Standalone ESS will also take shape. Strengthening the domestic supply chain with a robust and sizeable manufacturing base will enhance self-sufficiency. Direct support measures such as VGF, which only includes BESS, can also become technology agnostic in the future, extending to other storage technologies such as PHS and gravity storage.

Standalone ESS will play a pivotal role in India’s energy transition by enhancing grid flexibility and security. Its ability to provide freedom in end-use applications while reducing risks for technology providers makes it a cornerstone of the country’s long-term decarbonisation strategy. However, continuous policy support and collaboration within the industry will be essential to its long-term success. With the right momentum, India can establish a competitive and self-sustaining energy storage market that aligns with its clean energy goals for decades.

Annexure: List of All Awarded Standalone ESS Tenders

Tender	Tender Specifications	Winner (capacity) & Tariff (Rs/MW/month)
KPTCL 500MW/1000MWh, Karnataka, Feb 2025	ESS Technology: BESS Storage duration: 2 hours VGF support: Yes BESPA duration: 12 years Commissioning timeline: 18 months	Sarala Projects: 50MW, Rs249,500 Oriana Power: 50MW, Rs254,490 Pace Digitek: 250MW, Rs254,490
TGGENCO 250MW/500MWh, Telangana, Jan 2025	ESS Technology: BESS Storage duration: 2 hours VGF support: Yes BESPA duration: 12 years Commissioning timeline: 18 months	Bondada Engineering: 50MW, Rs240,347 Oriana Power: 50MW, Rs245,152 Pace Digitek: 125MW, Rs245,153
SECI, 125MW/500MWh, Kerala, Dec 2024	ESS Technology: BESS Storage duration: 4 hours VGF support: Yes BESPA duration: 12 years Commissioning timeline: 15 months	JSW Neo Energy: 125MW, Rs441,100
RVUNL 500MW/1000MWh, Rajasthan, Nov 2024	ESS Technology: BESS Storage duration: 2 hours VGF support: Yes BESPA duration: 12 years Commissioning timeline: 18 months	Solarworld Energy Solutions: 125MW, Rs221,100 Oriana Power: 50MW, Rs222,100 Rays Power: 75MW, Rs222,300 JSW Neo Energy: 250MW, Rs222,400
NVVN 500MW/1000MWh, Pan India, Sep 2024	ESS Technology: BESS Storage duration: 2 hours VGF support: Yes BESPA duration: 12 years Commissioning timeline: 18 months	Indigrid: 250MW, Rs236,999 Kintech Synergy: 65MW, Rs237,490 HG Infra Engineering: 185MW, Rs238,000
GUVNL 500MW/1000MWh (Phase IV), Gujarat, Aug 2024	ESS Technology: BESS Storage duration: 2 hours VGF support: Yes BESPA duration: 12 years Commissioning timeline: 18 months	Kintech Synergy: 100MW, Rs225,985 HG Infra: 250MW, Rs225,985 Bhilwara Energy: 100MW, Rs225,993 Advait Infratech: 50MW, Rs226,000
MSEDCL 300MW/600MWh, Maharashtra, Aug 2024	ESS Technology: BESS Storage duration: 2 hours VGF support: Yes BESPA duration: 12 years Commissioning timeline: 18 months	Pace Digitek: 300MW, Rs219,001
MSEDCL 3000MW/24000MW, PAN India, Mar 2024	ESS Technology: PHS Storage duration: 8 hours VGF support: No	JSW Neo Energy: 1500MW, Rs705,511 Torrent Power: 1500MW, Rs699,867

	ESFA duration: 40 years Commissioning timeline: 4 years	
GUVNL 250MW/500MWh (Phase III), PAN India, Mar 2024	ESS Technology: BESS Storage duration: 2 hours VGF support: No BESPA duration: 12 years Commissioning timeline: 18 months	Gensol Engineering: 250MW, Rs372,978
GUVNL 250MW/500MWh (Phase II), Gujarat, Nov 2023	ESS Technology: BESS Storage duration: 2 hours VGF support: No BESPA duration: 12 years Commissioning timeline: 18 months	Gensol Engineering: 70MW, Rs448,996 IndiGrid: 180MW, Rs449,996
TERI 20MW/40MWh, Delhi, Sep 2023	ESS Technology: BESS Storage duration: 2 hours VGF support: No BESPA duration: 12 years Commissioning timeline: 1 year from DERC approval	Indigrid: 20MW, Rs479,968
NTPC 500MW/3000MWh, PAN India, Jan 2022	ESS Technology: Technology agnostic Storage duration: 6 hours VGF support: No ESSA duration: 25 years Commissioning timeline: 2 years	Greenko: 500MW, Rs1,395,000

Source: JMK Research and news articles. Note: BESPA = Battery Energy Storage Purchase Agreement; ESSA = Energy Storage Service Agreement.

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The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

About the Authors

Prabhakar Sharma

Prabhakar Sharma is a senior consultant at JMK Research with expertise in tracking renewable energy and the battery storage sector. He has previously worked with Amplus Solar.
prabhakar.sharma@jmkresearch.com

Pulkit Moudgil

Pulkit Moudgil is a Research Associate at JMK Research with expertise in the renewable energy domain and industrial decarbonisation. He holds an MBA in Energy Management from the NTPC School of Business, Noida, and a B.Tech in Electronics and Communications Engineering.
pulkit.moudgil@jmkresearch.com

Aman Gupta

Aman is a Research Associate at JMK Research, specialising in market intelligence, Green Energy Open Access, energy storage market, and decarbonisation of hard-to-abate sectors. A passionate advocate for clean energy, he holds an MBA in Energy Management from NTPC School of Business, Noida, and a B.Tech in Mechanical Engineering.
aman.gupta@jmkresearch.com

Vibhuti Garg

Vibhuti Garg, Director, South Asia at IEEFA, has advised private and public sector clients on commercial and market entry strategies, investment diligence on power projects, and the impact of power sector performance on state finances. She also works on international energy governance, energy transition, energy access, reallocation of fossil fuel subsidy expenditure to clean energy, energy pricing and tariff reforms. vgarg@ieefa.org

Charith Konda

Charith is an Energy Specialist, India Mobility and New Energy at IEEFA. He works on issues related to clean mobility, newer clean energy technologies, and the overall energy transition challenges of the economy. ckonda@ieefa.org

Labanya Prakash Jena

Labanya is a Consultant – Sustainable Finance at IEEFA. He previously worked as a sustainable finance consultant at UNDP where he was leading in the development of India's sustainable finance roadmap in association with the Ministry of Finance. Before this, he worked in the financial services sector for ten years in various capacities in the private sector. ljena@ieefa.org

Institute for Energy Economics and Financial Analysis