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July 2022

Evolution of Grid-Scale Energy Storage System Tenders in India

Focus on NTPC and SECI Standalone Storage Tenders

Executive Summary

Energy Storage Systems (ESS) will be the next major technology in the power sector over the coming decade. The latest standalone ESS tenders from Solar Energy Corporation of India and NTPC will augment capacity manifold and help develop the local ecosystem. Given that ESS technology is in its infancy in India, the current tenders face several technical, procurement and regulatory challenges. However, the two tenders will act as a pilot project for policymakers and fast-track the evolution of future tenders. A comprehensive National ESS Policy, with a time-based target, will significantly address major impediments faced by the domestic industry and be an important growth driver. Going forward, we can expect to see the integration of new business models and domestic content requirement in future tenders for ESS projects.

The power industry is undergoing a remarkable shift worldwide by moving away from its dependence on fossil fuels to renewable energy sources. However, challenges posed by the intermittent and infirm nature of variable renewable energy (VRE) have introduced a new paradigm to energy storage system (ESS) applications.

To increase solar and wind capacity to the Indian government's target of 450 gigawatts (GW) by 2030, a significant amount of ESS installations will also be required. The Central Electricity Authority (CEA) undertook a study on optimising the energy mix, considering all technical and financial constraints to meet the projected peak electricity demand for 2029-30. The study predicts that India needs at least 27GW/108 gigawatt-hour (GWh) of grid-scale Battery ESS (BESS) in addition to ~10GW of Pumped Hydro Storage (PHS) by 2030.[1]

Realising the importance of ESS, the government has come up with several initiatives and policy support for the sector. The government has waived Inter-state transmission system (ISTS) charges for ESS projects commissioned before June 2025.[2] In addition to issuing standard bidding guidelines for BESS in March 2022,

[1] CEA. Report on Optimal Generation Capacity Mix for 2029-30. January 2020
[2] Ministry of Power

the government is working on a National Energy Storage Policy. A comprehensive national policy will significantly address major impediments faced by the ESS industry in India. Also, like with renewable energy development, a time-based target in the upcoming policy can become a key driver of the ESS industry's growth.

Through this upcoming policy, stakeholders expect relaxation in GST rates and import duties, especially in the initial years of ESS market development. Simultaneously, domestic manufacturing in the segment has received a boost through the 50GWh production-linked incentive (PLI) scheme for advanced chemistry cells (ACC). The scheme has an outlay of Rs18,100 crores (~US$2.4 billion).

As with renewable energy (solar/wind) development in India, grid-scale tendering will be crucial for developing the ESS market in India. This report looks at the evolution of grid-scale ESS tenders in India until now. In the past five years, ESS tenders have been evolving with innovative and new age tenders, such as round-the-clock (RTC), peak power and now, standalone ESS. The latest ESS tenders issued by Solar Energy Corporation of India (SECI) and NTPC are the first in India to combine standalone ESS with on-demand use.

As with renewable energy (solar/wind) development in India, grid-scale tendering will be crucial for developing the ESS market in India.

These two standalone ESS tenders, by SECI and NTPC, have a cumulative storage capacity of 1GW/4GWh. Thus, if executed well, these projects will augment Indian ESS capacity multifold. These large-scale tenders will also spur domestic manufacturing in the sector, boost investor confidence and help develop newer business models such as a capacity market. In a capacity market business model, the capacity providers/developers need to supply power for a scheduled time period in the future. The bidding is also in terms of capacity (per MW) rather than energy (per MWh).

However, at present, ESS technology is still nascent in India, because of which these standalone ESS tenders will likely face technical, procurement and regulatory challenges. For example, the NTPC tender requires a 6-hour ESS solution. While BESS is not a viable option beyond a 4-hour solution, PHS have a significantly larger lead time than the project commissioning timeline. An added risk is the recent uptick in battery prices after continuously falling over the past decade.

Considering the scale of these projects and ESS is still in the initial stages of technology development, availing of long-term supply and maintenance contracts from vendors/contractors will be an added challenge. There is also regulatory ambiguity since the Indian Electricity Act 2003 does not consider energy storage as a standalone asset. Thus, taxation of such assets might create a few regulatory hurdles, especially until the formulation of a national ESS policy. Policymakers view these projects as potential pilot tests that will advance all stakeholders along the learning curve and streamline regulatory processes for future tenders and projects.

The design of many upcoming tenders will utilise ESS-as-a-Service. In addition, future ESS tenders will integrate newer business models, such as energy trading. Going forward, multiple revenue streams will be essential for enhancing the productivity and viability of ESS projects. There also might be new tenders explicitly designed for alternate ESS technologies, such as PHS, gravity-based storage etc., apart from BESS. Furthermore, battery manufacturing in India should grow significantly due to the PLI scheme. Thus, future ESS tenders with a domestic content requirement (DCR) condition are also a strong possibility.

India, being a complex and diverse country, will need a combination of factors that have been the primary drivers of ESS deployment in the leading markets. Currently, the United Kingdom (UK) is one of the top ESS markets in Europe and is ardently pushing for the development of relevant projects in this market. Thus, the report presents a case study of one of the largest operational BESS plants in the world installed in the UK. The facility provides certainty of revenue flow to the BESS owner, owing to its dynamic participation in multiple markets (Ancillary, Energy Shifting). This project demonstrates to Indian stakeholders (tendering authorities, developers etc.) ways to optimise the viability of ESS by utilising multiple revenue streams.

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1. Introduction

Energy Storage System (ESS) is any technology solution designed to capture energy at a certain time, store it, and make it available to the off-taker for later use. Despite innumerable ESS technology inventions over time, only a few have proven viable at scale. In the power sector, battery energy storage system (BESS), pumped hydro storage (PHS), thermal energy storage and flywheel are a few effective technologies that make business sense. Furthermore, among these aforementioned technologies, BESS is expected to be the main driver for ESS growth globally in the coming years.

Traditionally, ESS has been used worldwide as ancillary support to the grid, aiding in frequency regulation and grid stability. However, in recent years, it has garnered interest for new applications in the renewable energy domain.

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In the past decade, the world has seen a massive upsurge in the power generation capacity of VRE, mainly solar and wind energy. The main challenge of VRE-based power is the intermittent and infirm nature of supply, reflected in its inability to meet variable electricity demand. However, this challenge has created a new dimension to the importance and application of ESS, which is grid balancing vis-à-vis integration of renewable energy into the grid.

Apart from this, other applications that add to the attractiveness of grid-scale ESS in India are:

1. **Energy Shifting/Arbitrage**: The process of storing energy during low-demand periods and high energy availability, and supplying the stored energy later during periods of high demand and low availability. This has a significant application with VRE systems, whose power supply cannot be regulated.

   Peak demand reduction/shaving is a sub-application under energy shifting, which helps the electricity distribution companies (DISCOMs)/utilities to relieve stress on the electricity transmission and distribution (T&D) infrastructure and reduce associated costs.

2. **Ancillary Services**: Fast response characteristic of ESS (specifically, ultracapacitor and batteries) supplement stability of the grid.

   - **Voltage and Frequency Control** - In periods of grid instability owing to unscheduled loads and power system faults, utilities use ESS to withdraw/inject excess power from/into the grid to maintain grid voltage and frequency. Indian Electricity Grid Code (IEGC) specifies the permissible frequency band for the Indian grid as 49.5Hz to 50.2Hz. In the future, ESS will play a major role in maintaining the frequency between these limits.

- **Ramp Up/Down Response -** Short-duration ESS, such as BESS, quickly respond to ramp-up/down input signals. This feature will be crucial to mitigating the challenge of the Duck Curve phenomenon observed in high VRE penetration markets.[3]

3. **Diesel Replacement (Grid Scale)**: Diesel Generators (DG) have always been a reliable backup power source for large and small consumers. They also provide base load power in isolated locations with no grid accessibility, such as islands. However, this method is not only highly polluting but also quite expensive in terms of per-unit cost. VRE coupled with ESS is a viable alternative in such scenarios. Andaman & Nicobar Islands and Lakshadweep islands have recently been the focus of several Solar+BESS projects/tenders.

In India, between 2011 and 2021, the installed capacity of VRE (solar+wind) grew about six-fold from 16GW to around 95GW.[4] Furthermore, the Government of India (GoI) has set an ambitious target to increase this capacity to 450GW by 2030. Achieving this target would require Indian electricity demand growth and significant ESS installations to counter the grid instability caused by VRE sources. Albeit renewable energy installations in India have grown at a commendable rate, its penetration in the overall electricity mix remains low. To improve the share of renewable energy, ESS will be a critical enabler. The CEA predicts India would need at least 27GW/108 gigawatt-hour (GWh) of grid-scale ESS, i.e., four hours of storage, by 2030.[5] This will be in addition to an anticipated ~10.1GW of PHS to be a part of the installed capacity by 2029-30. This study by the CEA aims to optimise the energy mix, considering all technical and financial constraints to meet the projected peak electricity demand for 2029-30.

To improve the share of renewable energy, ESS will be a critical enabler.

[3] Economic Times. The California Duck Curve-lessons for renewables in India? May 2017
[4] MNRE
[5] CEA. Report on Optimal Generation Capacity Mix for 2029-30. January 2020

2. Government Initiatives and Policy Support for ESS

Acknowledging the applications and associated potential of ESS, the Indian government has expressed keen interest in this sector in recent years. Some key initiatives undertaken by various central and state agencies in recent times include:

- In August 2021, the Government proposed to build a 10GW renewable energy plant integrated with 13GWh of BESS in the Ladakh region. It also proposed to set up a similar project of 14GWh BESS capacity in the Kutch region of Gujarat. The next section of the report discusses in detail a few more ongoing grid-scale ESS tenders.

- Additionally, the central government aims to set up a capacity of 4GWh spread across the country's four regional load dispatch centres (RLDCs).[6] This capacity will mainly act as ancillary support to the transmission network for maintaining grid stability. The same will also have a portion of its capacity dedicated for commercial use by the developers.

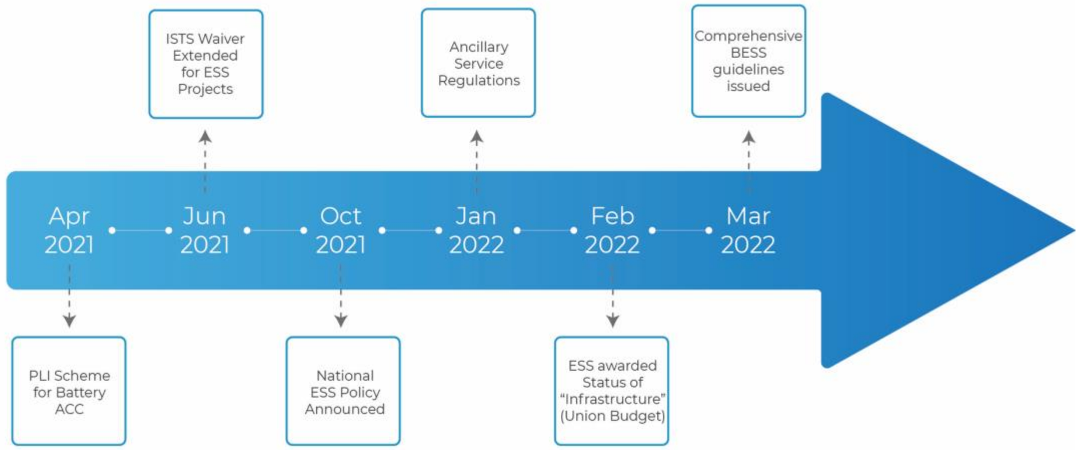
- Simultaneously, to boost domestic manufacturing in the energy storage sector, the GoI launched a production-linked-incentive (PLI) scheme in April 2021 with Advanced Chemistry Cells (ACC) as one of its focal areas. The total outlay for the scheme was Rs18,100 crores(~US$2.4 billion). The PLI for ACC intends to incentivise the setting up of a cumulative manufacturing capacity of 50GWh in India by 2025. In March 2022, four firms - Reliance New Energy (5GWh), Rajesh Exports (5GWh), Ola Electric (20GWh) and Hyundai Motors (20GWh) - were declared the winners under this scheme.

- Indian Union Budget of the fiscal year (FY) 2022/23, presented in February 2022, addressed the ESS industry's financing concerns. The Budget awarded infrastructure status to grid-scale ESS. This will help mitigate financing issues for ESS projects as the developers may apply for low-cost infrastructure loans.

On the policy front, the government has been active of late to standardise the regulatory framework and provide waivers to promote ESS.

[6] Mint. India to call bids for 4GWh of grid-scale battery storage. July 2021

Figure 1: Key Initiatives & ESS Policy Development Timeline



Source: JMK Research

- In June 2021, the Ministry of Power waived off inter-state transmission system (ISTS) charges for ESS projects commissioned on or before June 30, 2025. The sole condition for the waiver grant is that at least 51% of the annual electricity used to charge the ESS should come from solar and/or wind power plants. However, this proposal is still pending approval from the Central Electricity Regulatory Commission (CERC) for full implementation.

- Announced via a public notice on October 6, 2021, the Ministry of Power has been concurrently drafting the National Energy Storage Policy to create a standardised framework for ESS development. Delicensing of setting up standalone ESS, the introduction of ESS in Renewable Purchase Obligation (RPO), and power exchanges are some of the key proposals in the draft policy.

- In January 2022, CERC issued the Ancillary Services Regulations, 2022. The regulations propose to make ESS one of the acceptable solutions to provide secondary and tertiary reserve ancillary services to grid operations. However, the exclusion of ESS from the primary reserve ancillary services is irksome as ESS has a swift demand response, a critical requirement for primary reserves.

- In March 2022, the government formulated Guidelines for Procurement and Utilization of Battery Energy Storage Systems as part of Generation, Transmission and Distribution assets, along with Ancillary Services, hereafter referred to as BESS Guidelines.[7] The guideline provides suggestions for standardisation and uniformity in processes and a risk-sharing framework between various stakeholders in the energy storage sector.

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[7] Ministry of Power. Guidelines for Procurement and Utilization of Battery Energy Storage Systems as part of Generation, Transmission and Distribution assets, along with Ancillary Services. March 2022

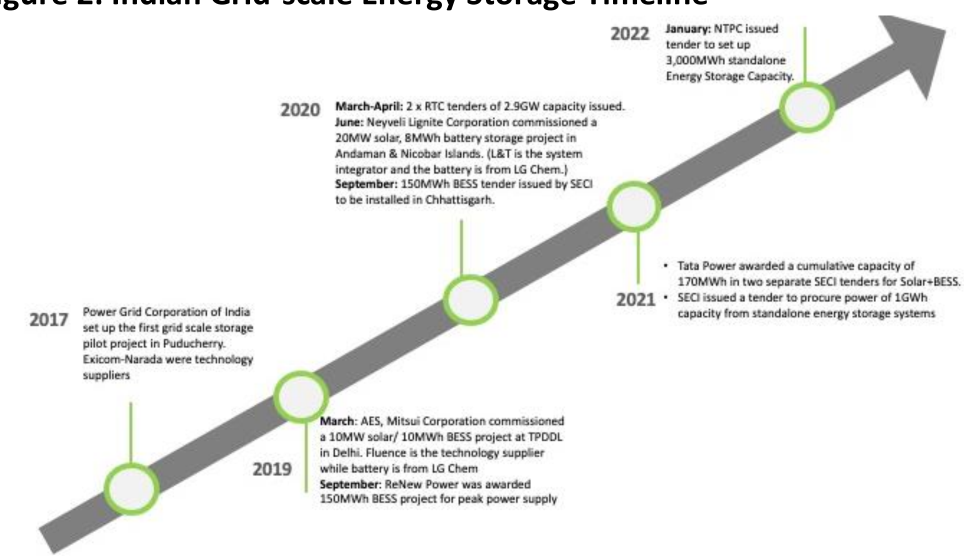
3. Analysis of Past Energy Storage Tenders

In addition to various initiatives discussed in the previous section, to bolster ESS market development, the GoI is also facilitating tendering for grid-scale ESS. Akin to the renewable energy development in India, the GoI targets tendering with reverse auctions to augment ESS installation and drive down the relevant tariffs.

Of the cumulative tendered capacity of ~4,320 megawatt (MW) across various utility-scale ESS tenders until now, only around 1,995MW (~46%) has been allotted.[8] However, out of the allotted capacity, only a handful of projects have been successfully commissioned. This represents challenges faced by the ESS industry within its initial years of development in India. A major challenge for SECI has been implementing back-to-back power purchase and sale agreements after the bidding concludes. Herein, state DISCOMs, usually the off-takers, refuse to sign Power Sale Agreements (PSA) even after having an initial pre-bid understanding with SECI. Major reasons for such backtracking by the DISCOMs include anticipation of falling tariffs by DISCOMs in future and their internal financial woes. The lack of significant participation from players in some of the tenders has also been a challenge.

The utility-scale ESS market in India saw its first installation with a pilot project by Power Grid Corporation of India in 2017 in Puducherry. It was set up with a capacity of 500 Kilowatt-hour (kWh), 250kWh li-ion + 250kWh lead acid, mainly to study and compare the two battery chemistries. Since then, several new ESS projects have been announced or tendered. Two notable commissioned projects are a 20MW/8 Megawatt-hour (MWh) solar+BESS project in Andaman islands by L&T and a 10MW/10MWh standalone BESS project in Delhi by Tata Power Delhi Distribution Limited (TPPDL).

Figure 2: Indian Grid-scale Energy Storage Timeline

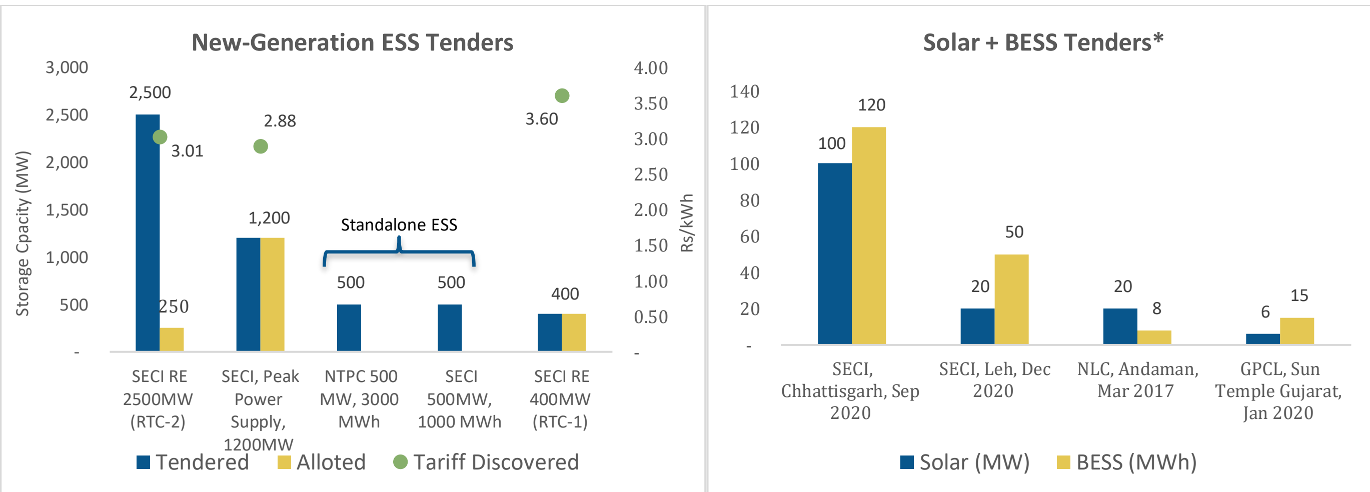


Source: JMK Research

[8] JMK Research (*includes peak power supply and RTC tenders)

The ESS industry in India is at a nascent stage. Indian tendering authorities are still trying to figure out the ideal/best tender conditions for different scenarios in the Indian ESS environment. Learnings developed during the bidding process of any new tender help the concerned tendering authority design its next tender. Thus the terms and conditions related to ESS tenders in India have been evolving over the past few years.

Figure 3: Major Utility-scale Energy Storage Tenders Issued in India



Source: JMK Research

Note: 1. Only major grid-scale tenders considered. Please refer Annexure-I for an exhaustive list of Indian ESS Tenders
2. For SECI peak power supply tender, off-peak tariff is shown, the peak tariff for the same is Rs6.12/unit for Greenko and Rs6.85/unit for ReNew Power.
3. For RTC-1 Tender, the tariff shown is the levelised tariff over the project tenure. The bidding tariff was Rs2.9/unit vis-à-vis the first year of the Power Purchase Agreement (PPA).

Initial ESS tenders issued in India were plain solar+BESS tenders. In these tenders, the developers' scope usually is complete engineering, procurement and construction (EPC). BESS was a secondary component in these tenders. Thus, the tariffs directly reflected the increase in the cost of the associated projects due to BESS. There was very little flexibility in tender conditions regarding system sizing/technology used for ESS. The lack of this flexibility limited the number of applications for ESS.

In recent times, SECI issued several major utility-scale ESS tenders. It included demand-oriented tenders, such as assured peak power supply and Round-the-Clock (RTC) tenders. Also, more recently, SECI and NTPC came up with standalone ESS tenders of 1,000MWh and 3,000MWh, respectively. These tenders aim to utilise the various applications a utility scale ESS can provide in terms of ancillary services and energy shifting. These new standalone tenders, especially the NTPC tender, give the developers much greater flexibility regarding sizing, preferred technology and location. Another difference in these recent SECI and NTPC tenders is the emphasis on treating energy storage-as-a-service.

Table 1: Evolution of ESS Tenders in India

Tender Type	Description	Tender Details
Solar+ BESS EPC	• Tender conditions are not flexible, with fixed absolute sizing of co-located solar and BESS components. • Main application of these projects is DG Replacement and energy shifting by utilising excess solar generation during the day.	• To reduce the dependence of the Andaman & Nicobar Islands on diesel-based energy generation, Neyveli Lignite Corporation (NLC) India issued a tender for setting up a 20MW solar power project along with 8MWh BESS capacity in 2017. • This was one of India's first tenders to couple solar power with BESS at a utility scale. • **Current Status**: L&T won the tender and successfully commissioned the project in July 2020. • Since then, several utility scale solar+BESS tenders have been announced and tendered. • One of the most recent ones is a SECI tender with a solar capacity of 20MW and a 50MWh BESS component. This project will be in Leh. • Tata Power won this tender in August 2021.
Peak Power Supply	• Increased electrification and reduced load shedding by DISCOMs have resulted in a steep increase in the peak energy demand, which the DISCOMs currently meet at significantly higher costs. • ESS charges during off-peak hours and supplies power during peak hours at a higher peak tariff. • The delta between peak and off-peak tariffs is critical to the project's commercial viability.	• SECI issued a 1,200MW renewable energy+storage tender with guaranteed peak power supply for 6-hours per day (morning peak 7-9 AM and evening peak from 6-10 PM) • Greenko won 900MW with pumped hydro storage and ReNew Power won 300 MW with BESS at peak tariffs: Rs6.12/kWh (Greenko) and Rs6.85/kWh (ReNew), off-peak tariff: Rs2.88/kWh • **Current Status**: SECI has not signed the PPA even though the auction concluded in September 2019. SECI is not able to sign PSA (power supply agreement) with DISCOMs because of higher tariffs in these tenders compared to other plain vanilla solar tenders with lesser tariffs
Round-the-Clock (RTC) supply	• Renewable energy-Hybrid Projects with suitable storage capacity can meet Round-the-Clock (RTC) base load without any external balancing need and/or strategy. • The developer must fulfil an annual minimum Capacity Utilisation Factor (CUF) requirement of 80% and a monthly CUF requirement of 70%.	• **RTC 1** • 400MW renewable energy power RTC supply to NDMC, New Delhi and Dadra & Nagar Haveli • Tender won by Renew Power (400MW) at a tariff of Rs2.91/kWh with 3% escalation per annum for 15 years • **Current Status**: PPA and PSA signed, under construction. (Expected Commissioning: April 2023)
		• **RTC 2** • Tender for Supply of 2,500MW RTC 2 Power from renewable energy projects, complemented with power from any other source, including storage, was first issued in March 2020. • Even though the tender proposed ESS as one of the components to supply RTC power, all bidders opted for thermal power to supplement VRE in their bids. • SECI declared Hindustan Thermal Projects as the winner with a winning tariff of Rs3.01/kWh for 250MW allotted capacity. It asked others to match the L1 tariff. • **Current Status**: Due to the inability of bidders to match the L1 tariff, SECI is likely to retender the remaining capacity.
Standalone ESS	• These tenders incorporate the learnings developed during past ESS tenders. • Emphasis was on keeping tender conditions flexible regarding technology, application, location etc. • Treatment of ESS-as-a-Service is independent of application rather than part of generation infrastructure.	• **NTPC 3,000MWh** • The largest utility-scale ESS tender in India issued to date. • **Cumulative Capacity:** 500MW/3,000 MWh (6-hour solution). • Minimum capacity to bid: 100MW/600MWh, Maximum capacity to bid: 500MW/3,000MWh • **Current Status:** After multiple date extensions, NTPC has scheduled the bidding for June 30, 2022.
		• **SECI 1,000MWh** • In late April 2022, SECI released the final Request-for-Selection (RfS) document after releasing a draft RfS in October 2021. • The RfS documents proposed a total capacity of 500MW/1,000MWh as a standalone ESS. • **Current Status:** Final RfS issued by SECI, with bidding scheduled for June 24, 2022.

Source: JMK Research

Key Players in ESS Space

Major renewable energy developers, such as ReNew Power, Greenko and Tata Power, are aggressively entering the utility scale ESS space. ReNew Power was the winner in both the new age ESS tenders (Peak Power Supply, RTC-1). Greenko is targeting ESS development in India through PHS. It is developing two Integrated Renewable Energy Storage Projects (IRESP) in Andhra Pradesh that will integrate GW-scale wind, solar and PHS. We summarise the major industry players operating in the ESS space below:

Table 2: Leading Developers in ESS Space in India

Developer	ESS Capacity (Commissioned + Pipeline)	ESS Technology	Remarks
ReNew POWER	700MW	BESS	• 700MW pipeline (300MW from peak power supply + 400MW from RTC-1) • Storage capacity of 150 MWh for 6 hours in peak power supply. • RTC -1 (demarcation): 900MW wind, 400MW solar, 100MWh BESS.
greenko	900MW	PHS	• 900MW pipeline awarded in peak power supply project. • Most likely to be met by Greenko's IRESP. • IRESP under development at Pinnapuram, AP: 3GW solar, 0.5GW wind, 1.2GW/10.8GWh PHS.
LARSEN & TOUBRO	20MW/8MWh	BESS	• Commissioned first large-scale Solar+BESS project in Andaman. • Project Commissioned in July 2020.
susten By Mahindra	6MW/18MWh	BESS	• Commissioned the largest Solar+BESS project yet in India (in terms of BESS capacity). • Project Commissioned in April 2022.
TATA POWER	80MW/180MWh	BESS, Gravity Based Storage	• 10MW/10MWh BESS commissioned in Delhi in February 2019. • 70MW/170MWh cumulative capacity under development in separate projects in Leh and Chhattisgarh. • Exploring gravity-based storage as a solution for the 20MW/50MWh Leh Project.

Source: JMK Research, news articles

4. Analysing NTPC, SECI Tender Terms and Conditions

NTPC 500MW/3,000MWh

NTPC Renewable Energy Ltd (NTPC REL) intends to avail energy storage facility under a service model from ISTS connected energy storage solutions with a total capacity of 500MW/3,000MWh for 25 years.

NTPC REL issued the tender in January 2022, with the bidding stage expected to be in June 2022. The original Expression-of-Interest (EoI) for this tender came out in June 2021 with a capacity of 1,000MWh. NTPC REL used the submitted response to EoI from various stakeholders to formulate the tender conditions of the present RfS document. This, along with the SECI tender, marks one of India's first forays into the large grid-scale standalone ESS.

Table 3: Salient Conditions of NTPC 3,000MWh Tender

Tender Attribute	Condition
System Capacity	• The minimum capacity of a project block at a single interconnection point should be 100MW/600MWh (6-hour solution). • Furthermore, developers can quote capacities in the multiple of 100MW, such as: ○ 100MW with 600MWh (minimum capacity) ○ 200MW with 1,200MWh ○ 300MW with 1,800MWh ○ 400MW with 2,400MWh ○ 500MW with 3,000MWh (maximum capacity)
Location of Generation Sources	• Selection of project location is entirely in the developer's scope. • The project location can be at any location Pan India, with the only condition being a connection to ISTS Network at a minimum voltage level of 220kV.
Scheduled Commissioning Date	• 24 months from the effective date of signing of the Energy Storage Service Agreement (ESSA).
Selection of Project Technology	• Selection of Energy Storage Technology is entirely in the developer's scope. • The selected technology solution can be later modified/amended until the financial arrangement closure (i.e., within nine months of the signing of ESSA)
Tariff Design	• ESS treated as a subscription/service. • The tariff is paid in terms of fixed annual payments for 25 years in return for using the system as "On-Demand" basis for its needs.
Potential Off-taker of Energy	• NTPC REL will be the sole off-taker of the ESS. • It will be solely responsible for charging/discharging the ESS system, provided all minimum technical requirements regarding its health are being maintained.
Project Scope of the Developer	• ESS developer will Build-Own-Operate (BOO) the plant during its entire project tenure of 25 years. • Responsible for maintaining the plant parameters inside stipulated technical requirements limits.
Application/Usage of Stored Energy	• Primary Application: Energy Shifting, Round the Clock (RTC) power • Secondary: Rest ESS Applications not explicitly listed in the tender.
Main Technical Requirements	• Round-Trip-Efficiency (RtE) at metering point > 75% • ESS annual availability > 95% • Maximum ramp up/down response: 30 seconds

Source: NTPC REL

The summary above demonstrates the flexible nature of tender conditions, be it in terms of location, sizing, or selection of project technology. This is understandable considering India's dearth of large grid-scale storage installations. Learnings from this project will likely be a benchmark for future similar installations by NTPC and other developers across India.

Another interesting point is the lack of explicit technical eligibility criteria for a bidder in terms of an installed portfolio of storage projects. However, there are detailed financial eligibility criteria regarding the net worth, revenue, profit, etc. This is most likely to encourage the participation of new entrants who might have a presence in the renewable energy space elsewhere but are yet to enter the ESS space.

Developers have discretion over selecting the project location (Pan India). However, NTPC has suggested considering the possibility of installing the project within or adjacent to any of its upcoming solar park/project premises across India. This would result in enhanced and simplified integration of the ESS with NTPC REL's solar plant. Both will connect to the same generator pooling substation, which would already have a connection to an ISTS network.

The bidding and reverse auction for this tender is not yet complete and will be held in June 2022.

SECI 500MW/1,000MWh

Selection of Battery Storage System Developers for Setting up of 1,000MWh (500MW x 2hours) Battery Energy Storage Systems in India for "On Demand" usage under Tariff-based Global Competitive Bidding (ESS-I)

SECI released this tender's draft request-for-selection (RfS) in October 2021. It issued the final RfS in April 2022. This issuance by SECI came in response to the considerable interest generated by prospective users/consumers to use energy storage systems on-demand during peak and off-peak hours. In July 2021, SECI issued a notice-inviting-tender (NIT) for power procurement from 2,000MWh standalone energy storage systems (ESS).

The 1,000MWh ISTS-connected pilot project would be set up on a build-own-operate-transfer (BOOT) basis.

Table 4: Salient Conditions of SECI 500MW/1,000MWh Draft RfS

Tender Attribute	Condition
Project Capacity	• The total capacity of 500MW/1,000MWh must be set up at a single location, including two projects each of 500MWh (250MW x 2 hours) capacity. • A bidder would be permitted to submit a single bid offering solely in the two formats as shown below.: ○ 250MW/500MWh (250MW x 2 hours) ○ 500MW/1,000MWh (500MW x 2hours)
Project Location	• The two projects, each of 500MWh, should be located in the vicinity of the Fatehgarh-III substation of the ISTS network in Rajasthan
Grid Connectivity	• The project must be designed for interconnection to the 400/220kV Fatehgarh-III ISTS Substation in Rajasthan. • The minimum voltage for interconnection will be 220kV.
Scheduled Commissioning Date	• 18 months from the effective date of the Battery Energy Storage Purchase Agreement (BESPA).
Selection of Project Technology	• The selected project developer/developers is/are mandated to use BESS. However, the RfS is technology agnostic on the nature of BESS
Tariff Design	• BESS is treated as a subscription/service. • The tariff is paid in terms of fixed monthly payments for 12 years in return for using the system as "on-demand" basis for its needs.
Potential Off-taker of Energy	• Final off-taker entities are yet to be defined.
Project Scope of the Developer	• Setting up of the BESS and interconnection of the BESS with the ISTS network
Application of Stored Energy	• Tender does not explicitly list the application of BESS
Technical Requirements	• Minimum round-trip efficiency (RtE) - 85% • Minimum annual availability of BESS - 95% • Operational cycles per day – 2 (i.e., complete charge-discharge cycles per day) • Power rating of 500MWh (250MW x 2 hours) BESS for each of the two projects. • Dispatchable capacity - 500MWh for each project at commercial operation date (COD), as measured at the metering point.

Source: SECI

Of the project capacity secured by a project developer, 60% will be contracted obligatorily by SECI. Of the capacity contracted by SECI, 30% of the project capacity will be for ancillary services. Arrangement for utilisation of the remaining 40% capacity will be at the developer's discretion. The developer will likely utilise this 40% project capacity for third-party sales, energy trading applications etc.

Any energy source can charge the project's BESS, including conventional energy sources. The selected project developer need not hold the ownership of such an energy source. But charging and discharging of the BESS will be under the scope of the end-user of BESS.

Throughout its tenure, the project should demonstrate a minimum plant availability of 95% and a minimum RtE of 85%. SECI will enforce Significant Liquidated Damages on the developer for failing to keep plant parameters within stipulated limits.

Comparison of NTPC and SECI Standalone ESS Tenders

Both the NTPC and SECI tenders have the potential to kickstart the ESS revolution in India. Both tenders must be connected to an ISTS network and cater to multiple ESS applications.

As both the tenders are for setting up standalone ESS at a similar scale, they share several similar tender conditions. However, there are a few differences which is a representation of the continuously evolving ESS landscape in India. Upon comparing the terms and conditions of both the tenders, the NTPC tender stands out for its flexibility. The NTPC tender has flexibility in project capacity, location, and project ESS technology.

However, to facilitate flexibility in use cases and create multiple revenue streams for developers, the SECI tender introduced an important provision. It allows developers to utilise 40% of the project capacity at their discretion for multiple applications (energy trading in exchange/third party sale etc.). The NTPC tender lacks a similar provision.

Table 5: Comparison of Utility Scale ESS Tenders

Tender Attribute	NTPC 500MW/3,000MWh	SECI 500MW/1,000MWh
Project Capacity	• Total Capacity: 500MW/3,000MWh (6-hour system). • Minimum Project Size: 100MW/600MWh.	• Total Capacity: 500MW/1,000MWh (2-hour system) • Further segregated into two sub-projects each of 500MWh (250MW x 2 hours) capacity.
Project Location	• Entirely in developer scope. • Can be located Pan India. • Mandatory to connect the project to the ISTS network at a minimum voltage level of 220kV.	• Both the sub-projects should be in the vicinity of Fatehgarh-III substations of the ISTS network in Rajasthan. • Land will be allocated by the Transmission licensee, facilitated by SECI.
Project Technology	• Any technological/financially viable storage technology is acceptable.	• Mandatory to use BESS as the storage technology.
Project Scope (Developer)	• BOO, i.e., Build Own Operate	• BOOT, i.e., Build-Own-Operate-Transfer
Tariff Design	• Fixed annual payments for the entire ESSA tenure of 25 years.	• Fixed monthly payments for the entire BESPA tenure of 12 years.
Energy Off-taker	• NTPC REL	• Final off-taker yet to be identified
Scheduled Commissioning Date (SCD)	• 24 months from the effective date of ESSA.	• 18 months from the effective date of BESPA.

Source: NTPC REL, SECI

Although the tariff design of both the tenders is similar in treating ESS as a subscription/service, the tenure and frequency of payments vary. NTPC has set the project tenure as 25 years, which may let the ESS developers quote lesser tariffs. The comparatively lower tariff is likely to be because of continuously falling ESS costs (especially in BESS) and sustained cash flow over a longer duration. Upon the completion of the project tenure, the project will be transferred to SECI "as-is" in case of SECI tender. But in the case of the NTPC tender, the developer will continue to own the project and will be free to use those assets for any further use. Next, we look at these two projects' impact on the Indian ESS and renewable energy market.

5. New Opportunities That Will Emerge

The NTPC and SECI tenders, both GW-scale projects, may catalyse domestic ESS market development. These projects, if timely and properly executed, will not only augment Indian ESS capacity multifold but also generate further opportunities for the growth of the entire sector. We discuss some key opportunities resulting from these tenders in the short-to-medium term.

Domestic Manufacturing and Ancillary Market Development

Like the ESS installed capacity, domestic manufacturing in the sector has been minuscule. Also, the domestic supply chain infrastructure is virtually non-existent. However, the two grid-scale standalone ESS tenders with a cumulative capacity of 1GW/4GWh might change that.

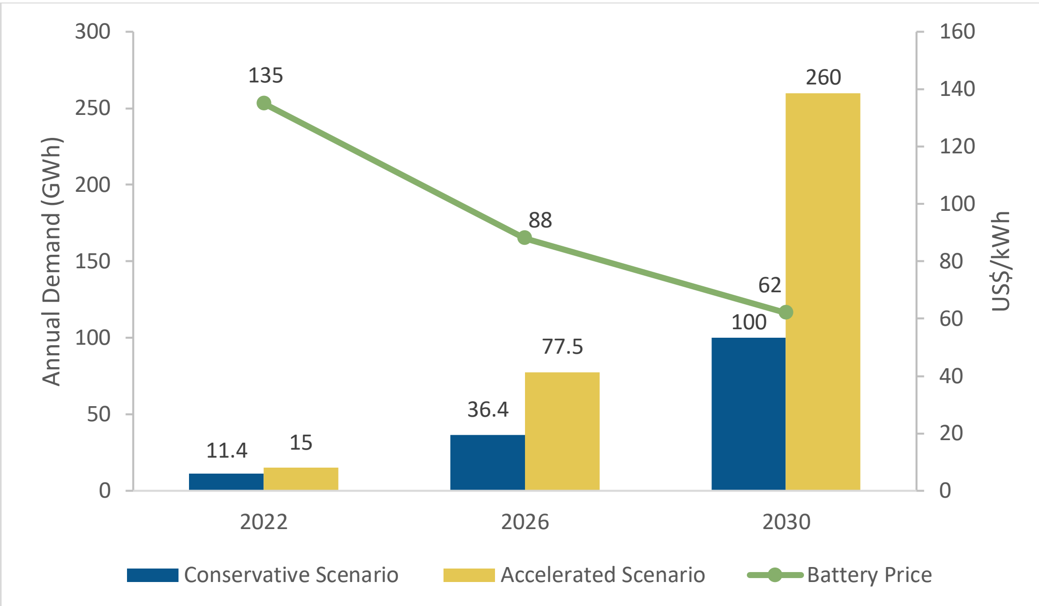
These projects indicate the scale expected in future ESS tenders. Anticipating huge demand, domestic manufacturing capacities could rise manifold. The development is expected both in the domestic manufacturing of major components (such as Battery, Battery Inverters) as well as ancillary supply chain infrastructure (such as electrolytes, casings, separators etc.). This will be in tandem with the 50GWh ACC PLI scheme, which outlines the stationary ESS market as one of the major consumers along with Electric Vehicles (EV). Consequently, NITI Aayog estimates a domestic battery demand of 100-260GWh in 2030, rising (almost 17x) from an anticipated value of 11-15GWh in 2022.[9]

NITI Aayog estimates a domestic battery demand of 100-260GWh in 2030.

The supply chain infrastructure created during the execution of these projects will pave the way for future domestic ESS development.

[9] NITI Aayog. Need for Advanced Chemistry Cell Energy Storage in India, Pg 29. February 2022

Figure 4: Forecasted Battery Demand (India) vs Battery Price



Source: NITI Aayog, BNEF

Newer Business Models (Capacity Market Development)

Globally, revenues from capacity markets have been explored as one of the potential use cases of ESS. In a capacity market business model, the capacity providers/ developers need to supply power at a scheduled time period, which can be years down the line. The bidding in the auction is in terms of capacity costs (per kW or MW) rather than energy (per kWh). The capacity providers may utilise the plant for electricity trading between the auction and scheduled capacity delivery time. Ministry of Power's BESS Guidelines, released in March 2022, also suggest this as a possible business model. Thus, when SECI reissued the RfS for its 1,000 MWh tender, it introduced a clause wherein developers can utilise 40% of the project capacity at their discretion. Developers can use this capacity for multiple applications, with a sale in the capacity market as one of the possible revenue streams.

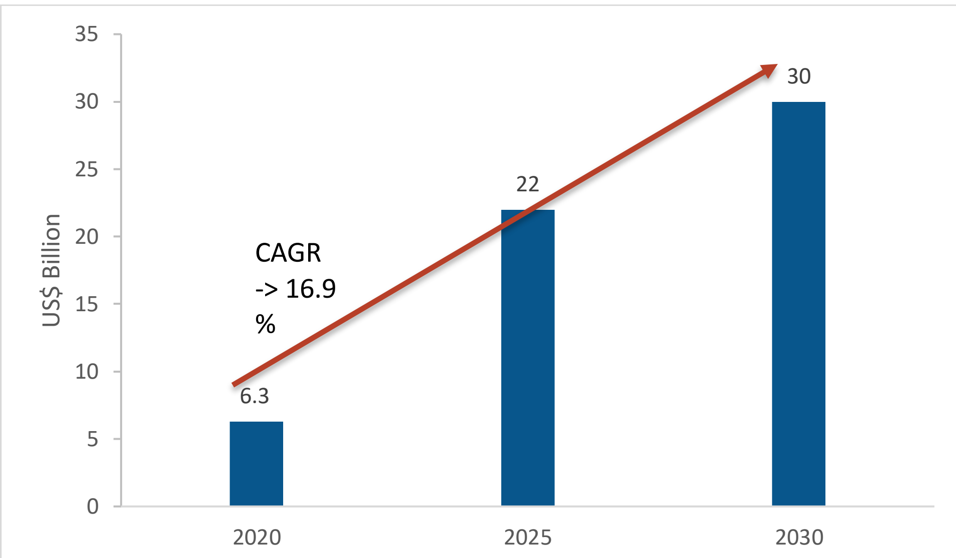
With better forecasting of load demand, future tenders may further explore the potential of capacity markets to provide additional revenue. Revenue from the capacity market can make up 5-10% of the total revenues of a BESS project, depending on the battery size.[10] This would ultimately contribute to a reduction in discovered tariffs.

[10] Energy Storage News. UK investor confidence in battery storage grows as industry does too. February 2022

Boost in Domestic Investor Confidence in ESS

Any new technology entering the market generates apprehension from investors who are cautious about associated technological and financial concerns. However, in recent years, grid-scale energy storage has made its case as a viable independent business. As a result, all stakeholders, including investors, are beginning to realise that ESS is the crucial element that will bind the whole power infrastructure together in the coming years. Globally, the annual investment in the ESS market could increase almost six times from US$6.3 billion in 2020 to more than US$30 billion in 2030.[11]

Figure 5: Annual Global Investments Growth



Source: NITI Aayog

Domestically, concrete investor interest in standalone ESS is not yet a reality. However, because of the PLI scheme, battery manufacturing in India is witnessing an influx of investments (~US$2.2 billion planned in the next 3-4 years).[12] Successful and timely execution of NTPC and SECI grid-scale tender projects will help demonstrate such projects' technological and financial viability to Indian investors.

6. Key Challenges vis-à-vis NTPC, SECI Tenders

ESS is an emerging technology in the power sector. The technology will have technical, commercial, geopolitical and regulatory challenges during the initial development period. Consequently, current standalone ESS tenders will face challenges partly due to their scale and partly due to the emerging nature of the technology. We outline the key challenges below:

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[11] NITI Aayog. Need for Advanced Chemistry Cell Energy Storage in India. February 2022, Pg 14

[12] JMK Research. Lithium-Ion Battery (LiB) Manufacturing Landscape in India. January 2022

Technical Challenges

The NTPC tender states that the energy storage system developer (ESSD) can use any technology in its bid submission. However, considering the scale of the project, the only feasible storage technologies would be BESS and PHS. Moreover, beyond a discharge time of four hours, the financial viability of BESS (especially Li-ion) gets adversely affected. Hence, the current tender's requirement of a 6-hour ESS solution might be a major impediment to BESS.

On the contrary, from contract awarding to project commissioning, PHS has a significantly larger lead time (as compared to BESS). This is partly due to several associated regulatory clearances related to the environment and construction. But the project's commissioning timeline of just 24 months might be a major impediment for PHS. However, the tender conditions also allow consideration of under-construction projects for bidding. Thus, an ongoing project such as the Greenko integrated renewable energy storage project (cumulative PHS capacity: 2.4GW/22.1GWh) in Andhra Pradesh can be a viable solution for implementing the project.

Procurement Challenges

India's current BESS installed capacity(<50MW) is minuscule compared to the current GW-scale standalone ESS tenders. Safe to say, there will be a dearth of suppliers and associated supply chain infrastructure for ESS components at this scale in India. Consequently, few developers have reported that they are finding difficulties in securing vendors for the aforementioned projects. Also, given the scale, they are finding it difficult to find entities to provide long-term Annual Maintenance Contracts (AMC), a requirement in both the tenders. However, the stakeholders remain optimistic that there will be some solution by the time the tendering process is complete.

Regulatory Challenges

Indian Electricity Act, 2003 does not treat energy storage as a standalone asset. Instead, it treats ESS as a part of generation, transmission or distribution infrastructure, depending on its owning entity. Consequently, there is no clear framework yet on how to tax such standalone ESS assets. Thus, the lack of a coherent central ESS policy (viz. currently being formulated), which might address all these issues, will be one of the major impediments.

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Additionally, there has been ambiguity regarding the Goods and Services Tax (GST) rates for ESS. For ESS coupled with renewable energy, the GST is 12% (increased from 5% in September 2021).[13] For standalone ESS, as pointed out above, there is no clear GST tax rate. The stakeholders have requested the government to implement lower GST rates on ESS, at least in the first few years of its development. Any further increase in rates might affect the viability of not only the current standalone ESS tenders but the entire ESS market. Separately, from April 2022, the government will levy a Basic Customs Duty (BCD) of 40% on solar modules. Therefore, for solar+BESS projects, an increase in BCD will increase project costs, thus indirectly affecting BESS projects' viability.

Also, the policymakers expect a few more regulatory hiccups that might arise during the execution of NTPC and SECI standalone tenders. Thus, policymakers view these projects as potential pilot tests that will enhance the learning curve of all stakeholders and streamline regulatory processes for similar future projects.

7. Future Tender Types Expected

Previous sections depict the evolution of ESS tenders until now. We will see a significant evolution in upcoming tenders in their tariff design and business models incorporating multiple revenue streams. In addition, the inclusion of Domestic Content Requirements is also a possibility. Based on discussion with concerned stakeholders, along with recent market and regulatory activity in the ESS space, we list the expectations from future ESS tenders below:

- **ESS-as-a-Service –** The standalone tenders from SECI and NTPC treated BESS as a subscription/service. In March 2022, the Ministry of Power finalised the "Guidelines for Procurement and Utilization of Battery Energy Storage Systems as part of Generation, Transmission and Distribution assets, along with Ancillary Services". The guidelines emphasise that the energy procurer should pay for storage capacity rather than energy delivered, especially when BESS is not a part of the energy generation infrastructure. Upcoming new grid-scale ESS tenders are likely to be designed keeping this in mind, wherein Rs/MW/year would be the defining bidding parameter.

- **Domestic Content Requirement (DCR) condition –** At present, end-to-end battery manufacturing in India is non-existent. However, because of the "PLI scheme in ACC" introduced by the government to boost domestic battery manufacturing, the domestic manufacturing capacity may rise to more than 50GWh in a four-to-five year period. Thus, future tenders may have some level of DCR condition for efficient utilisation of upcoming facilities.

- **Distribution-specific ESS tenders –** Past and recent ESS tenders focus on utilising ESS for generation and transmission applications. However, ESS's applications as part of distribution infrastructure are equally vital. The BESS guidelines emphasise "storage for distribution" as one of the major business cases. ESS, connected to the load centres of DISCOMs, can help it manage

[13] Economic Times. GST hike from 5% per 12% to make solar projects unviable, say industry players. September 2021

peak load, enhance grid resilience, and strengthen its operations. Additionally, BESS can facilitate DISCOMs in its large-scale expansion in electric mobility. Thus, new tenders entirely focused on distribution infrastructure could come in the near future.

- **Inclusion of Additional Performance Parameters –** The standalone tenders of SECI and NTPC place a great emphasis on performance parameters that need to be met continuously over the project tenure. The performance parameters are ESS availability, round-trip efficiency, and ramp up/down response. Based on learnings of current tenders, future tenders could include further detailed performance requirements in terms of new parameters. These will likely be charging/discharging rate (C-rate), power surge handling, etc.

- **Focus on PHS and Alternate ESS Technologies –** Li-ion BESS has become one of the most significant ESS technologies in automotive and stationary applications in recent years. All the past major ESS tenders have directly or indirectly emphasised BESS as the most suitable technology for the ESS. However, CEA analysis reveals both BESS and PHS will be viable solutions for ESS in India. The government is realising the importance of alternate ESS technologies like PHS and is thus, formulating separate guidelines for PHS. Subsequently, future ESS tenders designed specifically for PHS can be expected. Other alternate technologies around which ESS tenders are most likely to be modelled in the future include ultracapacitors, gravity and thermal-based storage systems etc.

- **Utilisation of ESS for Energy Trading –** Developers and policymakers alike have now realised that multiple use cases of ESS are essential to offset the high initial capital expenditure (CAPEX) of ESS projects. Thus, future ESS tenders will likely be designed to employ BESS for various applications.

  Power trading is one such application that can significantly influence revenue generation. In future ESS tenders, there may be a provision allowing ESS developers to use their assets for energy trading or third-party use during off-peak hours. Formulating merchant power PPA contracts between ESS developers and third-party entities can help achieve such a provision.

8. International Experience

Around the world, the demand for flexibility of supply-side resources of the electricity network is rising. The industry estimates that during 2021-30, worldwide energy storage capacity addition will be 345GW/999GWh.[14] The United States of America (US) and China are the two largest markets, representing over half of the global storage installations by 2030. Undoubtedly, increasing penetration of renewable energy into the electrical grid will be the major driver for spurring the growth of energy storage capacity addition.

Undoubtedly, increasing penetration of renewable energy into the electrical grid will be the major driver for spurring the growth of energy storage capacity addition.

Some of the countries/markets that are paving the way for the adoption of energy storage systems are the US, China, the UK, Germany, Japan, South Korea, Australia, etc. Grid reliability and stability have been the key factors driving ESS deployment in the US. Thus, ESS plants in the US (especially California) are large scale with a long duration of storage. Germany has been a frontrunner in distributed residential ESS. Achieving grid parity in the residential sector by PV+BESS was the major driver of the growth here. China, already a BESS manufacturing hub, is betting on Time-of-Day (TOD) differential tariffs for ESS development. The UK, due to the already high penetration of renewable energy (especially wind), is prioritising ESS deployment.

Currently, the UK is one of the top ESS markets in Europe and is ardently pushing for the development of relevant projects in this market. Almost 729 BESS projects are in various phases of development in the UK, accumulating to a total capacity of 16.1GW.[15] To boost further deployment, Central Government in the UK has been decentralising the large-scale ESS development process to local planning authorities.

At 11GW, the UK has one of the highest offshore wind energy capacities among all the countries across the globe. Further, wind energy (both onshore and offshore) is the primary source of renewable energy-based power in the UK, with a market share close to a quarter of the country's total power generation (as of 2020).[16] On its path towards becoming a low-carbon economy, the UK has not just ardently driven the capacity addition of renewable energy but also has greatly reduced its dependence on fossil fuels such as coal and natural gas for electricity generation. However, the expansion of VRE, specifically wind capacity, has invited a severe challenge for the UK market.

When the wind speed is critically low, a shortage in wind power supply engenders the electricity market to rely on conventional energy sources, mainly natural gas. Lately, however, the availability of power at the expense of natural gas has become

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[14] BloombergNEF. Global Energy Storage Market Set to Hit One Terawatt-Hour by 2030. November 2021
[15] International Trade Administration. UNITED KINGDOM ENERGY STORAGE MARKET. June 2021
[16] Office for National Statistics. Wind energy in the UK: June 2021. June 2021

quite uncertain across Europe owing to geopolitical issues. The lack of power supply flexibility of VRE (primarily wind energy) and constricted gas supply have caused significant fluctuations in the power market prices. For example, in early January 2021, the UK witnessed an enormous surge in (intraday) market prices to GBP1,000/MWh (~US$1,360/MWh).[17] This was when the temperatures and wind power output were very low, and the market had to pivot towards coal and gas-based power.

Herein lies a significant opportunity for ESS in the country. The ESS can act as a direct alternative to conventional coal or gas-fired power by providing the requisite supply flexibility and enabling frequency control. Under the UK's 2008 Climate Change Act, the country targets to achieve net-zero greenhouse gas (GHG) emissions by 2050. And recently, the UK government recognised energy storage as a high priority, identifying it as a key component in its ambitious plan to become a net-zero carbon economy.

Hereon, the report illustrates a successful deployment of BESS in the UK through the following case study.

Case Study: Minety BESS Project (United Kingdom)

Overview: Regarded as the largest operational BESS facility in Europe, the Minety battery storage project became a reality after the immense pressure of the market demand. Furthermore, the project became a priority for the UK government following one of the most severe power blackouts in the country in August 2019. The incident laid bare the immense need for frequency regulation of the power grid and hence, ancillary support via BESS.

Project Details:

Location: Minety, Wiltshire, England, UK	**BESS Capacity:** 100MW/100MWh	**BESS Configuration:** 2X50MW (1,500V NMC1 and LFP1 batteries)
Owner: China Huaneng Group and Chinese government-backed fund, CNIC Corporation	**Project Developer:** Penso Power	**BESS Supplier:** Sungrow Power Supply Co. Ltd.
Power Off-taker: Shell Energy Europe Ltd. (SEEL)	**O&M Contractor:** RES Group	**Commissioning Date:** July 2021

Purpose: Power stored in the Minety storage facility is evacuated into the National Grid while following the Dynamic Containment requirement, which requires power systems to respond to the power instruction of the grid within 1 second.

Sungrow ESS enables the project to be active in the UK local capacity market, frequency regulation market, triads market, and arbitrage trading in spot and balance markets. Notably, the project preferentially provides Dynamic Containment (DC) services in the frequency regulation market and can earn 17 pounds per MW per hour.

Learnings: The Minety BESS is designed to store excess energy generated from RE and then feed this energy into the National Grid, providing an ancillary market service. It also acts as a balancing mechanism, if and when abrupt and extreme market volatility occurs. And lastly, by securing a capacity market contract, the Minety project is assured of monthly payments. Thus, the Minety battery facility provides certainty of revenue flow to the BESS owner owing to its dynamic participation in multiple markets.

[17] International Trade Administration. United Kingdom Energy Storage Market. October 2021

9. Conclusion

India is at the cusp of a potential ESS revolution. For significant augmentation of renewable energy capacity in the coming decade, large-scale deployment of ESS is imperative. Firm renewable energy+storage power will be a suitable replacement for increasingly uneconomic coal-based power. The recent power crisis (in May 2022) caused due to coal shortage has demonstrated that the government should invest significantly in ESS capacity addition to alleviate power sector risks.

India, being a complex and diverse country, will need a combination of factors that have been the major drivers of ESS deployment in the leading markets. Enhancing grid stability like the US, implementing TOD differential tariffs like China and decentralising ESS development to states/districts like the UK will also be crucial factors for ESS development in India. The evolution of Utility Scale ESS tenders in India highlights the increasing focus and efforts of all stakeholders. In the past five years, the ESS tenders have been evolving with innovative and new age tenders such as RTC, Peak Power and now standalone ESS.

Current standalone ESS tenders, being the first large-scale tenders of such kind, can be a catalyst for the entire Indian ESS market. Successful and timely execution of these projects will boost investments into the ESS space and spur domestic manufacturing in this segment. SECI has deliberately declared its tender as a pilot project. Thus, the learnings from these tenders (bidding and execution) will contribute heavily to future ESS tender designs by central tendering authorities such as NTPC and SECI.

Current standalone ESS tenders, being the first large-scale tenders of their kind, could be a catalyst for the entire Indian ESS market.

To improve ESS projects' viability, driving down tariffs discovered in ESS tenders will be vital. The treatment of ESS-as-a-Service in the current standalone tenders will be a major step in driving the ESS market. Future ESS tenders should have a similar design to enforce bidding in terms of MW, ultimately developing a capacity market in India. Another major factor leading to lower tariffs would be the utilisation of ESS for creating multiple revenue streams (e.g., trading stored power in exchanges).

A major driver for BESS in the past decade has been the continuously falling curve of key component prices, mainly batteries. However, due to supply chain constraints, there has been a rise in battery prices from late 2021. This may be a short-term deterrent impacting the development of the stationary BESS market and EVs. To counter this foreign supply chain impact, the Indian government have developed a PLI scheme in ACC for the GW-scale manufacturing of Li-ion batteries in India. However, it will still take 4-5 years for that manufacturing capacity to become functional. Thus, till then, dependence on imports to meet domestic BESS demand will be there.

To conclude, ESS will be the next major technology influencing the power sector in the coming decade. A comprehensive National ESS Policy will significantly address major impediments faced by ESS industry in India. In the initial years of development, stakeholders believe that the ESS industry should get the support of lower GST rates and duties. Also, like with renewable energy development, a time-based target in the upcoming policy can become a major driver of the ESS industry's growth.

Thus, it is the responsibility of tendering authorities to design technologically inclusive, flexible, and detailed utility scale ESS tenders for the organic development of the ESS industry in India. Subsequently, a repeat of those successful tenders will be essential to enable adoption and growth momentum. Also, it is the government's responsibility to facilitate discussions/dialogues between the various stakeholders in the ESS industry. This aids in formulating effective policy design and overcoming other challenges associated with an emerging technology like ESS.

10. Annexure – I (List of all major ESS Tenders Issued in India, as of May 2022)

Tender	Status	Date of Issue	Tender Type	Tendered Capacity (MW)	Winners	Location	Storage Component
Neyveli Lignite Corporation (NLC)	Commissioned	Mar-18	Solar+ BESS	20	L&T	Andaman & Nicobar	8MWh
SECI Peak Power Supply	Auction Completed	Aug-19	Peak Power Supply	1200	Greenko (900MW), ReNew Power (300MW)	Pan India	Mandatory (ReNew Power confirmed its storage component as 150MWh)
SECI Lakshadweep	Auction Completed	Sep-19	Solar+ BESS	1.95	SunSource Energy	Lakshadweep	2.15MWh
SECI RTC-I	Auction Completed	Oct-19	RTC	400	ReNew Power	Pan India	100MWh (as declared by ReNew)
SECI Floating Solar	Auction Completed	Jan-20	Floating Solar+ BESS	4	SunSource Energy	Andaman & Nicobar	2MWh
Gujarat Power Corporation Limited (GPCL)	Commissioned	Jan-20	Solar+ BESS	6	Mahindra Susten	Modhera, Gujarat	15MWh
SECI 14MW,42 MWh	RfS Issued	Jan-20	Solar+ BESS	14	-	Ladakh	42MWh
Military Engineering Services (MES)	RfS Issued	Sep-20	Solar+ BESS	3	-	Leh/Kargil	5MWh
SECI 100MW, 120MWh	Auction Completed	Sep-20	Solar+ BESS	100	Tata Power	Chhattisgarh	120MWh
SECI 20MW, 50MWh	Auction Completed	Dec-20	Solar+ BESS	20	Tata Power	Leh	50MWh
Tamil Nadu Generation & Distribution Corporation Limited (TANGEDCO)	RfS Issued	Feb-21	Solar+ BESS	1	-	Tamil Nadu	3MWh
Railway Energy Management Company Limited (Indian Railways)	RfS Issued	May-21	Solar+ BESS	15	-	Maharashtra	14MWh
NTPC 4MW,1MWh	RfS Issued	Jun-21	Solar+ BESS	4	-	Uttar Pradesh	1MWh
Gujarat State Electricity Corporation Limited (GSECL)	RfS Issued	Sep-21	Solar+ BESS	35	-	Gujarat	57MWh
SECI Standalone BESS	RfS Issued	Apr-22	Stand-alone BESS	500	-	Rajasthan	1,000MWh
NTPC Standalone BESS	RfS Issued	Jan-22	Stand-alone ESS	500	-	Pan India	3,000MWh
GUVNL Peak Power Supply	RfS Issued	Jun-22	Peak Power Supply	500	-	Gujarat	250MWh

Source: JMK Research

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