

Report on Mechanism for Sale of Storage Power

1. Introduction

1.1 The renewable sources with zero marginal costs such as Wind, Solar Power are intermittent in nature, that is, their output depends on external conditions, such as sunshine or wind. The value and timing of their output are not controllable. As of September, 2023, non-fossil based installed capacity is 43.2 % of the total installed capacity. As per Nationally Determined Contributions (NDC) submitted by India under UNFCCC framework, 50% of installed capacity in the country will be non-fossil based by 2030. India's energy mix is set to undergo a transition from fossil fuel sources to non-fossil fuel-based sources dominated by Renewable Energy (RE) in the future.

1.2 However, the incorporation of a significant amount of variable and intermittent RE into the energy mix presents a challenge for maintaining grid stability and uninterrupted power supply. The conventional energy sources as coal, hydro (with storage), nuclear can be stockpiled and generation or energy output from these power plants can be controlled. However, the same is not the case with Renewable Energy (RE) sources such as Solar, Wind & Run of the River Hydro (without pondage or storage) which are to be used instantly, and in case they are not utilized they will be lost forever. The challenge with RE sources arises due to their varying nature with time, climate, season or geographic location. The variability associated with the RE sources leads to issues such as grid balancing and creating a need for flexibility.

1.3 In this context, Energy Storage Systems (ESS) can be used for storing energy available from RE sources to be used at other times of the day. Storage of energy will help in bringing down the variability of generation in RE sources, improving grid stability, enabling energy/peak shifting, providing ancillary support services and enabling larger renewable energy integration. Storage Systems will also benefit consumers by bringing down peak deficits, peak tariffs, reduction of carbon emissions, deferral of transmission and distribution capex. For energy transition, shifting from fossil fuel-based capacity to Renewable Energy capacity- it is necessary that the Renewable Energy becomes dispatchable, and available 24x7. This is possible only with Energy Storage.

1.4 The grid level ESS is specifically useful to address controlling of renewable generation. In fact, Solar Energy Corporation of India (SECI) has already come out with tariff based competitive bidding tenders which would require to the ESS developer to supply a firm and dispatchable supply during peak periods. This report is based on extensive consultations with stakeholders including Grid India, Indian Energy Storage Alliance, NRVN and SECI.

2. Policy Framework

2.1 Legal Status to ESS

The Electricity (Amendment) Rules, 2022 provide that the Energy Storage Systems shall be considered as a part of the power system, as defined under clause (50) of section 2 of the Act. Further as per these Rules, ESS can be used independently or in

conjunction with generation, transmission, and distribution infrastructure and would be accorded status based on its application area i.e. generation, transmission and distribution.

2.1.1 ESS owners or developers are permitted to lease or sell storage space to utility companies or Load Despatch Centres, as well as to use the storage space themselves to buy and store electricity for future sale.^[1]

2.1.2 The ownership and operation of the independent energy storage system is be a delicensed activity at par with a generating company in accordance with the provisions of section 7 of the Act^[2]. However, if an ESS owner or developer wishes to operate independently, they must register with CEA along with their capacity and location details and meet the safety requirements set by the CEA. Standalone ESS shall be provided connectivity under the Electricity (Transmission System Planning, Development, and Recovery of Inter-State Transmission Charges) Rules, 2021.

2.2. Energy Storage Obligation

2.2.1 A long-term trajectory for Energy Storage Obligations (ESO) has also been notified by the Ministry of Power on 22.07.2022 to ensure that sufficient storage capacity is available with obligated entities^[3].

2.2.2 The trajectory specifies a minimum percentage of electricity consumption within a Distribution licensee's area that shall be procured from renewable energy through ESS. As per the trajectory specified vide this Ministry's order dated 22.07.2022, the ESO of obligated entities shall gradually increase from 1% in FY 2023-24 to 4% by FY 2029-30, with an annual increase of 0.5%.

2.2.3 Based on the prescribed trajectory, resource availability, and grid stability needs, the Appropriate Commission may further increase the Energy Storage Obligation.

2.2.4 The renewable energy power purchased from an ESS shall also qualify for minimum share of consumption of non-fossil sources (renewable energy) by designated consumer - subject to the condition that at least 85% of the total energy stored in the Energy Storage System (ESS), on an annual basis, is procured from renewable energy sources, or any other condition as stipulated by Ministry of Power from time to time.

2.2.5 Waiver of ISTS Charges on Hydro Pumped Storage Projects (PSP) and BESS Projects, commissioned up to 30.06.2025, has been provided vide order dated 23rd November 2021. The waiver shall be applicable for a period of 25 years for Hydro PSP and for a period of 12 years for BESS, or for a period subsequently notified for future projects by the Central Government from the date of commissioning of the power plant.

3. Business cases for Storage

This section looks into the mechanisms through which storage may be integrated in the power system and associated tariff recovery mechanism(s). Although storage may provide multiple benefits, each of which may be priced separately, the ESS developer or the financing agencies may need to have some certainty in the revenue recovery

model. For example, an ESS developer cannot be expected to recover costs through only selling in the ancillary services market or through energy arbitrage, though these could be additional sources of revenue recovery. In order to give certainty to the ESS developer and the financiers the following base models/business cases for storage are suggested:

3.1 Storage system as part of generation

3.1.1 ESS, used as part of generation, could have multiple uses. One of the possible uses of ESS is to shift generation output from one period to another and gain through energy arbitrage. Generating companies could use ESS to enhance the market value of its generation by shifting off-peak generation to more lucrative peak periods. This is equally applicable to both renewable and non-renewable generation. Besides, ESS could be used for capacity firming of renewable energy generation.

3.1.2 It may neither be required nor viable to establish the ESS equivalent to the generating capacity, due to high capital cost and corresponding fixed charges of the ESS. Further, the evacuation of transmission system will limit the injection beyond the installed capacity. Thus, ESS capacity to the extent of 10% or 15% may be considered as dedicated to the generating station to enhance the availability during peak hours which will obviate the requirement of buying costly peaking power.

3.1.3 Different models for development of ESS by a generating company and its revenue models could be as under:-

Model	Charging/Discharging to be done by	Revenue Model
ESS developed by the generating company under Section 62 of the Act	Generating Company	Tariff for the ESS based on following i. Fixed charge in Rs/MW/month (as part of generation tariff), or ii. Peak Energy Charges (as part of generation tariff), or iii. Combination of above
A nodal agency/procurer invites bids for firm and dispatchable RE power, which inter-alia includes setting up of ESS	RE Generator cum ESS developer will have to charge and discharge as per terms and conditions of the contract with the nodal agency/procurer	RE Generator cum ESS developer will get quoted tariff from the procurer/nodal agency for the energy supplied.

Existing Generator with untied capacity wants to set-up ESS on its own	Generator will itself do the charging/discharging	RE Generator can recover charges for ESS from its users through: i. Supply of Firm Power (Rs/MW) and thus earning a premium for firm power supply ii. Supply of peak power (Rs/MW) iii. Sale to Power Exchange (Rs/kwh) iv. Ancillary Services (Rs/kWh) v. Combination of above
Existing generating company having PPA under Section 63 of the Act is required to set up ESS	Generator will itself do the charging/discharging	Willing PPA holders to share the tariff of ESS in proportion to their PPA.

3.1.4 The Generator may also get into contract with Standalone ESS developer for making available ESS capacity through Tolling arrangement. In that case, Fixed charges (Rs/MW/month) shall be paid to ESS owners by the generator and the generator shall recover the same from its users as given above.

3.1.5 ESS can either be co-located with the Generator or not co-located with the Generator. In case, ESS is co-located with the Generator, then it may not need additional transmission connectivity upto Installed Capacity of the Generator. However, if the ESS is non co-located with the Generator, then it will need additional transmission connectivity.

3.1.6 In case ESS is non co-located with the Generator, then separate scheduling for ESS may be required. In case ESS is co-located with the Generator, then separate scheduling may not be required ideally. However, it is preferable to opt for separate scheduling to facilitate calculation of storage obligation met.

3.1.7 For renewable projects, guidelines on firm and dispatchable power are already issued by MoP dated 09.06.2023. In future, RE tenders may be mandated to have predefined dispatchability character so that ESS is part of the renewable planning/procurement process. This can be done by following National Framework guidelines on ESS which states that for all new RE capacity additions of > 5MW, 5% ESS may be mandatory. This will ensure firm power and avoids oversizing of the assets

3.2 Storage system as part of distribution

3.2.1 The distribution licensees could use ESS to optimize renewable generation procurement, to manage imbalances/deviation, to meet the requirement of Energy Storage Obligations, to shift energy to follow load curve to effectively serve the electricity requirements of consumers, to meet ancillary services, including reactive power requirements, etc.

3.2.2 The ESS could either be owned by the distribution licensee or the distribution licensee may tie up with standalone ESS providers (tolling arrangement through availability based fixed tariff mechanism). The distribution company will call tariff based competitive bids for procurement of storage services from standalone storage provider or establish its own ESS through competitive procurement.

3.2.3 The different revenue recovery models for ESS in distribution level can be as under:

Models	Charging/Discharging to be done by	Revenue Recovery
Distribution Company set up its ESS	Distribution Company	Tariff for ESS would form part of Annual Revenue Requirement of the Distribution Company. The distribution company would maximize the revenue from ESS through participation in ancillary markets and other products as and when available.
Distribution Company enters into contract with standalone ESS capacity through Tolling Arrangement	Distribution Company	Capacity charges to be paid to ESS owners by distribution company in Rs/MW/month and distribution company to recover as part of Annual Revenue Requirement

3.2.4 ESS can either be co-located within the network of the distribution company or outside the network of the distribution company. In case, ESS is co-located within the network of the distribution company, then ESS may not need additional Inter-State Transmission System (ISTS) connectivity. However, if the ESS is located outside the distribution company, then it may need additional transmission connectivity.

3.1.6 In case ESS is located outside the network of the distribution licensee, then separate scheduling for ESS may be required. In case ESS is co-located within the distribution company, then separate scheduling may not be required ideally. However, it is preferable to opt for separate scheduling to facilitate calculation of storage obligation met.

3.3 Storage system as part of Transmission

3.3.1 The transmission licensee undertakes wire business involved in the power transmission. The transmission licensee is not allowed to undertake the business of trading of electricity under the Act. The requirement of ESS in transmission system will come out of the planning process and will not be left to the business decision of transmission licensee.

3.3.2 As a part of physical transmission system, storage can help in the following ways:-

- i. **Transmission Deferral:** By smoothing out the peak power flows in the transmission lines, it can reduce expenditure in new transmission infrastructure.
- ii. **Congestion Management:** Storage facility can be used for maintaining flow of power over tie-line. The flow control of tie-line is important to address the congestion in the transmission system and for reliable operation of the transmission system. It also helps to maintain area control error by managing unscheduled interchange transfer within the regulatory limit.
- iii. **Ancillary Services:** Storage facility can be used by Grid Operators for providing ancillary Services like frequency control, ramp-up etc.

3.3.3 Once a decision has been taken by the competent authority to put ESS at transmission level, then the ESS can be developed by the transmission licensee. Charging/Discharging of the ESS along with different revenue recovery model could be as under:

Charging/Discharging of ESS	Revenue Recovery Model
Transmission Licensee	Transmission Licensee needs to procure power for charging and then sell the stored power to another entity and this may involve the issue of trading by transmission licensee. In order to avoid such issue, it is suggested that transmission licensee may not engage in the charging/discharging of storage facility installed by itself, and charging/discharging can be done only by third party (aggregator or trader).
Third party (aggregator or trader).	Fixed charges (Rs/MW/month) of the ESS will be payable from the transmission charges pool to the transmission license. Transmission Licensee will call bids from third party (aggregator/trader) for operation of the ESS and the entity offering minimum trading margin or maximum pay out to the pool will be selected.

	Aggregator/Trader can recover the charges from the users (generator, distribution licensee, or grid operator) as under: - Recover fixed charges (Rs/MW/month) from users and responsibility of charging/discharging will be with users - Aggregator/Trader can procure the charging power from Power Exchange or through contract and sell the power to users/Power Exchanges and recover charges in terms of Rs/kWh - Combination of above
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3.3.4 Separate Scheduling of ESS connected at Transmission level will be required.

3.4 Standalone Energy storage Systems

3.4.1 In the earlier sections, we have discussed how ESS can be developed by a generation, transmission or distribution entity. However, ESS can also be developed by a third party ESS developer and it can sell the ESS capacity/stored energy to a generation, transmission, distribution entity, grid operator or **bulk consumers** or Power Exchange.

3.4.2 **Standalone ESS developers can consider** any of **following revenue recovery models** or mix of models:-

Models	Description	Revenue Recovery
Tolling model	The off-taker typically exercises full authority to charge and discharge the ESS, subject to the ESS's operating limitations and other agreed dispatch parameters. ESS developer is responsible for developing, owning, operating and maintaining the ESS project, and retains technical operational control of the ESS.	The off-taker pays the ESS developer a fixed (usually monthly) capacity charge for its right to utilize the ESS's capacity. The capacity charge may be subject to reduction for decreases in capacity, availability or efficiency of the project
Firm Contract	The ESS developer shall provide energy as product for agreed PPA and charging/discharging responsibility lies with the ESS developer.	The off-taker pays the tariff for the power supplied.
Energy Arbitrage supplemented with Ancillary revenues	The ESS developer sells as available energy bundled with any other available products (capacity attributes, renewable energy credits,	Price for energy consisting of an energy charge (Rs/kWh) for energy delivered

	etc.) to any off-taker and takes the entire risk. The responsibility of purchase of energy for storage is of the ESS developer. The ESS developer, not the off-taker, typically has full discretion to charge and discharge the ESS, subject to operating parameters set forth in the PPA.	
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4. Tax Implication

4.1 While there will be no tax implications in case of ownership of ESS by the generating/transmission/distribution entity directly, there may be GST implications in case the storage is procured from a standalone system ESS developer. In order to mitigate the GST implications, ESS may be treated on a similar footing with the generating company from which it is charged (as deferred generation) in case of Wind/Solar procurement and thus GST may not be a hindrance to the adoption of Standalone ESS.

5. Carbon Credits for Energy Storage Projects

Under Article 6.2 of the Paris Agreement Renewable Energy with storage (only stored component) has been considered as an approved mechanism for trading of carbon credits under bilateral/cooperative approaches. ESS developers can consider Carbon Credits as another revenue stream.

[1] National Framework for Promoting Energy Storage Systems, August 2023

[2] Electricity (Amendment) Rules, 2022 Dated 29.12.2022

[3] Ministry of Power RPO & ESO Trajectory order dated-22.07.2022