Government of India
Ministry of Power

NATIONAL FRAMEWORK FOR PROMOTING ENERGY STORAGE SYSTEMS

August 2023
New Delhi

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NATIONAL FRAMEWORK FOR PROMOTING ENERGY STORAGE

1. Context: Energy Transition and Sustainability

India is taking all steps necessary to achieve energy transition. India has set a target to achieve 50 percent cumulative installed capacity from non-fossil fuel-based energy resources by 2030 and has pledged to reduce the emission intensity of its GDP by 45 percent by 2030, based on 2005 levels. India has launched several initiatives such as National Solar Mission and National Mission for Enhanced Energy Efficiency to achieve its goal of increasing non-fossil fuel-based capacity and promoting energy efficiency. Additionally, India is investing in new technologies, such as electric vehicles, to reduce its carbon footprint.

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 keeping energy security in view. 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) are to be used instantly, and in case they are not utilised 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 as grid balancing creating a need for flexibility.

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, and energy arbitrage.

For energy transition, shifting from fossil fuel-based capacity to Renewable Energy capacity- it is necessary that the Renewable Energy becomes despatchable, and available 24x7. This is possible only with Energy Storage.

Therefore, to achieve twin objectives of ensuring energy transition and energy security, it is crucial to create an ecosystem for development of ESS that is independent of technology, based on requirements, and financially feasible, to guarantee affordable, clean, stable, flexible, and secure power for everyone Accordingly, a National Framework on ESS is necessary to encourage the adoption of Energy Storage for ensuring an environmentally sustainable and financially viable power sector.

2. Objectives of the ESS Framework

2.1. To have 24×7 dispatchable RE power i.e., RE-RTC (Renewable Energy- Round the Clock)

2.2. To reduce greenhouse gas emissions and reduce overall costs of energy by incentivizing the deployment of ESS and reducing the need for fossil fuel power plants.

2.3. To support the development and deployment of ESS through policy and regulatory measures, financial and fiscal incentives, and performance-based incentives.

2.4. To redesign energy markets to incentivize participation of ESS in the markets and to establish market mechanisms through introduction of products, and compensation methods for storage services.

2.5. To improve grid stability and reliability through deployment of ESS that provides grid services such as frequency regulation, voltage support, ramping, and other ancillary support services.

2.6. To promote energy independence and resiliency through deployment of ESS in remote or islanded communities.

2.7. To foster innovation and research for improving the performance, safety, and cost-effectiveness of energy storage technologies and development of new energy storage technologies.

2.8. To develop technical standards for ESS to ensure safety, reliability, and interoperability with the grid.

2.9. To promote equitable access to energy storage by all segments of the population regardless of income, location, or other factors.

2.10. To monitor and evaluate the performance and impact of ESS, and to provide feedback for making policy and investment decisions.

3. Estimation of Storage Requirement

3.1. Central Electricity Authority (CEA), while preparing the National Electricity Plan (NEP), 2023 has also calculated the ESS capacity required to integrate the upcoming Renewable Energy capacity in the country in order to satisfy the peak electricity demand.

3.2. As per NEP2023 the energy storage capacity requirement is projected to be 16.13 GW (7.45 GW PSP and 8.68 GW BESS) in year 2026-27, with a storage capacity of 82.32 GWh (47.6 GWh from PSP and 34.72 GWh from BESS). The energy storage capacity required for 2029-30 is likely to be 60.63 GW (18.98 GW PSP and 41.65 GW BESS) with storage of 336.4 GWh (128.15 GWh from PSP and 208.25 GWh from BESS). By the year 2031-32, this requirement is expected to increase to 73.93 GW (26.69 GW PSP and 47.24 GW BESS) with a storage capacity of 411.4 GWh (175.18 GWh from PSP and 236.22 GWh from BESS). In order to develop this storage capacity during 2022-27 the estimated fund requirement for PSP and BESS would be Rs. 54,203 Cr. and Rs. 56,647 Cr.,

respectively. Further, for the period 2027-2032 estimated fund requirement for PSP and BESS would be Rs. 75,240 Cr. and Rs. 2,92,637 Cr., respectively.

3.3. CEA has projected that by the year 2047, the requirement of energy storage is expected to increase to 320 GW (90GW PSP and 230 GW BESS) with a storage capacity of 2,380 GWh (540 GWh from PSP and 1,840 GWh from BESS) due to the addition of a larger amount of renewable energy in light of the net zero emissions targets set for 2070.

4. Applications and Use cases of ESS in Power Sector

Energy Storage Systems (ESS) have a multitude of applications in the energy sector and can be used independent of or as a part of, power system infrastructure at various levels in generation, transmission, and distribution. ESS technologies with varying performance metrics, such as energy efficiency, power-to-energy ratio, useful life, depth-of-discharge, and energy density, find use in applications outlined below.

4.1. **Storage with Generation:** ESS integrated with RE projects provides dispatchable and firm RE power to procurers and reduces RE curtailment while ESS integrated with conventional projects improves the flexibility of conventional generation resources.

4.2. **Storage with Transmission:** Integrating ESS with transmission infrastructure maximizes the use of transmission assets and increases the duration of their usage and enhances grid stability. It optimizes transmission capacity, reduces network congestion, and minimizes the need for infrastructure augmentation.

4.3. **Storage with Distribution:** ESS installed at load centres enables peak load management (peak shaving/ load shifting), enhances grid resilience and flexibility. DISCOMs can use ESS to optimize power portfolio, minimize need for infrastructure augmentation, and improve operations by prolonging asset life and reducing asset shifting.

4.4. **Standalone ESS:** Standalone ESS operating independently can function as merchant units that have the capability to engage in energy or capacity trading in power markets in accordance with existing rules and regulations. Alternatively, they can provide energy to de-centralized loads i.e., off-grid applications or store and supply energy to Electric Vehicles.

4.5. **Storage for ancillary services/ balancing services / flexible operations:** ESS with fast ramp rates can provide frequency control, voltage control, and fast response, peak shifting, balancing and ancillary services over time horizons ranging from seconds to minutes.

4.6. **Lease and sale of ESS:** Licensees, developers, owners, lessors, lessees, procurers, and intermediary procurers can all make use of ESS. Developers or owners of ESS have the option to sell or lease storage capacity for a specific period.

5. Existing Policy framework for promotion of Energy Storage Systems

Ministry of Power, Government of India has already notified various measures to promote the development of ESS in the country, which are highlighted below:

5.1. Legal Status to ESS

5.1.1. 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.

5.1.2. 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.

5.1.3. 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.

5.1.4. The independent energy storage system shall be a delicensed activity at par with a generating company in accordance with the provisions of section 7 of the Act. 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.

5.2. Energy Storage Obligation

5.2.1. 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.

5.2.2. 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%.

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

5.2.4. The renewable energy power purchased from an ESS shall also qualify for Renewable Purchase Obligation (RPO) compliance.

5.3. Waiver of Inter State Transmission System Charges

5.3.1. Given the importance of facilitating RE integration in the grid and in pursuance of National Tariff Policy 2016, waiver of transmission charges for using Inter-State Transmission System has been made available to Energy Storage Systems, including BESS and PSPs, vide Ministry of Power's order dated 23.11.2021, as amended from time to time.

5.3.2. As per the said order, complete waiver of ISTS charges has been made applicable to BESS and PSP projects commissioned up to 30.06.2025, subject to certain conditions. The transmission charges for ISTS network shall be levied gradually for the projects

commissioned after 30.06.2025. The transmission charges shall be gradually increased by 25% annually starting from 1st July 2025 till 30th June 2028.

5.4. Rules for replacement of Diesel Generator (DG) sets with RE/Storage

5.4.1. The Electricity (Rights of Consumers) Amendment Rules, 2022 notified on 20th April 2022 mandates that the consumers, who are using the Diesel Generator (DG) sets as essential back up power, shall endeavour to shift to cleaner technology such as renewable energy with battery storage and the like in five years or as per the timelines given by the State Commission for such replacement based on the reliability of supply in that city covered under area of supply of the distribution licensee.

5.4.2. This will encourage installation of ESS by Commercial and Industrial consumers who are using DG sets for enhancing reliability of power supply.

5.5. Guidelines for Procurement and Utilization of Battery Energy Storage Systems

5.5.1. Ministry of Power vide resolution dated 10.03.2022 has issued detailed guidelines for procurement and utilization of BESS as part of generation, transmission, or distribution assets, or along with ancillary services.

5.5.2. These guidelines, inter alia, provide standardization and uniformity in procurement of BESS and a risk-sharing framework between various stakeholders, involved in the energy storage and storage capacity procurement, thereby encouraging competition and enhanced bankability of these Projects.

5.5.3. These guidelines would ensure transparency and fairness in procurement processes and provide for a framework for an Intermediary Procurer as an Aggregator / Trading licensees / Implementing Agency for the inter-state/intra-state sale-purchase of power.

5.5.4. Based on these Guidelines, Solar Energy Corporation of India (SECI) has carried out bidding of 500 MW/1,000 MWh BESS project which has been awarded at a cost of Rs. 10.835 Lakh/MW/month.

5.6. Guidelines for the development of Pumped Storage Projects

5.6.1. Recognizing the need for expeditious and cost-effective development of Pumped Storage Projects (PSPs) to enhance energy security of the country, Ministry of Power, Government of India has come out with measures in the form of "Guidelines to promote the development of Pumped Storage Projects" on 10.04.2023.

5.6.2. The guidelines, inter alia, provide for formulating a transparent criteria for awarding project sites, allowing self-identification of off-river PSP sites, removal of upfront premium for project allotment, market reforms for monetization of ancillary services provided by PSPs, allowing Government land, if available, at concessional rate to the developers annual lease rent basis, exemption of PSPs from free power obligation, rationalization of Environmental Clearances for off-river PSP sites and utilization of exhausted mines for development of PSPs. MOEF notification dated 18th May 2023 is a step towards obtaining the environment clearances much faster.

5.6.3. The guidelines would enable the development of Pumped Storage Projects (PSPs) which are clean, sustainable, mature, and domestically available, with the proactive support of State Governments.

5.7. Timely concurrence of Detailed Project Reports (DPRs) of Pumped Storage Projects

5.7.1. In order to ensure timely clearances for Pumped Storage Projects, the Central Electricity Authority has issued Guidelines for Formulation of Detailed Project Reports for Pumped Storage Schemes in June, 2023. As per these guidelines, the timelines for preparation of DPR for PSPs located in Himalayan and non-Himalayan Regions have been reduced from 900 days to 840 and 690 days, respectively depending upon geology.

5.7.2. In addition, since no tariff / financial evaluation is required to be done by CEA for PSP projects allotted through Tariff Based Competitive Bidding or as part of integrated Renewable Energy Project or as captive plants, CEA has reduced the timeline for concurrence of such projects to 50 days. For other PSPs, the timeline for concurrence has been reduced to 90 days.

5.8. Introduction of High Price Day Ahead Market

5.8.1. Ministry of Power vide note dated 11.10.2022 has come up with a detailed framework for the High Price Day Ahead Market segment (HP-DAM) in the existing Integrated DAM (I-DAM), wherein sellers with high cost of generation would be allowed to participate. HP DAM has been launched on 9th March 2023.

5.8.2. Battery Energy Storage Systems (BESS) have been included in the list of eligible generators that are allowed to participate in the HP DAM segment of the Energy Exchange.

5.8.3. This would enable ESS developers to take suitable advantage of the price differential between Peak and Off-Peak tariffs.

5.9. Harmonized Master List for Infrastructure

5.9.1. Recognizing Energy storage as an essential infrastructure in India, Department of Economic Affairs vide notification dated 11.10.2022 has included "Energy Storage Systems (ESS)" in the Harmonized Master List of Infrastructure subsectors by insertion of a new item in the category of 'Energy'.

5.9.2. The notification defines ESS as dense charging infrastructure and grid scale energy storage system with a minimum qualifying capacity of 200 MWh, given that the ESS is not being established on merchant basis.

5.9.3. Inclusion of ESS in the HML will ensure easier access to institutional credit, concessional funds and reduces developer's cost of borrowing for projects related to these sub-sectors.

5.10. Budgetary support for enabling infrastructure for Pumped Storage Projects

Pumped Storage Projects are often taken up in remote areas which have infrastructure deficits. The infrastructure created for these projects enables further development of the

area as the same is available for reuse for other purposes. Given the same, the Central Government is providing budgetary support for construction of roads and bridges by Hydro Power Project developers, including PSPs up to Rs 1.5 crore/MW for projects up to 200 MW and up to Rs 1 crore/MW for projects above 200 MW.

5.11. **RE Must Run Rules**

The Electricity (Promotion of Generation of Electricity from Must-Run Power Plant) Rules, 2021were notified on 22nd October 2021. These Rules provide that a wind, solar, wind-solar hybrid or hydro power plant (in case of excess water leading to spillage) or a power plant from any other sources, as may be notified by the Appropriate Government, which has entered into an agreement to sell the electricity to any person, shall be treated as a must-run power plant.

A must-run power plant shall not be subjected to curtailment or regulation of generation or supply of electricity on account of merit order dispatch or any other commercial consideration except in the event of any technical constraint in the electricity grid or for reasons of security of the electricity grid. In the event of a curtailment of supply from a must-run power plant, compensation shall be payable by the procurer to the must-run power plant at the rates specified in the agreement for purchase or supply of electricity. These Rules will stimulate the requirement of ESS in the system to avoid curtailment of RE and subsequent penalty as provided in the Rules.

5.12. **Ancillary services from ESS under CERC (Ancillary Services) Regulations, 2022**

5.12.1. The Central Electricity Regulatory Commission (Ancillary Services) Regulations, 2022 were notified on 31st January 2022 to provide mechanisms for procurement, through the administered as well as market-based mechanisms, deployment, and payment of Ancillary Services at the regional and national level to maintain grid frequency within allowable band and for relieving transmission congestion to support reliable and stable operation of the grid.

5.12.2. The Regulations provide for eligibility of ESS to provide Secondary Reserve Ancillary Service (SRAS) and Tertiary Reserve Ancillary Service (TRAS), under certain conditions.

5.12.3. This will create an additional revenue stream for ESS service providers and will nudge investments in the Energy Storage.

5.13. **Inclusion of ESS in Technical Standards for Connectivity to the Grid**

5.13.1. Central Electricity Authority has notified CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007 and its latest (Amendment) Regulations, 2019 on 6th February 2019 which provide the requirements to be complied by ESS to get connectivity to the Grid at voltage level 33kV and above.

5.13.2. This will enable faster and smoother integration of ESS with the Grid.

5.14. **Bidding guidelines for Round the Clock (RTC) RE Supply**

5.14.1. Guidelines for Tariff Based Competitive Bidding Process for Procurement of Round-The Clock Power from Grid Connected Renewable Energy Power Projects, complemented with Power from many other source or storage were notified in November 2020.

5.14.2. As per these Guidelines, the firm power from storage can be utilized to balance renewable energy and provide round the clock (RTC) power to the buyers/DISCOMs, thereby facilitating the State Load Despatch Centres (SLDCs) in ensuring grid stability and security within their control jurisdiction.

5.14.3. The procurement of RTC power will create demand for establishment of ESS in the country and help in faster energy transition.

6. Way forward

The policy measures enumerated in previous para have encouraged the planning and establishment of ESS in the country. However, keeping in view the various developments in Power Sector and other related sectors, more steps are required to be taken at the policy and regulatory level for ensuring an enabling ecosystem for ESS. Accordingly, following policy and regulatory measures are either under active consideration or may be considered in due course of time:

6.1. **Financial Incentives**

6.1.1. **Viability Gap Funding for Battery Energy Storage Systems**

For establishment of BESS projects, costs are a challenge in the initial years because the volumes are low. Therefore, Viability Gap Funding becomes essential for supporting initial uptake of BESS by consumers. In order to decrease the levelized cost of storage and make BESS a viable option, it has been proposed to offer Viability Gap Funding to initial few BESS projects. The VGF may be up to 40% of the capital cost of the project, with the condition that the projects must be commissioned within 18 to 24 months.

With the proposed VGF, the Levelized Cost of Storage (LCoS) can be managed at affordable levels. Considering the cost of energy for charging the BESS, the total cost of energy from BESS would be comparable to the price in the power exchanges during the peak demand periods. Thus, with the proposed VGF, the BESS would become a viable option for peak power management. The scheme is further expected to support development of eco-system for BESS and help reduce cost with subsequent large-scale expansion of BESS capacity.

6.1.2. **Additional Budgetary support for enabling infrastructure for Pumped Storage Projects**

Pumped Storage Projects are often taken up in remote areas which have infrastructure deficits. The infrastructure created for these projects enables further development of the area as the same is available for reuse for other purposes. The scope of enabling infrastructure may be considered to cover transmission infrastructure up to pooling point.

6.1.3. **Green Finance**

Concessional Green Finance accessed by the Government may be used to initiate and accelerate the pace of establishment of ESS industry. Sovereign Green Bonds raised as a part of the government's overall market borrowings may be used for funding green infrastructure and reducing the carbon intensity of the economy. Further, financial institutions like PFC, REC, and IREDA may also extend long term loans to ESS projects.

6.2. **Guidelines for Resource Adequacy Plan**

6.2.1. The Electricity (Amendment) Rules, 2022 mandate that guidelines for assessment of resource adequacy shall be issued by the Central Government in consultation with CEA. SERCs have been mandated to issue Regulations in accordance with the Guidelines to be issued by the Central Government and review the resource adequacy, for each of the distribution licensees, as per the timeline given in the Guidelines. SERCs may also determine non-compliance charges for failure to comply with the resource adequacy target approved them.

6.2.2. The guidelines for developing a Resource Adequacy Plan (RAP) may incorporate ESS into the planning process. This plan will establish a mechanism in the country to ensure that there are sufficient generation and demand-responsive resources available to reliably meet expected peak demand.

6.2.3. The Central Electricity Authority (CEA) will release a Long-term National Resource Adequacy Plan (LT-NRAP) estimating the storage requirement at the national level for the next 10 years.

6.2.4. Additionally, the Distribution licensees will also be required to undertake a Long-term Discom Resource Adequacy Plan (LT-DRAP) for a 10-year period.

6.2.5. The long-term RAP would give the trajectory for requirement of ESS from distribution level up to the national level. This will facilitate the developers, especially the PSP developers to plan for the additional capacity, well ahead of time. The statutory obligation of RAP would provide certainty in future demand of ESS. Further, the statutory provision for supplying power 24 × 7 will require distribution licensee to make ESS an integral part of their respective RAP.

6.3. **Connectivity and Grid Access**

6.3.1. In order to promote the development of Energy Storage Systems, connectivity of ESS to nearest Inter State Transmission (ISTS) may be granted on priority basis.

6.3.2. Further, connectivity to Intra-State Transmission and Distribution System may be facilitated by the respective State Commission and State Transmission Utility.

6.3.3. The Central Electricity Authority (CEA) and the Central Transmission Utility (CTU) may include ESS while planning the ISTS system. The State Transmission Utilities (STUs) may also follow this while planning their intra-state transmission system.

6.4. Technology Agnostic Bidding Guidelines for procurement of ESS

6.4.1. In order to ensure optimum development of Energy Storage systems, it is necessary topromote a range of established ESS technologies alongside emerging technologies that demonstrate significant potential.

6.4.2. The Central Government may notify technology agnostic bidding guidelines for Long Duration Energy Storage (LDES), Short Duration Energy Storage (SDES), and Ancillary Services to assist utilities, procurers, and developers in faster development of financially viable and environmentally sustainable ESS projects for the Indian power sector.

6.4.3. Further, in order to assist the obligated entities, the Central Government may designate any agency with sufficient experience in the field as a nodal agency for inviting and aggregating bids and associated works of ESS.

6.4.4. The bidding may be on the basis of either composite tariff (including the cost of input power) in case input power is arranged by the developer or tariff for storage on a per Megawatt Hour basis if the input power is to be arranged by the procurer of the storage capacity. The appropriate Commission shall adopt the above tariff u/s 63 of the Electricity Act, 2003.

6.5. Storage Capacity with future Renewable Generations

6.5.1. In order to ensure adequate storage capacity to supply reliable power, new RE projects (excluding Hydro Projects) with an installed capacity of over 5 MW or as specified by the Central Government may be mandated to install ESS (of at least 1 hour storage) for minimum 5% of the RE capacity. Further Hydro Projects may be encouraged to have minimum pondage capacity to manage variability and peak demand.

6.5.2. Such ESS capacity may be considered during the bidding stage and can be either co-located with the RE project or integrated with any other storage located elsewhere. In the case of RE projects, operating in off-grid mode, the storage capacity may be suitably enhanced keeping in view the seasonal variation of RE and demand in the Island area.

6.6. Facilitating Ease of Doing Business (EoDB)

6.6.1. The financial value of ESS is greatly influenced by regulations and policies that determine the revenue sources. Therefore, a comprehensive and integrated regulatory and policy framework would be formulated to facilitate the ease of doing business in the field of ESS.

6.6.2. To achieve this, the entire process, from bidding to installation and connectivity of the ESS, may be completed within a specified timeframe. The procedures would be simplified, with an interactive and responsive interface for ESS developers and investors.

6.6.3. The clearance and permission procedures may be kept at a minimum and conducted concurrently wherever possible to ensure speedy deployment.

6.6.4. A supervising agency or nodal agency may be appointed to oversee the entire process, and to ensure adherence to various regulations, standards, and norms, and to address any grievances or complaints from involved parties.

6.7. Regulatory Measures

6.7.1. To achieve financial and commercial viability, ESS developers and intermediary agencies would be permitted to offer a range of market-based energy and power products. These products may include a) Spot Energy Market b) Capacity Market/Energy Arbitrage (boosting capacity value by shifting off-peak generation to peak times) c) Provision of ancillary services to the grid d) Providing storage to other generating stations e) Bundling to make RE firm and dispatchable RE power f) Replacing diesel generators in various sites such as construction sites, commercial and residential areas, and islands. g) Any other product that meets market demand or requirements.

6.7.2. Power purchase guidelines may be framed in such a way as to encourage planning and purchase of ESS for meeting demand and reliability requirements. Further, the Appropriate Commission may consider ESS as an alternative when approving the CAPEX requirements for any new Transmission and/ or Distribution System.

6.7.3. The Central Government vide Electricity (Rights of Consumers) Amendment Rules 2023 dated 14th June 2023 had notified Rules for making Time of Day Tariff effective from the prescribed dates. Appropriate Commission needs to specify ToD Tariff for Commercial and Industrial consumer category and other categories of consumers in accordance with the Rules. This will incentivize consumers and utilities to use ESS for optimizing the cost of power.

6.7.4. Further, ESSs that use renewable energy for charging may be provided with carbon credits, with the detailed methodology for accounting to be released separately.

6.7.5. Appropriate Commissions may notify suitable regulations to encourage the deployment of distributed energy storage systems such as electric vehicle batteries, rooftop solar with integrated battery storage, and others.

6.7.6. The BESS used in rooftop solar projects or in a distributed manner may be aggregated at grid scale for utility of both DISCOMs and owners/users. Appropriate Commission may establish a supportive framework for peer-to-peer trading.

6.7.7. The Appropriate Commission may bring out a separate tariff regulation for PSPs under Section 62 of the Act to ensure the viability of tariff, which may involve rationalizing of factors such as Return on Equity, Debt: Equity Ratio etc.

6.8. Waiver of Cess, Tax and Duties

6.8.1. The Government may consider tax benefits to ensure rapid development of ESS.

6.8.2. Storage is an intermediary system where energy is stored and released later. In line with the principles of double taxation avoidance, Electricity Duty (ED) and Cross Subsidy Surcharge (CSS) may not be made applicable on input power for charging of ESS as these systems are merely facilitating conversion of energy where Electricity is stored during off-peak hours and discharged during peak hours. ED and CSS may only be levied on the final consumption of electricity.

6.8.3. States may exempt land to be acquired by setting up Energy Storage Systems from payment towards stamp duty and registration fees. Government land, if available, may be provided at a concessional rate to the developers on annual lease rent basis.

6.9. Promoting indigenous technology in manufacturing of BESS

6.9.1. In order to promote indigenous manufacturing, Central Government may formulate a PLI Scheme specific to the Battery Energy Storage System (BESS) to be used in the Power Sector.

6.9.2. Such a scheme may be technology agnostic and may be structured to provide incentives to advanced technologies with better performance parameters.

6.10. Quality and Standards

6.10.1. In order to maintain quality and standards for Battery Energy Storage Systems, the Central Government may consider issuing an "Approved List of Models and Manufacturers (ALMM) for BESS" for power sector applications, similar to the list of ALMM for Solar Photovoltaic Modules issued by the Ministry of New and Renewable Energy (MNRE). Models and manufacturers included in the list would qualify for use in Government or Government assisted Projects, Projects under Government Schemes and Projects set-up for sale of electricity to public utilities within the country.

6.10.2. Specifications, standards, and test methods including fire safety may be prepared by the Appropriate Agencies to ensure quality and to manage safety when ESS is in usage, transport, storage, under maintenance, or undergoing processing at end-of-life including disposal.

6.10.3. Testbeds/ Test labs for safety and performance testing may be set up to demonstrate commercial readiness of ESS.

6.10.4. Further, CEA Safety Standards and CEA (Technical Standards for Connectivity to the Grid) Regulations may be suitably updated to cover ESS and other technologies like electrolysers for Green Hydrogen. The Technical Standards may also cover the ‘Performance Standards’ for different services as well as ‘Operation and Maintenance Standards’ for ESS facilities.

6.11. Research and Development

6.11.1. India's surge in energy demand and rapid shift towards renewable energy sources offers opportunities for emerging Energy Storage System (ESS) technologies. Domestic innovation and manufacturing of ESS technologies can stimulate job creation, economic growth, and position India as a global leader in sustainable and low-carbon energy systems. Investing in R&D of ESS technologies, such as Liquid metal, Ni-Fe, Gravity storage, Green Hydrogen storage and others, will enable tapping of diversified natural resources. R&D investments in existing technologies may lead to enhancement in efficiency and longevity of these technologies and make them viable and cost-effective for commercial use.

6.11.2. To address the need for long-term research and development in energy storage technologies, collaboration between academia and industry will be necessary. The government may establish a Nodal Agency to coordinate R&D efforts in the field, and funding will be provided through this agency. Additionally, a national portal may be created and maintained by the Nodal Agency to facilitate knowledge sharing and avoid duplication of R&D efforts.

6.11.3. Research and Development (R&D) may be promoted in areas of cost-effective recycling methods for maximum recovery of materials from waste and designing of safe disposal methods.

6.11.4. Training institutes may be encouraged to design training programs for upskilling the manpower in the field of ESS technologies.

6.12. **Pilot Scheme**

6.12.1. Pilots/ Demonstration Projects may be taken up for storage technologies which are yet to attain large scale commercial deployment like novel Advanced Chemistry Cells (ACC), Compressed Air Energy Storage (CAES), Flywheel, Gravity storage, Thermal Energy Storage (TES) Green Hydrogen etc.

6.12.2. The Government may advise Central/ State Public Sector Undertakings / Implementing Agencies (CPSUs/SPSUs/IAs) under its administrative control to take up technology demonstration projects of appropriate capacities at different locations.

6.12.3. The Central Government may provide assistance from Power System Development Fund or any other fund to the Central/ State PSUs/ IAs, to utmost two Pilot ESS Projects with a maximum capacity of 20 MW, for both SDES and LDES applications, and limited to a maximum cumulative capacity of 80 MW.

6.13. **Recycling and Sustainability**

6.13.1. In order to ensure the shift from a linear economy to a circular economy based on the principles of 3Rs i.e., Reduce, Reuse, and Recycle, the end-of-life management plan may be included in the bidding documents of all ESS projects.

6.13.2. Manufacturers may design systems with end-of-life management approach. They should promote the reuse of batteries and minimize waste by establishing partnerships with companies or organizations that specialize in repurposing used batteries for second-life applications and provide information and guidance to ESS developers on how to properly maintain and manage the batteries to extend their lifespan. Dedicated Waste Management Centres may be set up to facilitate e-Waste collection in compliance with the Rules/ Regulations of Government. Producer/manufacturer shall have the obligation of Extended Producer Responsibility in terms of the Battery Waste Management Rules, 2022.

6.13.3. A mechanism with predefined criteria and necessary standards may be established for repurposing ESS components used in one application for reuse in another application. A standard operating procedure may be developed to encourage recycling efforts and reclaim of materials from the end-of-life batteries.

6.13.4. All environmental concerns that arise from usage of ESS may be addressed. Further, monitoring may be done to ensure compliance with all relevant regulations and guidelines issued by the concerned authorities.

6.13.5. Further, those mines that have outlived their usefulness, stretch located between existing reservoirs of hydro power projects and other infrastructures like transmission lines and switchyards of thermal generating stations, present an opportunity for installation of ESS. Discarded and fully exploited mines, including coal mines that are not currently designated for ash back-filling can be repurposed as hydro storage facilities, serving as natural facilitators for the development of PSPs. In addition, new mines that are identified for mining should have an approved mine closure plan that includes the development of PSPs. Power Sector CPSUs may collaborate with Coal Sector CPSUs to identify potential and viable sites and facilitate the speedy development of PSPs in such coal mines in the country.

6.14. **Monitoring and Evaluation**

6.14.1. The strategy under the framework shall be to promote and accelerate the development of ESS in the country, including mature and promising technologies. Investment will be encouraged through stakeholder-friendly schemes, exemptions or incentives as deemed appropriate. The framework pertaining to ESS shall be periodically revised as per feedback gathered from the stakeholders or based on advances in technology or based on maturity in the operating ecosystem.

6.14.2. The concessions and incentives should be provided only for a limited period of time. With the deepening of supply chain in the upcoming years, there is an expectation of decrease in prices of ESS. The Government may review the situation regularly to determine whether to continue with the concessions and incentives. In the long-term, ESS deployment should be self- incentivized.