



MacArthur  
Foundation



## **“Role of Battery Energy Storage System (BESS) in Electricity Distribution”**

*Magnolia, India Habitat Centre (IHC), Complex, Lodhi Road, New Delhi – 110 003, India*

*11<sup>th</sup> February (Monday), 2019 (16:00 – 17:50)*

### **Concept Note**

India is transitioning towards a low-carbon future through clean energy based pathways. A sustainable energy framework is one of the key pillars to enable this paradigm shift. Renewable Energy (RE), accompanied with power-grid modernization thus assumes prime importance in this endeavor. India has shown greater commitment to reduce its emission intensity from the electricity sector which is reflected in its ambitious target of achieving 175 GW of grid-connected installed capacity from renewable energy sources by 2022 including plans for a cumulative RE installed capacity of 275 GW by 2027 (as per the National Electricity Plan, 2016), and approximately 300-400 GW is envisaged by 2030 (TERI’s estimate under the on-going ‘Energy Transitions Commission India’ initiative). However, the intermittent nature of generation from such power sources will pose one of the several challenges to smooth operations of power system. A significant quantum of power will be injected into the distribution network since the Government of India has set a target of installing 40 GW of solar Photovoltaic (PV) power from rooftop mounted systems for realizing its mission of sourcing 100 GW (of the 175 GW) from solar PV by 2022. Clean mobility is also one of the priorities for the country and there are plans to convert 25% of the total vehicle fleet into electric by 2030. Integration of a large number of distributed Electric Vehicle (EV) charging stations with the power distribution network will lead to an additional dimension of bi-directional power flows since EV batteries could supply power back to the utility grid just similar with net-metered rooftop solar PV systems. These set of operational challenges get compounded at the distribution level of the power system since it usually deals with uni-directional power flow.

Globally, the pattern of increasing load growth with increase in purchasing power, rising standards of living and ageing of the existing electricity distribution infrastructure is affecting the quality and reliability of power supply. However, the rising trend of increasing penetration of distributed energy resources will affect the power flows which also need to be managed. The intermittency and variability in the generation from distributed RE sources and the power exchanges with EVs (distributed energy storage units) will be among the major contributors to such additional operational challenges. This establishes the need for balancing measures at distribution network that can facilitate large-scale integration of clean and distributed energy resources such as RE generators and EVs, and assist in grid-management. Battery Energy Storage Systems (BESS) can provide the required flexibility and agility to help the power system transition towards the paradigm of smart grids while addressing the day-to-day operational challenges. A grid-scale BESS is defined by various applications that it can serve to mitigate some of the broad challenges mentioned above. The technology, size, operational strategies and various benefits that it can offer, all are dictated by the application(s) that a BESS can serve.



For the past several years, investor enthusiasm for grid-scale energy storage technology has risen steadily. The battery energy storage technology in particular, is moving forward at a gradual pace driven by consumer demand for better portable electronics and EVs. Quite pertinently, the need for grid-scale energy storage has become ever more apparent as countries like Germany see solar PV and wind penetrations rise towards 25% of installed capacity and China is facing challenges to integrate 35% of RE by 2030 (as per the target stated under draft policy of China's National Development & Reform Commission) with a power grid originally designed for centralized coal based thermal power plants. Appropriate policies, some of those existing in California, USA are also now entering the fray as investment drivers and helping some applications enter the commercialization phase. Battery energy storage is envisaged as one of the transformative technologies in the power sector. Rapidly evolving innovations, increasing interest by utilities and consumers, coupled with more competition in this space are key drivers that are making grid-scale storage more and more attractive to utilities and related companies. Battery prices are projected to continue with a downward trend, and grid-scale battery storage is now being seriously looked at for several different applications on the grid. Globally, a handful of projects on BESS integrated at the distribution level are running successfully which is indicative of huge opportunities for distribution utilities to utilize BESS as a source to stabilize operation of their network. Distribution equipment augmentation deferral (the UK power project at Leighton Buzzard), frequency regulation (in California) and peak-shaving are some of the examples of various distribution-grid level applications that can be served by BESS.

With increasing electricity consumption in a developing country like India, the electricity distribution system in many distribution utilities is expected to be overloaded at some points of time. It is crucial for distribution utilities to keep their system up and running and maintain their equipment in order to avoid power outages. Reliability of supply to consumers is of critical importance to them since the Ministry of Power, Government of India vide its 'National Tariff Policy, 2016' (Draft Amendment) has proposed "24 hours supply of adequate and un-interrupted power may be ensured to all categories of consumers by March, 2019 or earlier. In case of power cuts other than in force majeure conditions or technical faults an appropriate penalty, as determined by the respective State Electricity Regulatory Commission (SERC) shall be levied on the concerned distribution company, and credited to the account of the respective consumers". Furthermore, with the role of distributed energy resources such as RE generators and EVs becoming more important in view of the large-scale integration targets, system-level management and maintenance of grid-operations will undergo a transformation.

All the aforementioned developments could have adverse impacts on power distribution utilities due to over-loading of distribution equipment, additional distribution system up-gradation & RE integration cost, and purchasing of expensive power to meet peak-demand during peak demand hours, when RE is not available, RE sources could also contribute to changing demand profile with increasing peak-demand. For instance, uniform trajectory specified by MoP in June 2018, RPO states are expected to witness acceleration in solar rooftop PV deployment in the distribution network. Many Distribution Companies (DISCOMs) in India have apprehensions about the possible impacts of integrating a large amount of power from such distributed sources with their networks. However, these efforts and the



associated challenges can provide synergistic opportunities for applications of BESS as an enabler of a stable electricity grid by managing variability of RE generation and addressing the increasing peak demand by storing electricity and enabling time-shifting of stored energy through utility-scale stationary storage. Therefore, it becomes imperative to explore the possibility of integrating localized-controllable balancing fleets such as energy storage (stationary batteries or, mobile ones as in EVs or, aggregation of distributed storage options) at the distribution network level in-order to improve the overall operational efficiency of power utilities, manage load of distribution transformers and provide 24x7 quality power supply. The operational problems exist in the power distribution sector in India can provide a plethora of applications that can be explored for BESS to cater to. The modularity of such systems is one of the most favorable attributes that can make financial sense for DISCOMs to adopt a phase-wise implementation in view of huge upfront investments.

Understanding the market for energy storage and anticipating the returns poses a huge hurdle for investors to assess the applications of BESS at the downstream level of a distribution network. The market depends on the structure of wholesale power markets, the spatial sub-hourly profile of demand rate of increasing demand for different categories of customers, the regional mix of electricity generation, transmission & distribution network capacity, and above all putting pricing policies in place to address way and means to compensate storage and also to identify the ones who would be eligible to receive compensation. The policies which are to be designed in-order to support increasing uptake of energy storage are incidentally, much more challenging in terms of magnitude and complexity than those to promote wind or, solar. The challenges accrue from multiplicity of storage applications – renewable energy integration, micro grids, peak load management, load shifting which calls for different type of storage technologies and sizing of storage for different applications impacting the cost benefit analysis.

It thus seems necessary to bring-together all the perspectives, those of – prospective end-users primarily DISCOMs, system designers, BESS and related equipment manufacturers, project developers, financing institutions, regulators, policy makers, and collectively discuss the associated key issues and potential solutions. To deliberate various applications, possible use-cases, addressing current challenges of various stakeholders and the way forward for adoption of BESS at the distribution-level, TERI with support from MacArthur Foundation and Department of Power & Non-Conventional Energy Sources, Government of West Bengal is organizing a thematic session titled “Role of Battery Energy Storage System (BESS) in Electricity Distribution” on the side-lines of the World Sustainable Development Summit (WSDS) 2019 in New Delhi. Experts from various domains of the grid-scale BESS eco-system will share their views on the theme which will be followed by a panel discussion, and an interactive Q&A session.

**Session Style:** One introductory session including addresses by dignitaries, followed by a panel discussion along-with an interactive Q&A session with the participants.



**Target Audience:** Discoms, SERCs, Energy Storage Manufacturers & Developers, Financial Institutions, and Other Nodal Agencies.

**Key Questions:**

1. Identifying plausible applications for BESS at distribution network-level
2. How to realize potential revenue streams for distribution utilities to make BESS integration a viable business case
3. Deliberations on project financing and viable business models, including battery as a service
4. Key considerations on BESS sizing, placement (location on the distribution downstream), and control strategies
5. Current eco-system on domestic manufacturing in India, technology options, and future opportunities
6. Development of regulations & safety norms related with BESS applications at distribution-level

\*\*\*\*\*