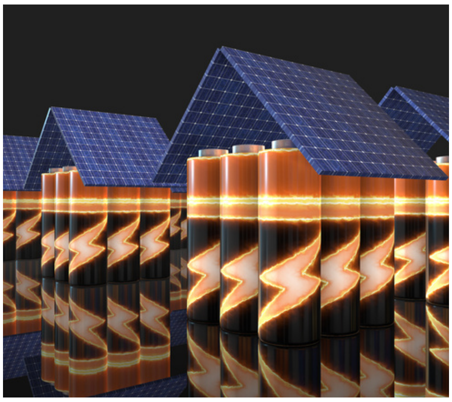
CAN BATTERY STORAGE PROPEL

ENERGY TRANSITION FOR INDIA?

WILL INCLUSION OF POLICY FRAMEWORK HELP?



BATTERIES HAVE BEEN IN USE FOR SOME TIME BUT SO FAR NOT ON A SCALE THAT COULD SUPPORT THE GRID. THE INCREASED USE OF BATTERIES WOULD HELP DECARBONISE THE POWER SECTOR AND BRING DOWN EMISSIONS AND HENCE PUBLIC HEALTH ISSUES CAUSED BY AIR POLLUTION. INCLUSION OF POLICY FRAMEWORK WILL BE HELPFUL TO START ANCILLARY SERVICES AND FREQUENCY REGULATION THROUGH ENERGY STORAGE AS A FLEXIBLE ASSET. IT WILL ALSO HELP TO ENABLE ELECTRIC VEHICLES (EVS) CHARGING INFRASTRUCTURE, V2G (VEHICLE TO GRID) CONCEPTS, AND MICROGRID INTEGRATION WITH EXPANDED GRID CONNECTIVITY IN THE LONG RUN. READ ON TO FIND OUT OUR EXPERTS' OPINIONS ON THE SAME...

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India with an ambitious target of 450GW renewable generation by 2030 has achieved 86GW of renewable capacity recently. The falling price of renewable generators and global concern for climate change is driving the demand for renewable generation.

Renewable generation being intermittent in nature cannot match load and demand. Grid-feed of renewables has been adopted using net metering to counter this issue. However, this directly affects revenue of DISCOMs. This has resulted in lack of support from DISCOMs for renewable generations. Several states have put limitations on the maximum size of rooftop solar projects which can implement net metering. The rising cost of energy is driving the commercial and industrial sector to move from conventional grid-based supply towards integrating renewable generation. However, lack of support for net metering is proving a hurdle in their path.

Another concern with increasing the share of renewables in the grid is its impact on the stability of the grid. Renewables being non dispatchable in nature also lacks the inertia inherent in conventional generators. The energy stored in the rotating mass of conventional generators stabilized the sudden mismatch of demand and generation. Incorporating energy storage in the grid can compensate for stability issues arising due to rising renewable integration. Energy storage also helps in minimizing wastage of renewable generation due to mismatch between generation and demand.

Batteries are becoming popular for application for grid-scale energy storage systems because of their falling costs, rapid response, flexible installation and modularization. Lithium ion batteries are capable of providing their peak capacity power within milliseconds. This rapid response time brings flexibility and stability to the grid. Advanced power electronics used in energy storage make it capable of reducing voltage sag and surges and harmonic distortions in the system.

Grid connected solar inverters depend on reference supply from grid for operation and cannot function during grid outage. This causes wastage of solar generation even in presence of demand. Integrating battery energy storage using hybrid inverters solves this issue. The hybrid system can supply solar generation even during grid outages. Energy storage also provides numerous services like peak demand reduction, frequency regulation etc and increases reliability of supply during extreme weather events.

Renewable generation being distributed in nature while having a low gestation period, making it easy to be installed in rural areas. Also, batteries are modular and are capable of being installed in most of the geographic locations. Lithium ion batteries having high energy density, long life and minimum maintenance are becoming suitable for remote applications. With availability of cheaper battery energy storage, reliability of off-grid and micro grid is being improved. This is driving demand for renewable microgrids in rural areas where grid supply is insufficient and unreliable. The falling cost of energy storage is increasing their demand and has resulted in renewable plus energy storage tenders coming in the market.

Recently 400MW of round the clock renewable energy supply tender was floated by Solar Energy Corporation of India (SECI). It allowed the bidder to select energy storage of their choice like battery energy storage or pumped hydro energy storage. Tenders for renewable generation with certain percent solar are also being floated by state governments. Such initiatives can propel growth of renewable generation in India. The demand for renewable generation with energy storage can be driven further with inclusion of a policy framework.

Most of the regulations and policy framework at present do not lend enough incentives for implementing advanced and cheaper energy storage. Also, where and when energy storage can provide benefits to the grid are not assessed and encouraged effectively. Energy storage faces the obstacle of not being able to monetise all the services it provides. In case of energy storage there could be a wide range of owners ranging from generation, distribution and transmission companies, bulk consumers or other third parties which also needs to be addressed.

Similar to Renewable purchase obligation, Storage purchase obligations should be imposed for improving grid stability while integrating renewable generation. The untapped potential of Behind-the-meter energy storage for grid support services can be maximised by updating rules. There a need of developing inspection protocols and safety codes for behind-the-meter energy storage. Further, metering techniques could also be improved for leveraging grid interactive application of renewable plus storage. More focus could be given on battery to grid and new technologies to accelerate this transition.

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As part of its goals under the Paris Agreement, India aims to reduce its emissions intensity by 33-35 percent by 2030 from the 2005 levels and increase the share of non-fossil-fuel-based energy to 40 percent of the total generation capacity. In line with this commitment, India has set a target of achieving 175 GW of renewables-based energy (RE) capacity by 2022, and 450 GW by 2030. A large part of this will be solar power followed, to a lesser extent, by wind power. Over the years, the Government of India has consistently supported schemes for setting up centralized and distributed REsources. These efforts have been successful in creating demand, spurring improvements in technology, and enabling economies of scale. As a result, solar tariffs in India have dropped from about 10 US cents/kWh in FY15 to about 2.70 US cents/kWh in FY20.

The importance of battery storage in India's energy mix
As the country transitions towards an energy mix with an increasingly higher proportion of RE, energy storage – especially battery storage systems – will have an important role to play in ensuring grid stability. In India, solar power output is typically at its maximum in the period from just before noon till early afternoon. Wind power output, on the other hand, tends to be highest late in the evening and early in the morning. Meanwhile, the country witnesses peak power demand from around 6-9 PM. If we can store the energy generated during the peak RE generation hours both through solar during the day and through wind during the night and feed it into the power grid during the demand hours, such a system can provide round-the-clock clean energy throughout the day. This will also address the issue of costly solar power generated through the storage as otherwise also DISCOM's are buying costly power through the exchanges at the peak hours.

India is looking to renewable hybrids as a part of its efforts to power the growth in RE. The complementary nature of wind and solar power makes wind-solar hybrid systems well-suited to meet the country's energy demands. As per my estimate, India's total wind-solar hybrid capacity will reach around 10 GW by 2025. However, the uncertainty of solar and wind power makes it essential to have battery storage if we are looking at them to provide round-the-clock power.

Another very interesting application for battery storage is for industrial, commercial and residential rooftop which itself is a very huge market, once there will be a resolution on Net metering concept at each and every state level, we will see a jump in this market for Rooftop

Solar with battery storage. Residential rooftop markets are yet to be evolved. While independent solar generating costs have already reached their minimum, we are yet to see the battery cost reach to their bottom and the time we see it's happening, let's say after 2025, we will see another area of business ie residential solar with battery storage. There was a time while we had cable operators providing the cable TV facility at home, we may see the same kind of network coming in the market providing residential solar facility to residents and shops in small cities.

There's another reason why battery storage is so important. The electricity fed into the grid should be of the same frequency as the electricity consumed. If demand exceeds supply, or vice versa, the frequency at which the grid equilibrium is maintained gets disturbed. Beyond a point, this imbalance can cause the grid to collapse. The variable nature of solar and wind power output makes it difficult for grid operators to maintain the frequency of a pure RE grid. As the penetration of variable renewable energy sources increases, frequency stability becomes more important too. Battery storage is good for frequency management while synchronizing with the grid. Around 15 minutes of storage is enough for frequency management, while 3-4 hours suffices to address the evening peak.

Moreover, the declining price of batteries around the world makes battery storage one of the most viable solutions for RE storage.

THE WAY FORWARD TO ENCOURAGE BATTERY TECHNOLOGY DEVELOPMENT AND ADOPTION

The adoption of energy storage in the past, however, has raised concerns over the financial viability of DISCOMs. Although India has developed battery storage facilities, we need a robust framework to regulate the use of storage systems, and guidelines for attracting prospective investors. Earlier this year, the India Energy Storage Alliance (IESA) shared its recommendations with the Ministry of Power, which included the suggestion of having a policy framework for energy storage in the Electricity Act. The framework, when it is established, should incentivize the ownership of energy storage systems appropriately for some or all of the stakeholders in the ecosystem, but most importantly for power generators and DISCOMs.

Li-ion batteries are used around the world to store energy for EVs and RE systems. Their disposal, however, isn't easy, as they are classified as hazardous waste. In an ideal scenario, the batteries should be "renewable" or recyclable too. India should invest in research and development and find ways to address these challenges while, at the same time, making energy storage technologies more cost competitive. Over time, standardization of technology and value-chain management will help in minimizing the environmental and safety risks associated with the use and recycling of batteries.

India has made an impressive start in its journey towards its RE goals. Addressing the challenges ahead will call for even more concerted efforts guided by a clear policy and regulatory framework, and incentives for investment, and powered by innovation and improvements in energy storage solutions.

“ BATTERY STORAGE HAS GOT THE SPECIFIC FEATURE OF QUICK RESPONSE IN TERMS OF MILLISECONDS, WHICH PERHAPS ONLY DEMAND RESPONSE HAS. BATTERY, THEREFORE, HAS A SPECIFIC PLACE FOR QUICK RESPONSE ANCILLARY SERVICES"

KESHAV PRASAD
Chief Executive Officer, Saurya urja Company of Rajasthan

Aiming to implement 100 Gw by 2022 and with 35 Gw solar capacity operating as on end 20 , India's solar policy is at a crucial stage, seeking review by policy makers . Our current Solar policy focuses on adding capacity to central and state grids through reverse auctions(by SECI) and encouraging residential Rooftop solar through financial assistance. We have seen limited Policy support and implementation in emerging technologies , applications and R & D efforts limiting our ability to embrace "atma nirbhar" to its true spirit . This is evident from limited Technology demonstration projects which we can see in India, over dependence on imports and also lack of neutral agency which captures, analyses and publishes their performance .

Nevertheless, solar power procurement policy implementation is a great success and solar energy prices have fallen to a historic low. Production linked incentive schemes for Storage and PV manufacturing are expected to drive local manufacturing and jobs.

Continuation of the solar power procurement policy in its present form could pose significant challenges like (a) inability to dispatch solar power on demand (b) inability of solar projects to deliver greater compliance to scheduling and forecasting protocols (c) impact of higher RE penetration (no growth in thermal capacities) on grid quality . With storage battery costs likely to hit sub $100 per kwh in next 2 years (driven by higher volumes of electric vehicles and more & more demo projects in PV+ storage) and other promising technologies in hydrogen , CSP+ storage , it is imperative to review and reorient the Solar policy framework urgently.

Following are few ideas for consideration:

1. Instead of seeking bids for "pure vanilla" Solar projects, policy to encourage bidding on " Dispatch-able solar Base load" -which incorporates part of total capacity as energy storage ..Storing about a third to a quarter of all kilowatt-hours produced by a given PV power plant will suffice to smooth intermittent generation so as to provide predictable, and thus tradable, energy blocks during the day – as well as at night. Differential tariff for night time dispatch may be supported by seci/ MNRE to accommodate increase in capex cost due to energy storage
2. Policy must specify the duration of storage and be neutral to multiple emerging and reliable technology options including PV+electro chemical and CSP+thermo chemical to the choice of bidders.
3. Policy to make a budget provision for implementation of Fast track demonstration projects on an exclusive basis...This could be done @ any existing solar parks in operation and should cover power projects of 5-10 Mw size with wide range of technology options in Solar PV, CSP with storage, Battery storage , Hydrogen with solar etc ....Performance outcome of such a time bound and well managed policy driven program would be of immense value to the country in developing future Investments in Technology, manufacturing and project.
4. Many of the recent solar projects adopt AC:dc ratio of 1:1.5 which during peak generation period would lead to clipping losses... SECI may allow solar parks to incorporate a suitable battery bank at their evacuation point and store the energy generated (otherwise a clipping loss) for sale during non solar hours . This would act as demo storage projects at existing solar parks and also help the SPDs to recover revenue loss due to clipping and may encourage them to go for higher ratios in future to optimise LCOE.
5. Considering the rich potential of direct solar irradiance in states like Rajasthan, Gujarat and Leh Ladakh, technology demonstration projects based on hybrid PV with battery storage and CSP with thermal storage systems may be implemented. Such hybrid projects would be ideal for delivering 24*7 firm power based on renewables at competitive tariff. bids for such systems in the Middle East and Spain have discovered tariffs of around Rs 3 per unit. The configuration of such hybrid systems would be PV with minimum storage which will supply firm power during daytime and CSP with 8-10 hours thermal storage would supply power during night time.
6. Solar rooftop policy to include energy storage batteries and cfa may be suitably revised to accommodate to cover part of additional battery cost Solar rooftop with storage is very popular in us and Europe

While India's solar journey till date is ably supported by government's Policy , recalibrating its policy now is critical for India to lead this disruptive Technology space.

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With an installed capacity of approximately 85 GW of solar and wind capacity, India ranks fourth in the world in terms of installed capacity. However, a review of the actual consumption of renewable energy in the energy mix shows that the percentage generally varies between 6-10%, clearly evidencing under-utilization of the installed capacity. The major cause for such under-utilization is that solar and wind energy are intermittent energy sources and cannot be modified to mimic the energy demand and hence, generation patterns and demand/consumption patterns may not always be in sync. Currently, the gap in generation and demand/consumption is being covered through the use of energy from coal based thermal generation plants. However, given India's ambitious target to reach 175 GW of renewable energy by 2022 and the objective of reducing dependence on thermal power generation, it is imperative to introduce large-scale battery storage to ensure proper utilization of generated energy and also to ensure grid stability.

Large scale implementation of battery storage will result in many good things for India. It will introduce flexibility in electricity systems so that they are able to effectively respond to changes in supply and demand, increase the value of solar and wind energy, bring about grid stability and efficiency and it is also the most cost-effective way to ensure deeper penetration of renewable energy in isolated areas and communities. Unfortunately, various drawbacks impede the development of the energy storage sector in India, the primary being the lack of any central regulation, rule or framework to govern the sector. Thus, the first step to jumpstart the sector seems to be the introduction of, at the very least, a policy framework to set out objectives, short term and long term goals and a basic framework for the development of energy storage systems in India. In the past, policies, guidelines and acts have worked as stepping stones for nascent sectors and technologies including the renewable energy sector and charging infrastructure for electric vehicles in India and the battery storage sector in the United Kingdom and the United States. Once the initial setup is set out in the policy document or guideline, the sector usually undergoes organic growth and is able to sustain itself purely through market driven forces and course correction, if required, though government agencies.

Since energy storage systems have a wide range of applications for almost every stakeholder in the renewable energy value chain, the policy framework will have to either be comprehensive, such that it addresses each stakeholder separately or flexible, such that the same approach is applicable to all stakeholders. Accordingly, the government can either look to introduce a central policy for the sector and allow states to issue their own guidelines (in conjunction with the views of the electricity regulatory commission) or can take complete control over the sector in the initial phase until it stabilizes. In addition, the policy framework will have to account for sharing of costs between the owner of the system and the users, which consideration will have to be tailored for each stakeholder. For example, for independent power producers, any costs will have to take into account a profit margin, which may not be the case for distribution and transmission licensees. The Central Electricity Regulatory Commission in its staff paper on 'Introduction of Electricity Storage System in India' has addressed sharing of costs between users quite comprehensively and may be used as a reference.

Further, the policy framework should provide for drafting and issuance of tariff formulation guidelines through the identification of the appropriate commission along with recognition for the initial development models, both CapEx and OpEx, for energy storage systems.

The above is all subject to development of multiple cost-competitive energy storage technologies in India through extensive engineering, research and development for new storage concepts and materials, which will require making India an attractive location to develop battery storage systems through incentives and subsidies.

Once a policy framework is developed, bids for development of energy storage systems either on a standalone basis or bundled with a generation system may be invited. Thereafter, the sector should be able to grow organically with minimal intervention from the government similar to the renewable energy sector in India, which became a fairly regulated market driven sector in less than a decade.

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India is a signatory to the Paris Agreement under the United Nations Framework Convention on Climate Change. One of India's Nationally Determined Contributions (NDC) under this agreement is to have 40% of non-fossil fuel installed electric power capacity by 2030. As of 31 December 2020, India has an installed electric capacity of 374.2 GW, of which renewable power, including hydropower, constitutes around 36% of total installed capacity.

India has a target to install 175 GW of renewable energy sources (RES) by 2022 and increase it to 450GW by 2030. With this addition, it is expected that the installed capacity of RES including hydropower would be more than 60% of total installed capacity, and 40% in terms of total gross generation. However, RES, especially wind and solar pose major problems for balancing supply and demand on different spatial and time scales due to their variable natures. The distributed nature of RES also adds complexity in terms of connecting them to existing grid infrastructure. This is where energy storage has an important role to play in facilitating the large integration of RES.

India would require all types of energy storage technologies given the huge requirement of RES anticipated in its generation mix. Lithium ion (Li-ion) batteries in particular will have a significant role given that it is suitable for all applications of bulk energy services, ancillary services, transmission & infrastructure services, energy management and microgrid services and renewable integration. Amongst current and upcoming battery storage technologies, Li-ion batteries have the highest level of energy density, long cycle numbers, low discharge rate as well as no-memory effect. Its other major applications are in electric vehicles (EVs) where selection criteria are stringently for the highest energy density.

Li-ion batteries are currently expensive and not commercially viable in most application scenarios. However, its prices have dropped more than 80% between 2010-2018 and it is expected that it will further drop to less than 100 USD per unit by 2023 where it would become commercially viable.

India has the ambition of not only using the Li-ion batteries for its energy transition, but also developing a manufacturing hub to cater to all local demands, as well as partially catering to international needs. Towards this end, the Indian Government has taken a number of policy measures. It approved the National Mission on Electric Mobility in 2011 and launched National Electricity Mobility Mission Plan (NEMMP) in 2013 which promotes the uptake of electric and hybrid vehicles in the country with the aim to achieve national fuel security. As part of the NEMMP 2020, the Faster Adoption and Manufacturing of (Hybrid &) EVs in India (FAME India) Scheme was launched in the year 2015 to promote the manufacturing of electric and hybrid vehicle technologies.

The Indian Government has recently taken a number of measures under the Phased Manufacturing Program (PMP) and FAME to promote local manufacturing through creating local demand and supply. It has provided incentives of 10,000 crores for sale of EVs with 6.8GWh of total batteries, viability gap funding under various scheme for grid connected Li-ion batteries co-located with renewable sources and tenders for Round The Clock (RTC) and peak-power supply are being floated to promote energy storage. On the supply side, it has announced production-based incentives to set up 3-10 giga-factories totalling 50GWh by 2022, graded basic custom duties for Li-ion batteries and other manufacturing and export related incentives.

One of the key challenges, however, in the manufacturing of Li-ion batteries is securing the long-term supply of its major raw materials such as cobalt, nickel and lithium. More than 50% of the world's cobalt reserves is in Congo and the volatile political situation there presents a risk. Indonesia, Australia and Brazil hold the world's major reserves of Nickel. Li-ion batteries require a very high purity and hence only 46% of world's nickel production can be used for batteries. More than 50% of the world's lithium reserve is in the Lithium Triangle, which is a region of the Andes around the borders of Argentina, Bolivia and Chile. Since 2019, India has been making efforts to have joint ventures, acquisitions, as well as exploration rights in the lithium mines and access to cobalt within the Lithium Triangle. Unfortunately, the long-term sourcing of these materials would continue to pose a challenge for end-to-end manufacturing of Li-ion batteries in India.

As mentioned above, India has taken policy intervention to accelerate its energy transition, in particular through the local production of Li-ion batteries. However, the current focus majorly around the uptake of EVs is not enough. There needs to be a shift of focus and attention to the grid infrastructure where EVs would draw power from. Grid operators need to modernize their infrastructure to cater for non-traditional energy sources in order to achieve a carbon neutral energy value chain.

The use of battery storage needs to be looked at holistically from the grid integration perspective to allow for maximum value-stacking, rather than continuing with the sporadic integration with RES projects we are seeing now. With the current scenario, even if India achieves its target of 30% of electrification of vehicles by 2030, these EVs would be still running on 60% of fossil fuel sources – thereby defeating the intended purpose.

With a population of 1.3 bn people and less than half of world's average per capita electricity consumption, India requires a massive increase in electricity production to support its economic and population growth. A holistic, long-term policy framework, considering various energy storage technologies and how they fit into the energy value chain, is essential for a complete energy transition.