

**SOLAR ENERGY CORPORATION OF INDIA LIMITED**  
**NEW DELHI**

**Concept paper on**  
**FIRM AND FLEXIBLE RENEWABLE ENERGY PROJECTS WITH HIGH PLF**

Solar Photovoltaic and Wind Power have proved to be successful power generation technologies and these power projects have become mainstream sources of electricity like other conventional sources. RE power growth in India is well ahead on the path to achieve the Government of India's target of 175 GW capacity installation by the year 2022. Further, it is expected to grow up to 450 GW by 2030 as declared by the Honorable Prime Minister.

Initial success of the Renewable mission has not seen any issues in integration with the grid as the grid is flexible to that extent to absorb the RE power and other conventional sources are being managed synchronously with the available balancing resources. As the RE power mix is now rapidly increasing, various grid integration issues need to be addressed simultaneously.

As the RE power became the cheapest source of electricity in India, efforts are being made to initiate gradual replacement of existing conventional power generation capacities with clean RE power generation capacities as per the national targets. The major advantage of conventional sources of power generation are higher Plant Load Factor (PLF), firmness and flexibility in power supply. To replace the same with RE sources, these three characteristics are essential to be built into the RE power projects to keep RE power capacity addition targets on track.

**Improving PLF of Renewables:** Currently the typical PLF numbers for RE projects are 20-25% for solar, 30-38% for wind and 40-45% for solar-wind hybrid projects; such projects are being successfully implemented and are performing well. The PLF can be improved further above 60% for the Solar-Wind hybrid projects by adding higher generation capacity before the meter and employing energy storage to store the excess energy beyond the rated capacity of the plant and to release the stored energy during fall in generation below the rated capacity of the plant. Various combinations of solar or wind with storage capacities are possible to improve the PLF of projects beyond 60%.

**Improving Firmness:** As the solar and wind power generation is given a must-run status, it is inevitable to absorb such generated energy by the Discoms. However, as the share of RE capacity in India's energy mix grows, very sharp fluctuations in intra-day generation, along with daily and seasonal variation of the generation will pose serious threat to the grid to absorb such infirm power beyond tolerable limits within the available balancing generation resources. Also to the Discoms and the generators the precise scheduling of this fluctuating RE power may lead to technical and commercial impediments. To meet the national targets of future RE power capacity addition, a gradual shift towards firm RE power is the need of the hour.

Various nations which are having high targets of RE power capacity addition have already initiated various measures to address the issues in integration of infirm RE energy with the grid. The solutions vary from deploying huge energy storage capacities in the grid network, scheduled curtailments, developing virtual power plants, smart grids with micro storage network, adding the gas power plants into grid network etc.

Deploying energy storage at grid level will add additional cost to transmission network and thereby increase the cost of transmission of power. Already, the cost of transmission for Renewables will be expensive due to poor utilization of the network established because of low PLF. Thus, it is required to address the issues of PLF and firming of renewables simultaneously.

Hybridizing with Gas power plants also can be a solution to provide firmness, but this solution will not improve the PLF of RE plants. Therefore, the development of solar or wind projects with storage is an ideal solution to make the RE power firm, which also improves the PLF.

Depending on the location of the projects, hybrid RE power projects with storage can be designed to deliver 12-16 hours of firm energy as per the utility/grid needs.

**Flexibility in generation:** The electricity load today is quite dynamic in nature which demands good amount of flexibility in generation sources to maintain the health of the grid. As the RE power is infirm in nature, flexibility in generation is very much limited with respect to addressing the grid requirements. Recent amendments in the connectivity guidelines issued by the CEA, demand the same features from an RE power project, and addressing the same without adding storage capacity is difficult. Adding sufficient energy storage in the projects will address the

concerns of the Discoms in flexibility of RE power. To begin with, a flexibility of 20-30% is proposed, wherein the Discoms can schedule the power requirement between 70-100% of the contracted capacity of the project based on the availability declared by the developer.

**Solutions:**

Thus, it emerges from the above that in order to address all the above three requirements of High PLF, Firmness and Flexibility in RE Power, a possible solution is developing solar-wind hybrid projects with energy storage. The combination of solar-wind capacities and the storage requirements typically depend on site conditions based on the solar and wind resource availability and generation profiles.

Solar power generation is more or less stable with constant profile throughout the year, except during overcast conditions. PLF > 60% can be achieved by adding 2.5 to 3.3 times of DC capacity with around 3 to 4 times of storage capacity with innovative mounting structure combinations like dual axis tracker or combination of vertical mount and latitude tilt structures, etc. The levelized cost of generation of such power will be a little bit expensive, but it will be suitable to the needs of the utilities.

The storage requirements can be reduced by appropriately adding wind capacity into the system. The wind power generation profile is different at different sites in India. For example, for the sites in Gujarat, the lean season consists of only two months (Nov & Feb), where as for the sites in Tamilnadu, there are 5 months of lean season (Nov-March). As the solar generation is quite stable during these lean seasons of wind, the output requirements can be easily met. Therefore, by employing wind capacity in the solar project, the tariff can be reduced.

All these combinations provide firm output for about 12-16 hours in a day with a flexibility of around 20-30% of the output to provide flexibility to the Discoms. The stored energy depending on the availability can be scheduled to meet the peak demand requirements of the utilities.

Development of such projects will improve not only the better adaptability to the grid but also the economic IRR of the projects and will enable achieving RE targets of 450 GW of the country.

## **STAKEHOLDER MEETING**

To take further the above ideas, a stakeholders' consultation meeting is scheduled to be held on **Monday, 22.06.2020, at 2 PM IST.**

The meeting will be chaired by Sh. S. K. Mishra, Director (Power Systems), SECI, and will be moderated by Dr. Y. B. K. Reddy, AGM (Solar-PV), SECI. The meeting is open to all the stakeholders, including Discoms, IPPs, Developers, Organizations, and other Government Agencies working in the area of RE combined with storage technologies.

Agenda for the meeting would be to discuss the above proposed solutions, and other possible options to achieve the trinity of Flexibility, Firmness and high PLF in RE Projects, and to finalize the broad contours of a bidding methodology in this regard. The meeting will be held online, and details for the same will be provided shortly.

Stakeholders interested in attending the meeting, may register themselves by mailing to [pratikpr@seci.co.in](mailto:pratikpr@seci.co.in) and [jayansh.gaur@seci.co.in](mailto:jayansh.gaur@seci.co.in). The meeting links will be emailed to the participants through email, before 22.06.2020. Participants willing to present their views/ideas on the above subject are welcome to do so, through PPT presentations (each presentation time will be limited to 5-8 minutes). Such presentations may be mailed to [ybkreddy@seci.co.in](mailto:ybkreddy@seci.co.in), and [prashantu@seci.co.in](mailto:prashantu@seci.co.in), latest by 19.06.2020.