Research

CRISIL
An S&P Global Company

The new power couple in town

Wind-solar hybrid finding favour with Centre and states

June 2020

WSH fulfilment

Wind-solar hybrid (WSH) is fast becoming the preferred renewable energy (RE) option in India. Although the Ministry for New and Renewable Energy (MNRE) has not yet set a generation target for the nascent sector, WSH has received strong support from the central public sector undertaking Solar Energy Corporation of India (SECI) and several state governments.

SECI intends to set up 5 GW of solar and wind projects with storage under the engineering, procurement and construction (EPC) mode over the next 10 years, adding to the country's total of 37.69 GW of wind energy capacity and 35 GW of solar capacity as of fiscal 2020. WSH projects, which harness both solar and wind energy, are expected to account for a good chunk of the pipeline.

In January this year, SECI invited bids for 1.2 GW WSH capacity under its tranche-III tender for RE projects.

Among the states, Andhra Pradesh formulated a Wind-Solar Hybrid Power Policy in 2018 and has set a 5 GW generation target from WSH projects by 2022. Other windy states such as Gujarat and Maharashtra have also identified land parcels to develop WSH projects.

Given this, CRISIL Research estimates ~15 GW of WSH power to come up in the country over the next five years, compared with only ~100 MW today. Of this, ~10 GW is already in the works – either under construction or being tendered – and will start feeding the grid by 2024.

WSH has found favour globally, too. Among others, China, Germany, Spain, Netherlands and the US have set up such projects to unlock value from hybrids. The advantages include lower capex costs, improved power integration and matching with the demand profile of the market.

The case for WSH power

Boosting grid resilience

Integrating wind and solar energy projects with the grid can be challenging because of the variability in generation from these projects.

Generation of solar energy tends to peak during the day and wind energy at night. This results in intermittencies in supply from RE projects, impacting grid resilience. As a result, although RE plants enjoy a must-run status, there have been instances recently when distribution companies (discoms) in RE-heavy states stopped offtake from solar power plants to ensure grid resilience, much to the discomfort of the generators.

It is in this context that Ministry of New and Renewable Energy (MNRE) adopted the National Wind-Solar Hybrid Policy in 2018. The policy seeks to promote hybridisation of wind and solar energy.

In WSH projects, the two energy sources complement each other to reduce the variability of generation and improve grid security. This could help discoms overcome their reluctance in power offtake from RE plants.

Also, for developers, cohabiting solar and wind plants could result in a higher capacity utilisation factor (CUF), even if they don't get the optimum generation sites in terms of irradiance and high wind speeds.

Refuelling the wind energy segment

WSH could also emerge as a saviour for India's wind energy sector, which has seen developer interest waning due to technical and pricing issues. Over fiscals 2018-2020, wind energy capacity logged a CAGR of just 5.2% to 37.69 GW, while that of solar clocked 26% to 35 GW.

In fact, tendering, auctioning and execution of wind projects have slowed. For instance, 47% of the projects tendered for bidding in fiscal 2020 were under- or un-subscribed, 7% were cancelled and 24% delayed.

States with high wind power generation such as Tamil Nadu have also complained that banking on wind energy is costly and poses technical challenges to the grid.

On the pricing front, as per CRISIL Research's analysis, a tariff of Rs 3.0-3.2 per kWh is required to achieve equity internal rate of return (IRR) of 9-11% in wind power projects.

Following the recent removal of tariff caps on RE tenders, wind tariffs could go up in order to price in the implementation challenges. Should they do so, WSH projects will undercut wind tariffs.

In such a scenario, WSH could offer a lifeline to the wind energy market by cross-subsidising costly wind power with cheaper solar power, thus helping the RE segment expand.

Upcoming WSH projects

There are two types of WSH projects – pure-play ones and those with storage. There are also projects that may come up under the government's round-the-clock (RTC) power scheme, which has a mandatory 51:49 blend of RE and thermal.

There are proposals to set up ~3.9 GW of pure-play WSH projects and ~4.5 GW of WSH projects with storage in the country. In addition, ~1.1 GW of hybrid projects are expected to come up as part of the ~5.4 GW that will be developed under the RTC scheme.

While the biggest beneficiaries of the WSH policy will be major windy states such as Madhya Pradesh, Karnataka, Gujarat, Tamil Nadu and Andhra Pradesh, under-penetrated windy states such as Maharashtra and Chhattisgarh are also expected to see some traction.

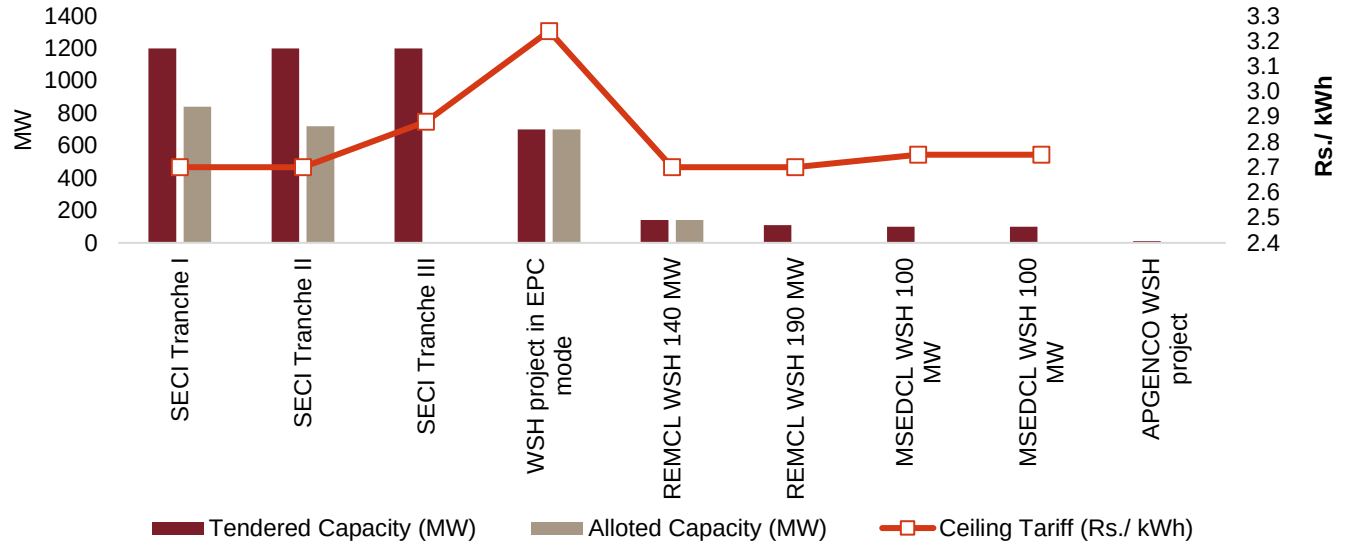
Pure-play WSH projects find the most takers

SECI cleared the way for pure-play WSH projects with a 1.2 GW tender in 2018. Of this, SECI awarded 840 MW at Rs 2.67 per kWh, which is expected to start generation this fiscal.

SECI has also tendered two more tranches of 1.2 GW each. While tranche-II has been bid out, tranche-III issued in January is awaiting bids.

SECI has awarded cumulative capacities of 720 MW with tariffs ranging from Rs 2.69- Rs 2.70 per kWh in tranche-II to private developers.

Break-up of pure-play WSH projects/ schemes



Note: APGENCO: Andhra Pradesh Power Generation Corporation; MSEDCL: Maharashtra State Electricity Distribution Company Ltd; REMCL: Railway Energy Management Company Ltd; SECI: Solar Energy Corporation of India

Source: CRISIL Research

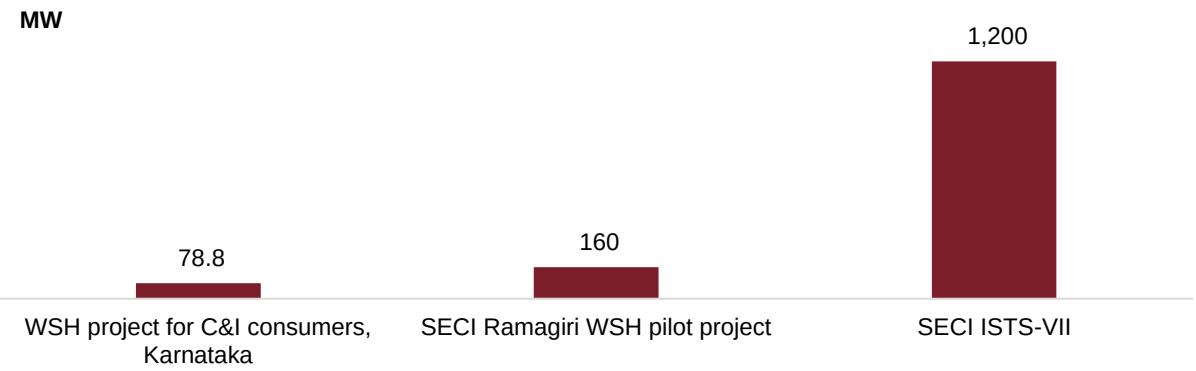
That's not all. Central entities such as Railway Energy Management Company Ltd (REMCL) and state agencies such as the Andhra Pradesh Power Generation Corporation (APGENCO) and Maharashtra State Electricity Distribution Company Ltd (MSEDCL) have also issued tenders to promote the adoption of WSH.

WSH projects with storage to cater to peak power

WSH projects with storage are capable of catering to peak load generation and improving CUF. There are two kinds of storage capacities – pump hydro energy and Li-ion batteries.

The market for WSH projects with storage capacity is nascent. However, SECI issued the first large-scale WSH with storage tender of 1.2 GW under the Inter-state Transmission System VII scheme (ISTS VII) in January 2020. Earlier, in 2019, SECI had set up a 160 MW WSH with storage project in Ramagiri, Andhra Pradesh, under the EPC mode.

Break-up of WSH-with-storage projects/ schemes



Source: CRISIL Research

Of the 1.2 GW tender, SECI awarded tranches of 900 MW and 300 MW to successful bidders, which are likely to be commissioned in fiscal 2022.

Furthermore, two WSH-with-pumped-storage EPC projects with cumulative capacity of 3000 MW are being set up. However, these Integrated Renewable Energy with Storage Projects (IRESP), as they are called, are intended to go beyond peak supply to offer round-the-clock power. Pumped storage capacity is expected to balance the intermittencies of RE and supply firm, dispatchable power to the grid round the clock.

Since WSH projects with energy storage systems (ESS) can cater to peak and RTC power demand, they have the potential to reduce the country's dependence on gas-based and pumped hydro-based peaking plants. They can also improve the role of RE in providing grid ancillary services on the generation side. Moreover, by building an effective storage ecosystem, they can spur ESS demand.

WSH to be the preferred RE component in a fifth of RTC power projects

Apart from pure-play WSH and WSH-with-storage projects, some WSH capacity is also expected to come up under the government's RTC power scheme. While the RTC-I scheme pertains to the procurement of 200 MW each for Delhi and Dadra & Nagar Haveli, the RTC-II is to procure 5 GW (with a mandatory 51:49 RE-thermal mix). SECI has awarded 400 MW contract under the RTC-I at a quoted tariff of Rs 2.90 per kWh.

Since SECI has not specified the type of RE power under the RTC schemes, it could come from a combination of large-scale solar or wind projects. However, this could be counter-productive and cost inefficient as the requirement of land and also ESS capacities to even out the variability of supply will be large. Instead, hybrid projects improve the overall CUF and also reduce the variability to a large extent. In order to even out the remaining intermittence, if any, a smaller ESS capacity will be sufficient.

In CRISIL Research's assessment, ~20% of the projects under the RTC-I and -II are likely to have WSH as the preferred RE component.

At Rs 2.8-2.9/kWh, WSH power tariff hits competitive sweet spot

As with all power projects, pricing will be key for the success of WSH projects, especially as these will be pitted against more competitive RE sources such as solar energy.

Indeed, with developers bidding aggressively, solar tariff has been falling consistently in recent times. For instance, SECI's tranche-VIII 1.2 GW solar auction held in February 2020 saw tariff discoveries of Rs 2.50 per kWh (L1) and Rs 2.51 per kWh (L2), while its wind auctions (tranches VI, VII, and VIII) in 2019 saw tariff discoveries between Rs 2.79 and Rs. 2.83 per kWh (L1).

In comparison, SECI's WSH tranche-II 1.2 GW auction saw prices of Rs 2.69 per kWh (L1) and 2.70 per kWh (L2).

This gives CRISIL Research reason to believe WSH pricing has hit a competitive sweet spot.

Our analysis shows that several factors influence the pricing of WSH hybrid power, a major one being location. The right assessment of exploitable wind and solar resource at a location can help determine the quantum of energy that can be extracted from the project, which can, in turn, help design the right wind-solar mix.

To achieve competitive pricing, WSH projects need to generate power at a minimum CUF of 45%, assuming a wind to solar installed capacity ratio of 1.5:1.0. We expect WSH tariff to hover in the range of Rs 2.8-2.9 per kWh with a wind-heavy WSH configuration. The tariff may be slightly lower if the solar component is higher, though the project may then have problems in achieving ideal CUF for optimum returns. Our analysis shows that the tariff can be brought down by another ~10 paisa per kWh if the co-location clause (necessitating the wind and solar components to be located at the same place) is removed.

As for WSH-with-storage projects, the recent bids have been aggressive with players quoting Rs 6.12 per kWh for peak tariff with pumped hydro-based ESS, and Rs 6.85 per kWh for Li-ion-based ESS. The weighted average tariff (peak and off-peak) comes to Rs 4.04- 4.30 per kWh.

Though higher than pure-play WSH tariff, these are still lower than the ~Rs 4.4 per kWh tariff discovered in recent thermal power tenders. In a conservative scenario with a Li-ion-based ESS servicing six hours of peak supply, peak tariff comes to ~Rs 7.1-7.2 per kWh. Thus, the industry seems to be cross-subsidising the levelised cost of storage with off-peak power tariffs in order to bring peak tariffs to a more acceptable level. Going forward, as the number of auctions and market participants increases, we expect peak pricing to firm up below the Rs 7 per kWh band.

The challenges

1. **Lack of good sites to set up WSH projects:** WSH projects require wind and solar plants to be co-located to inject power into the same pooling station. This means the ideal location should have good irradiation and also experience high wind speeds. But such locations are hard to find, especially as all major windy areas with strong grid evacuation facilities have been saturated. Hence, the industry has demanded that wind and solar plants of a WSH project be allowed to operate from different locations. This will also help bring down tariffs owing to better plant utilisation levels. The only advantage of co-locating is better utilisation of transmission infrastructure. However, CRISIL Research believes the advantage from reduced tariff (when wind and solar units are located separately) is much higher than the benefit of improved transmission capacity utilisation (with co-location).

2. **Grid balancing requirement poses implementation risks:** Developers are required to balance the grid before injecting electricity generated from a co-located WSH plant. This means they need to simulate the ideal wind and solar generation mix from the plant, in order to optimise the hybrid curve. This may lead to additional implementation risks for a developer.

3. **Tariff is a big challenge:** The average tariff for WSH is Rs 2.8-2.9 per kWh today – higher than solar tariff, which has dropped to Rs 2.5 per kWh in recent bids, and comparable to wind tariff, which has remained sticky at Rs 2.80-2.85 per kWh. And although cross-subsidising costly wind power with low-cost solar will provide some price cushion at the lower end, the pricing needs to be attractive to make WSH competitive.

4. **Lack of industry experience to undertake reverse bundling of RE power with thermal:** Since this is a new business opportunity for the RE sector, there will be a learning curve for all market participants.

In conclusion

By combining the best of wind and solar power, WSH could well become a viable RE option for India. In the process, it could help salvage the wind energy market, which is struggling to stay afloat. CRISIL Research expects the WSH market to grow and evolve as the number of projects and developers increases. Besides, new use cases are likely to come up that could make wind and solar truly dispatchable, thus overcoming the intermittencies currently associated with RE power.

That said, land availability and policies such as co-location will be key monitorables to ensure the viability of WSH projects. Other challenges, including adequate transmission infrastructure and technical issues, need to be addressed, too.

Analytical contacts

Rahul Prithiani
Director – CRISIL Research
CRISIL Limited
D: +91 22 3342 3574
rahul.prithiani@crisil.com

Pinal Mehta
Associate Director – CRISIL Research
CRISIL Limited
D: +91 22 3342 3850
pinal.mehta@crisil.com

Pramit Pal
Senior Analyst – CRISIL Research
CRISIL Limited
D: +91 22 3342 4111
pramit.pal@crisil.com

About CRISIL Limited

CRISIL is a leading, agile and innovative global analytics company driven by its mission of making markets function better.

It is India's foremost provider of ratings, data, research, analytics and solutions with a strong track record of growth, culture of innovation, and global footprint.

It has delivered independent opinions, actionable insights, and efficient solutions to over 100,000 customers through businesses that operate from India, the US, the UK, Argentina, Poland, China, Hong Kong and Singapore.

It is majority owned by S&P Global Inc, a leading provider of transparent and independent ratings, benchmarks, analytics and data to the capital and commodity markets worldwide.

About CRISIL Research

CRISIL Research is India's largest independent integrated research house. We provide insights, opinion and analysis on the Indian economy, industry, capital markets and companies. We also conduct training programs to financial sector professionals on a wide array of technical issues. We are India's most credible provider of economy and industry research. Our industry research covers 86 sectors and is known for its rich insights and perspectives. Our analysis is supported by inputs from our large network sources, including industry experts, industry associations and trade channels. We play a key role in India's fixed income markets. We are the largest provider of valuation of fixed income securities to the mutual fund, insurance and banking industries in the country. We are also the sole provider of debt and hybrid indices to India's mutual fund and life insurance industries. We pioneered independent equity research in India, and are today the country's largest independent equity research house. Our defining trait is the ability to convert information and data into expert judgments and forecasts with complete objectivity. We leverage our deep understanding of the macro-economy and our extensive sector coverage to provide unique insights on micro-macro and cross-sectoral linkages. Our talent pool comprises economists, sector experts, company analysts and information management specialists.

CRISIL Privacy

CRISIL respects your privacy. We may use your contact information, such as your name, address, and email id to fulfil your request and service your account and to provide you with additional information from CRISIL. For further information on CRISIL's privacy policy please visit www.crisil.com/privacy.

Disclaimer

CRISIL Research, a division of CRISIL Limited (CRISIL) has taken due care and caution in preparing this Report based on the information obtained by CRISIL from sources which it considers reliable (Data). However, CRISIL does not guarantee the accuracy, adequacy or completeness of the Data / Report and is not responsible for any errors or omissions or for the results obtained from the use of Data / Report. This Report is not a recommendation to invest / disinvest in any company / entity covered in the Report and no part of this report should be construed as an investment advice. CRISIL especially states that it has no financial liability whatsoever to the subscribers/ users/ transmitters/ distributors of this Report. CRISIL Research operates independently of, and does not have access to information obtained by CRISIL's Ratings Division / CRISIL Risk and Infrastructure Solutions Limited (CRIS), which may, in their regular operations, obtain information of a confidential nature. The views expressed in this Report are that of CRISIL Research and not of CRISIL's Ratings Division / CRIS. No part of this Report may be published / reproduced in any form without CRISIL's prior written approval.