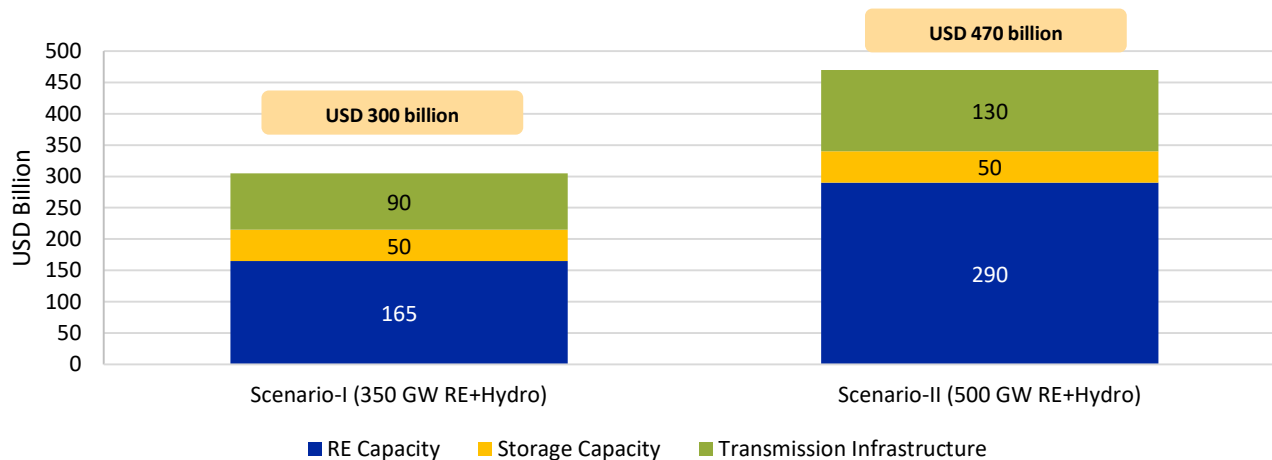


Investments of US\$450-500 billion required to achieve the capacity targets by 2030

EXHIBIT 18: Projected funding requirement by FY2030 under the two scenarios



Funding avenues

- Global PE, Pension & Sovereign wealth funds
- Domestic financial institutions
- Green bonds – domestic & international
- InvITs

Source: ICRA Research; funding requirement in the chart here considers investments towards transmission & storage infrastructure

- The investment requirement for achieving the non-fossil capacity target of 500 GW by 2030 remains large at close to US\$300 billion, over the next 8-9 years. This apart, investments would be required in augmenting the transmission infrastructure to integrate the renewable power with the electricity grid as well as investments to create storage infrastructure. ICRA expects the investments towards transmission infrastructure and storage capabilities to be over US\$150-200 billion over the next 8-9 years, taking the overall investment requirement to US\$450-500 billion. Thus, availability of adequate funding avenues at cost competitive rates remains critical to achieve these capacity targets.



Tariff Trends & Viability

Solar power tariffs under upward pressure due to sharp increase in module prices and hike in GST rates; nonetheless, tariff to remain competitive

Solar tariffs remain below Rs. 2.5 per unit in CY2021 YTD

EXHIBIT 19: Year wise average solar bid tariffs

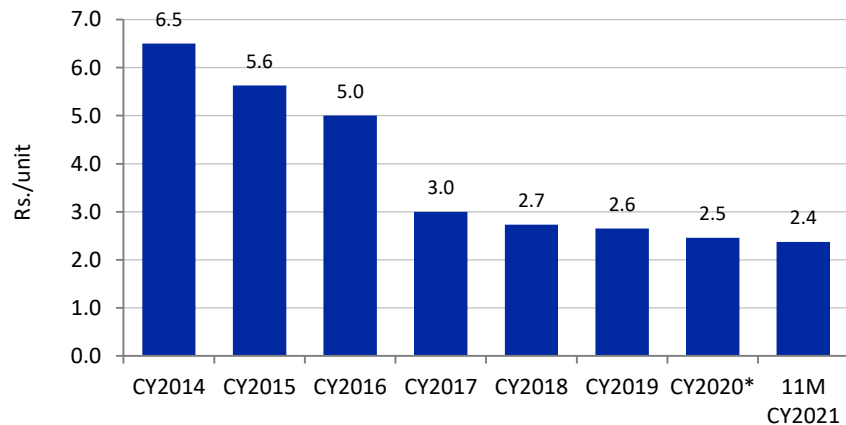
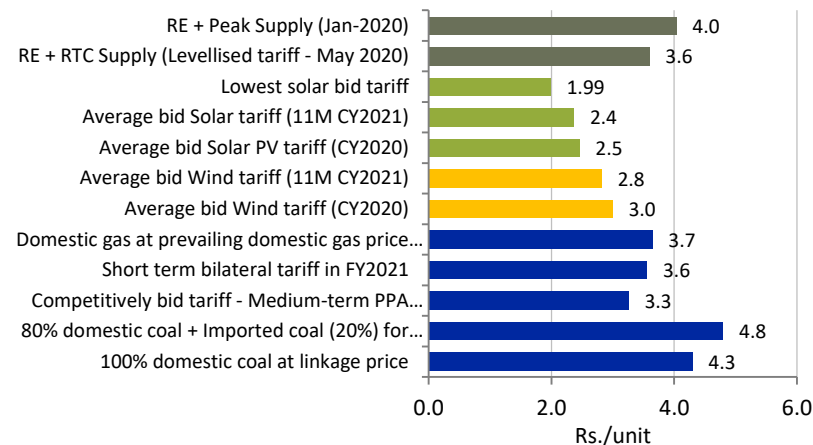


EXHIBIT 20: Comparison of solar and wind bid tariffs with competing sources

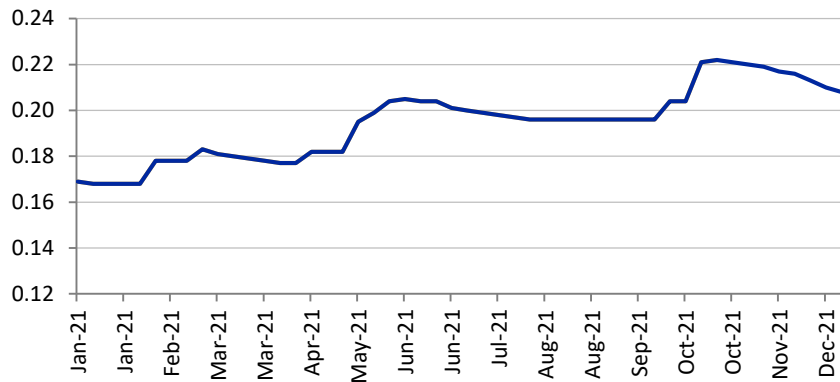


Source: ICRA Research; *Excluding manufactured linked tender; cost of generation estimates for coal-based project factors capex of Rs. 8.0 crore per MW & location within 500 KMs from coal source

- Over the years, the solar bid tariffs have been on a declining trend led by decline in module costs and improved module efficiencies, reaching an all-time low of Rs. 1.99 per unit in a GUVNL tender in December 2020. However, the bid tariffs witnessed an uptrend in the bids post thereafter to Rs. 2.2 – 2.5 per unit (except two bids), given the increase in imported PV module prices and the imposition of BCD on imported cells and modules at the rate of 25% and 40% respectively with effect from April 2022. Nonetheless, the tariff rates in recent bids continue to remain competitive, remaining below Rs. 2.5 per unit.

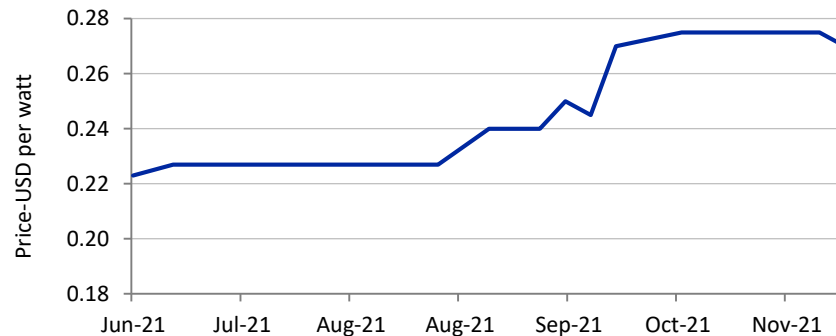
Sharp rise in module price levels amid supply-side disruptions in China

Exhibit 21: Average solar PV module price trend as per SOLRASSM Index



Source: ICRA Research, Bloomberg

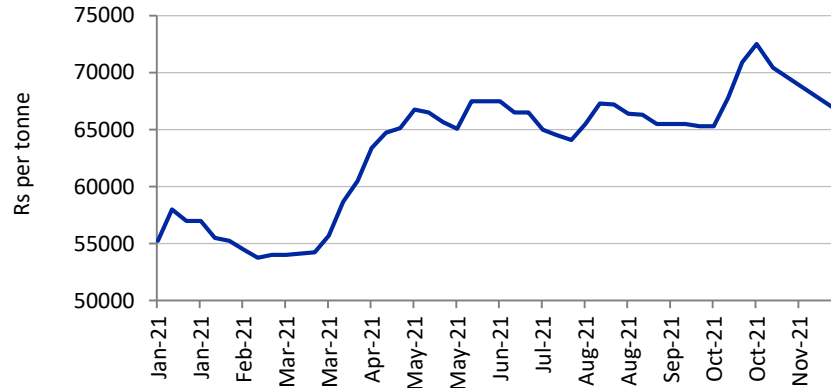
Exhibit 22: Price trend of Mono PERC modules



Source: ICRA Research, Infolink

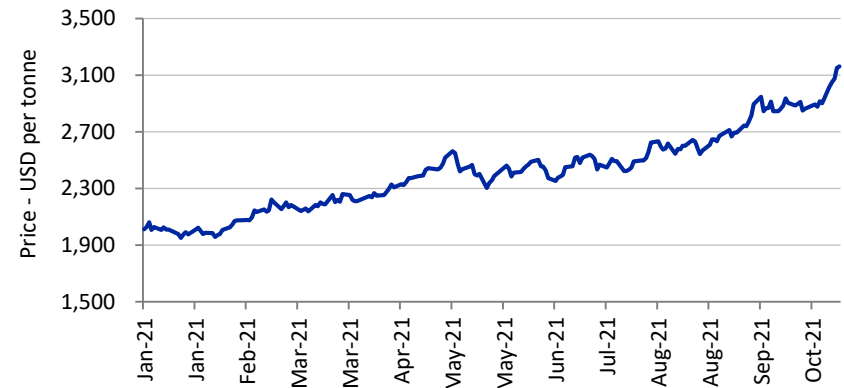
- The average price of imported solar PV modules (multi) remains elevated at about 22-23 cents/watt, which is higher by about 30-35% compared to the prices seen in December 2020. Also, most of the utility scale developers are deploying Mono PERC modules in recent times and its prices have increased from 19-20 cents/watt in December 2020 to 22-23 cents per watt in June 2021 and further to 27-28 cents per watt in Q3 FY22 i.e. increasing by over 35%.
- This is mainly driven by a sharp increase in the price of polysilicon, a key input for cell and module manufacturers, as seen over the last 10-12 month period. Further, the disruption in operations across the value chain of solar PV module manufacturing in China owing to the power cuts led to elevated price level for solar PV cells and modules. **As per Infolink, there is a marginal decline in MONO PERC module prices in December 2021 with module inventory returning to normalcy and stagnant global demand for first quarter of next CY with buyers in wait and watch mode.**

Exhibit 23: Steel price trend



Source: ICRA Research, Steelmint

Exhibit 24: Aluminum price trend



Source: ICRA Research, Steelmint

- Apart from polysilicon, a solar PV module requires glass and aluminium which is used as back-sheets. Further, a solar power plant is dependent on steel, which is used in the mounting structures. As reflected by the exhibits above, the prices of steel and aluminium have increased by more than 20% and ~55% respectively on a YTD basis. Similarly, soda ash, which is a key component in manufacturing glass, has witnessed an increase of over 80% on a YTD basis.
- These inflationary pressures are likely to put upward pressure on the capital cost of solar power projects and impact the returns for the developers having under-construction projects. Moreover, the bid tariffs in the subsequent auctions are likely to increase, as developers will have to factor in the increase in input prices along with implementation of BCD on solar PV cells and modules.

Moderation in returns for solar projects awarded over the last 6 to 12 months

Exhibit 25: Impact assessment on DSCR (Illustrative) of a solar power project in the wake of upward pressure on module prices (without considering impact of BCD as it is expected to be a change in law for projects bid out prior to March 2021)

Cumulative DSCR		Module Price (\$/Watt)					
		20.00	22.00	24.00	26.00	28.00	30.00
Tariff (Rs/unit)	2.00	1.23	1.17	1.12	1.08	1.04	0.99
	2.20	1.36	1.30	1.24	1.19	1.15	1.11
	2.40	1.49	1.43	1.36	1.31	1.26	1.21
	2.60	1.63	1.55	1.48	1.42	1.37	1.32
	2.80	1.76	1.68	1.60	1.54	1.48	1.42
	3.00	1.89	1.80	1.72	1.65	1.59	1.52

Source: ICRA Research; Debt and equity ratio of 70:30, interest rate of 8.0% with repayment tenure of 18 years post COD, DC plant load factor (PLF) of 18.0%, DC-AC ratio of 1.5 times and degradation factor of 0.7% per year; INR-USD exchange rate of 74.5; O&M cost of Rs. 2.5 lakhs per DC MW with annual escalation of 5.0%; Provision for inverter replacement reserve of Rs. 15 lakhs per MW is considered to be built over a 10-year period

- Given the large dependence on imported cells and modules for Indian developers, the increase in cell & module prices is likely to moderate the debt coverage and return metrics for the projects bid out over the past one year with expected commissioning over the next 6-12 month period.
- As the PV module component comprises about 50-55% of the overall project cost, an increase in the module price level by about 2 cents/watt is likely to moderate the debt service coverage metrics for the project developers by about 5-6 basis points. At a bid tariff of Rs. 2.2 per unit, the project can remain viable up to a module price level of 24.0 - 25.0 cents per watt considering a interest rates of 8.0%. This is applicable for projects wherein BCD is not applicable or is a pass-through under change in law.

Extent of moderation in returns higher for projects facing the impact of BCD

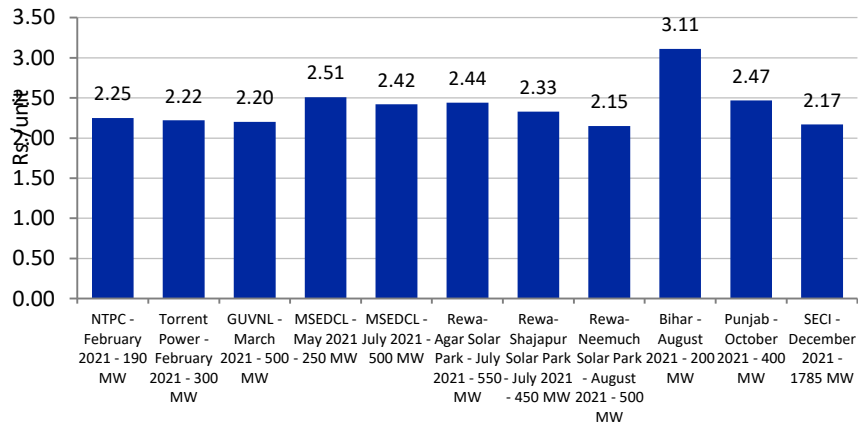
Exhibit 26: Impact assessment on DSCR (Illustrative) of a solar power project in the wake of upward pressure on module prices along with the impact of BCD on imported cell prices (for projects bid out post BCD notification in March 2021)

Cumulative DSCR		Module Price (\$/Watt)					
		20.00	22.00	24.00	26.00	28.00	30.00
Tariff (Rs/unit)	2.00	1.15	1.10	1.05	1.00	0.96	0.92
	2.20	1.28	1.22	1.16	1.11	1.07	1.02
	2.40	1.40	1.33	1.27	1.22	1.17	1.13
	2.60	1.52	1.45	1.38	1.32	1.27	1.22
	2.80	1.65	1.57	1.50	1.43	1.37	1.32
	3.00	1.77	1.68	1.61	1.54	1.47	1.41

Source: ICRA Research; Debt and equity ratio of 70:30, interest rate of 8.0% with repayment tenure of 18 years post COD, DC plant load factor (PLF) of 18.0%, DC-AC ratio of 1.5 times and degradation factor of 0.7% per year; INR-USD exchange rate of 74.5; O&M cost of Rs. 2.5 laksh per DC MW with annual escalation of 5.0%; Provision for inverter replacement reserve of Rs. 15 lakhs per MW is considered to be built over a 10-year period; BCD of 25% assumed on imported PV cells

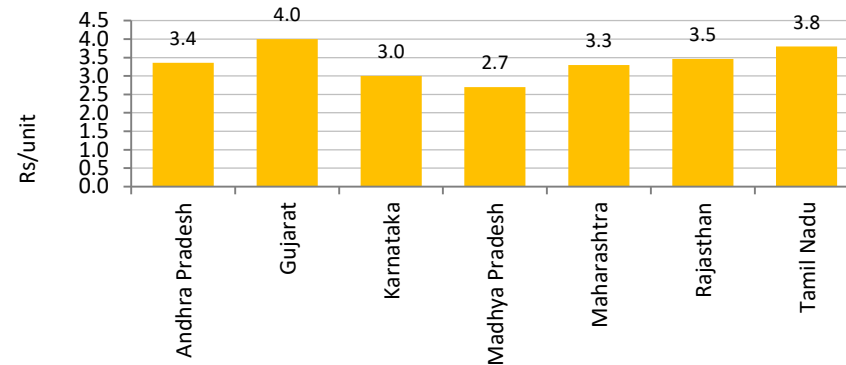
- Post the notification of BCD on imported PV cells and modules, the developers have won projects with quoted bid tariff largely between Rs. 2.3 to Rs. 2.5 per unit, which increased from the low of Rs. 1.99 per unit in December 2020. However, the extent of increase in the bid tariffs remained lower than expected level due to high level of competitive intensity in the bidding environment. The recent increase in module prices is likely to moderate the cumulative DSCR and project IRR for these projects by 10-12 bps and 100-110 bps respectively.
- Given the supply side constraints for procuring solar cells and modules from China, the projects may witness delays in execution. The availability of adequate timeline buffer under the PPAs or securing timeline extension from the bidding agency remains important for the developers. Also, the disruption in supply chain in procuring cells & modules from China is likely to accelerate the development of domestic solar PV manufacturing value chain.

Exhibit 27: Trends in solar bid tariffs in CY2021



Source: ICRA Research

Exhibit 28: Marginal variable cost of procurement (bottom 25% of merit order) for discoms in Key States



Source: ICRA Research, Meritindia.in

- While the increase in module prices and the recent hike in GST rate for solar power equipment from 5% to 12% requires the tariffs to go by ~20-25 paise per unit from the levels seen over the past six months to safeguard the developers, the tariffs have actually come down to Rs. 2.17 per unit in the latest bid held in December 2021. This can possibly be attributed to the intense competition and developer's expectation of a moderation in module prices over the next 12-18 months. From the perspective of ultimate off-takers i.e. state discoms, the solar power tariffs continue to remain cost competitive, given that marginal variable cost of power purchase (bottom 25% in merit order) for them across the key states remains well above Rs. 3/unit.

Viability of projects dependent on securing debt funding at competitive rates and module prices

Exhibit 29: Sensitivity of DSCR (Illustrative) of a solar power project to module prices and interest rate for a project bid out at Rs. 2.20 per unit (for projects bid out post BCD notification in March 2021)

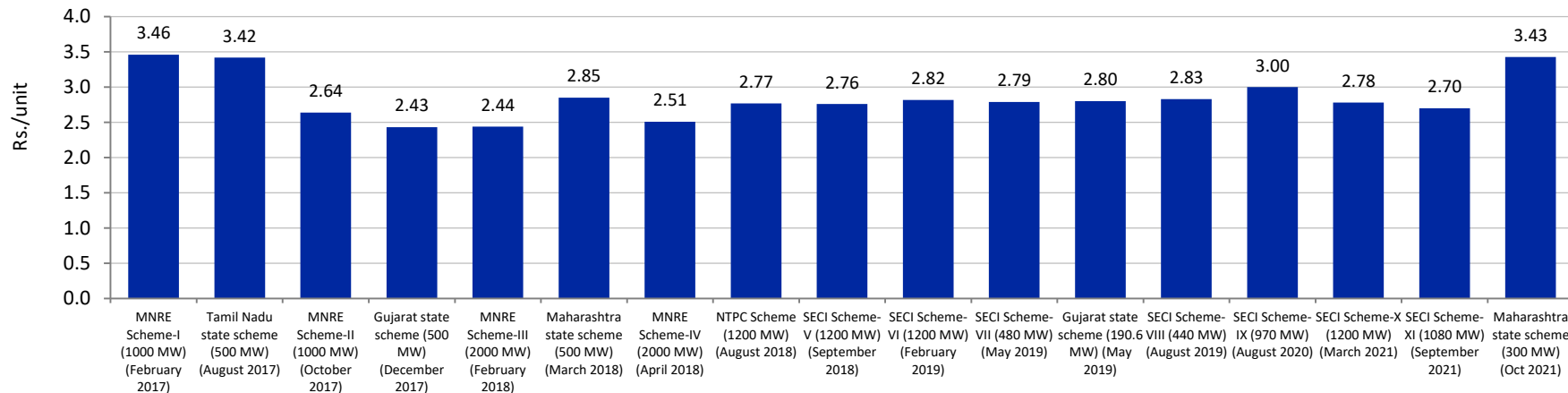
Cumulative DSCR	Module Price (cents/Watt)						
	20.00	22.00	24.00	26.00	28.00	30.00	
Interest rate on project debt (%)	7.5%	1.31	1.25	1.19	1.14	1.09	1.05
	8.0%	1.28	1.22	1.16	1.11	1.07	1.02
	8.5%	1.25	1.19	1.14	1.09	1.04	1.00
	9.0%	1.22	1.16	1.11	1.06	1.02	0.97
	9.5%	1.19	1.14	1.08	1.04	0.99	0.95
	10.0%	1.17	1.11	1.06	1.01	0.97	0.93

Source: ICRA Research; Debt and equity ratio of 70:30, Repayment tenure of 18 years post COD, DC plant load factor (PLF) of 18.0%, DC-AC ratio of 1.5 times and degradation factor of 0.7% per year; INR-USD exchange rate of 74.5; O&M cost of Rs. 2.5 laksh per DC MW with annual escalation of 5.0%; Provision for inverter replacement reserve of Rs. 15 lakhs per MW is considered to be built over a 10-year period; BCD of 25% assumed on imported PV cells

- Despite the rise in module prices in the recent months, the bid tariff rates have not witnessed any increase and in fact have witnessed a decline, as seen from the latest bid tariff of Rs. 2.17 per unit discovered in the 1785 MW bid by SECI. This is lower than the Rs. 2.3 – 2.5 per unit seen in the bids since March 2021 (except one bid of Rs. 2.15 per unit in August 2021).
- While this is positive from the off-taker's perspective, the ability of the developers to make these projects viable remains linked with the module price level in the market and the cost of funding. As depicted in the Exhibit above, the availability of debt funding at less than 8.0% along with the ability to source modules at less than 24 cents/watt.

Wind tariffs remain range bound between Rs. 2.7 - 2.9 per unit

EXHIBIT 30: Trend in competitive bid based wind tariffs



Source: ICRA Research

- The implementation of the tariff-based bidding along with expectations of higher PLF has led to a significant reduction in wind energy tariffs compared to a feed-in tariff regime (Rs. 4-6 per unit), thereby improving the cost competitiveness of wind-based generation. While the tariffs reached an all-time low of Rs. 2.43 per unit December 2017, there has been an increase thereafter and the tariffs have remained largely in the range of Rs. 2.7-2.9 per unit, with few exceptions like the latest tender in Maharashtra. This is owing to the higher execution risks, challenges in securing sites with high wind potential and securing supply of WTGs from OEMs. Nonetheless, the tariff continue to remain competitive and much lower than the tariffs under the feed in tariff regime.

Viability of quoted wind tariffs linked to achieving PLF > 30%

Exhibit 31: Sensitivity of cumulative DSCR to PLF and interest rate for a wind power project with tariff of Rs. 2.8 per unit and P-90 PLF of 32%

Cumulative DSCR		Interest rates					
		8.5%	9.0%	9.5%	10.0%	10.5%	11.0%
PLF (%)	24%	0.96	0.93	0.90	0.87	0.85	0.83
	26%	1.06	1.03	1.00	0.98	0.95	0.92
	28%	1.16	1.13	1.10	1.07	1.05	1.02
	30%	1.26	1.23	1.20	1.17	1.14	1.11
	32%	1.36	1.32	1.29	1.26	1.23	1.20
	34%	1.45	1.42	1.38	1.35	1.32	1.29

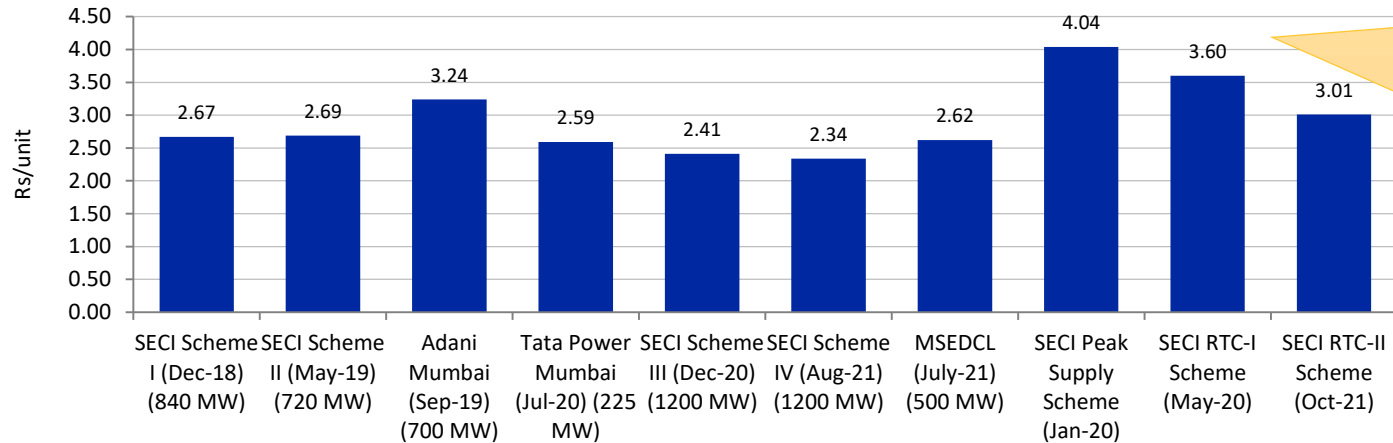
Source: ICRA Research; Capital cost of Rs. 7 crore per MW and O&M cost of 9 lakhs per MW escalating at 5%; Tariff at Rs. 2.8 per unit and debt repayment over 18 years



As illustrated in the exhibit here, the credit metrics for a wind power project remains highly sensitive to its PLF level. For a project with a tariff of Rs. 2.8 per unit and having PLF estimate of 32%, a 100 bps reduction in PLF level would impact the debt service coverage ratio of the project by 4-5 bps. Considering a 15-20% reduction in generation, as observed in few major states in FY2021, the DSCR would get impacted by 25-30 bps and remain closer or slightly higher than 1.0x depending on the interest rates. This is the typical delta seen between the P-90 PLF and the breakeven PLF for wind power projects.

Successful implementation of RTC projects would accelerate RE adoption

EXHIBIT 32: Trend in competitive bid based tariffs for hybrid projects



Competitive tariffs discovered under the RC tenders is a boost to the RE sector; demonstration of viability remains important

Source: ICRA Research

- The competitive tariffs discovered under the hybrid plus RTC tenders is a boost for the RE sector, given that the availability of peak / RTC supply from wind and solar projects using suitable storage system reduces the risk of variability and enables an efficient grid integration for renewables. The tariffs quoted by the winning bidders under these tenders remain lower than the cost of generation for recently commissioned as well as new thermal power projects. The demonstration of viability of the RE projects with peak/RTC supply would accelerate the growth of the RE sector in the country.