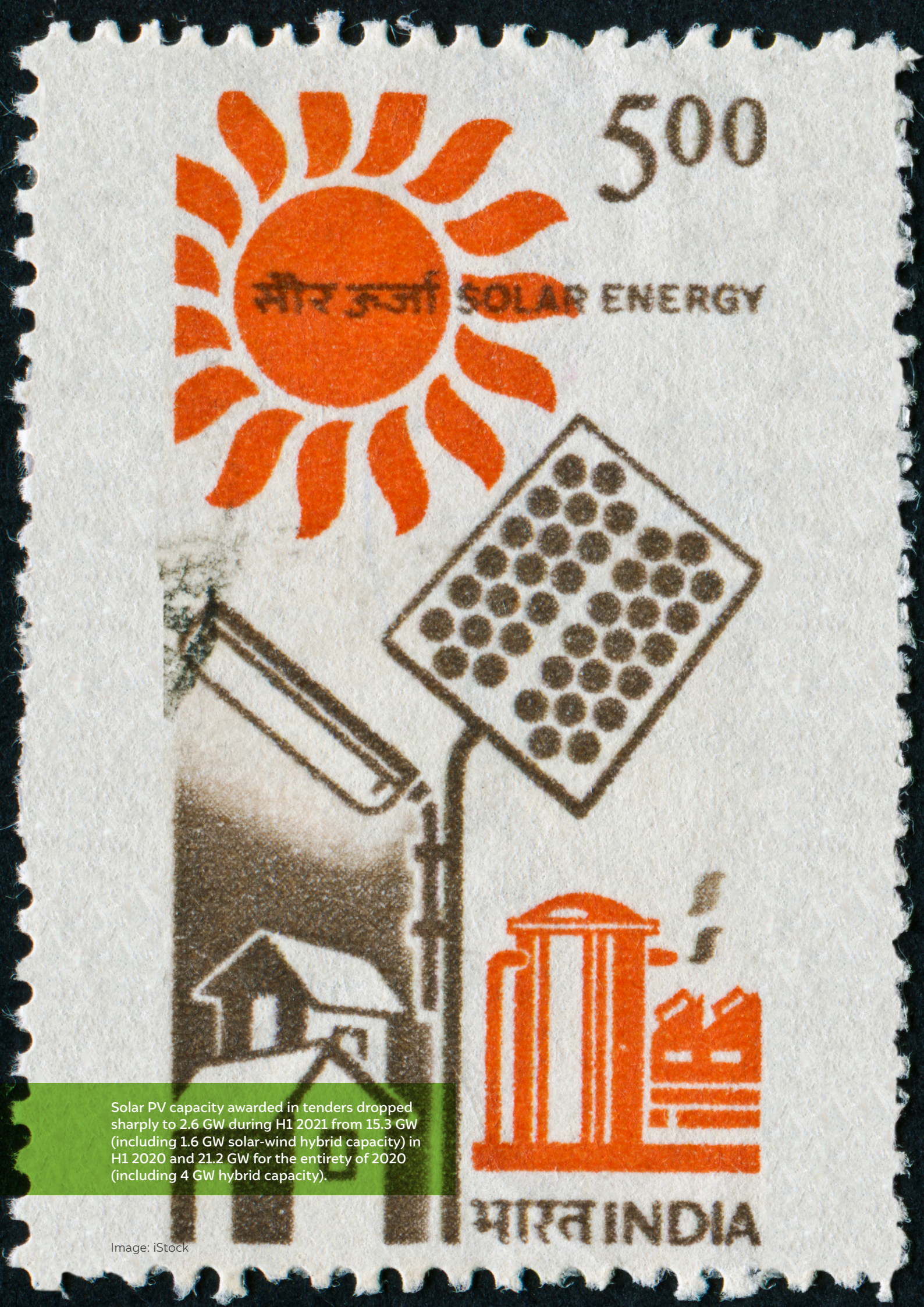
Clean Energy Investment Trends 2021

Evolving Financial Performance Expectations & Power Procurement Mechanisms In India

Edition authors: Arjun Dutt, Pablo Gonzalez, Nikhil Sharma, Lucila Arboleya, and Ruchita Shah

Series editors: Gagan Sidhu and Michael Waldron

Report | December 2021



Solar PV capacity awarded in tenders dropped sharply to 2.6 GW during H1 2021 from 15.3 GW (including 1.6 GW solar-wind hybrid capacity) in H1 2020 and 21.2 GW for the entirety of 2020 (including 4 GW hybrid capacity).

Image: iStock

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No new wind capacity was awarded in 2020.
Only 1.2 GW was awarded in H1 2021.

Image: iStock

Contents

A 20% increase in realised solar module prices from those assumed in the most competitive tariff bids could lower equity returns by around 45%.

Image: iStock

Tables

Figures

Boxes

Weighted average equity internal rate of return (EIRR) expectations for solar PV declined to 13.3% in H1 2021 from 14.9% in 2020 (nominal terms).

Image: iStock

About CEEW-CEF and IEA Clean Energy Investment Trends

The *Clean Energy Investment Trends* series provides a unique benchmark for monitoring and assessing progress in the investments required to meet India's sustainability goals. Now in its fourth edition, this joint project of the Council on Energy, Environment and Water's Centre for Energy Finance (CEEW-CEF) and the International Energy Agency (IEA) continues to evolve to better track the key market, investment framework and financial performance trends that are central to mobilising capital at scale for renewable energy (RE). It provides insights for policymakers, industry actors, and financiers on the critical risks and opportunities for investment, as well as draws implications for future policy action and business decisions.

Themes examined in the *Clean Energy Investment Trends 2021* report

The Indian utility-scale RE sector was characterised by contrasting fortunes in 2020 and the first half (H1) of 2021. Interest to invest remained robust even amid the COVID-19 disruption with solar PV and hybrid solar-wind capacity awarded rising 35% year-over-year to 21 GW in 2020. However, capacity awarded plummeted to 2.6 GW in H1 2021 as a backlog of unsigned power sales agreements (PSAs) held up the tendering of new capacity. In parallel, the awards of new wind capacity came to a standstill in 2020 and remained sluggish in H1 2021 amid subdued tendering activity. The RE sector has witnessed considerable innovation in tender design, largely geared towards easing the integration of variable renewable power. The sector also saw increased participation from central public sector undertakings (CPSUs) as well as new international independent power producers (IPPs) which drove solar tariffs fell to a record low of INR 1.99/kWh even amid considerable volatility in commodity prices.

These developments have intensified the scrutiny on the returns associated with the Indian RE sector. To shed light on these matters, the *Clean Energy Investment Trends 2021* report analyses project-level equity returns expectations associated with plain vanilla assets over the period July 2020 - June 2021 as well those corresponding to select hybrid projects. It endeavours to contextualise these returns expectations by comparing them with those in other geographies and examines their sensitivities to solar photovoltaic (PV) module prices, which are now subject to increased volatility. The report also examines land-related challenges inhibiting the utility-scale RE sector and offers updates on debt financing and other key market trends.

Key findings

The *Clean Energy Investment Trends 2021* analysis identified the following key trends:

- **The pricing of project debt finance for solar photovoltaic (PV) and wind has declined in the period of analysis enabled by accommodative monetary policy and the increased participation of central public sector undertakings (CPSUs) and new international independent power producers (IPPs) in tenders.** The interest rates for solar PV and wind project debt fell by around 100 basis points to a range of 9.25-10.00 per cent in the period July 2020 to June 2021 from prominent non-banking financial companies (NBFCs), with even cheaper debt available from banks (8.75-9.50 per cent). This was primarily because the Reserve Bank of India maintained an accommodative monetary policy to support the domestic economy amid the disruption caused by the COVID-19 pandemic. In addition, CPSUs and international IPPs have brought in low-cost debt from other sources. Compared with domestic IPPs, CPSUs can access lower-cost debt from the bond market owing to their quasi-sovereign status, while international IPPs can tap into a wider diversity of debt financing sources.

- **Equity internal rate of return (EIRR) expectations for solar PV declined to 13.3% in H1 2021 from around 14.9% in 2020 (nominal terms).** Average EIRRs decreased by over 150 basis points in H1 2021 compared to the full year 2020. Greater participation of CPSUs, most prominently

NTPC and Satluj Jal Vidyut Nigam (SJVN), and international IPPs in tenders led to record low tariffs of INR 2/kWh and EIRRs of around 12.0 per cent in November-December 2020. In addition to the continued participation of these players, discoms' desire for low tariffs amid rising input costs also put pressure on average returns over H1 2021. CPSUs and international IPPs, which have access to lower cost debt, may be at an advantage under these market conditions.

- **Solar PV capacity awarded in tenders dropped sharply to 2.6 GW during H1 2021 from 15.3 GW (including 1.6 GW solar-wind hybrid capacity) in H1 2020 and 21.2 GW for the entirety of 2020 (including 4 GW hybrid capacity).** The pace of solar capacity awards slowed considerably in 2021 as a result of a backlog of unsigned power sales agreements (PSAs) with the Solar Energy Corporation of India (SECI) of around 20 GW towards the end of 2020. These PSAs correspond to capacity awarded at relatively higher tariffs compared to average solar tariffs in recent times.

- **Wind capacity awarded continues to be limited, with no new projects awarded in 2020 and only 1.2 GW in H1 2021.** A combination of the limited tendering of fresh capacity and challenges with the availability of suitable sites for setting up projects has limited the scale of wind capacity awarded.

- **Our first analysis of returns expectations for solar-wind hybrid projects reveals higher initial EIRRs than those for plain vanilla tenders, though expectations have converged over time.** The Indian RE sector is witnessing increased innovation in procurement. While plain vanilla tenders (i.e., for single technology projects) have helped India scale renewables deployment, the country has introduced innovative tender designs to reduce output variability and facilitate RE grid integration. The analysis of solar-wind hybrid tenders (without storage) in this report indicates that the returns expectations associated with a hybrid tender awarded in January 2020 were around 400 basis points higher than comparable vanilla tenders. However, returns expectations converged with vanilla tenders by the end of 2020.

- **Volatility in capital costs, especially solar PV module prices, pose a significant downside risk to realised returns.** Rising PV module prices, driven by higher raw material and transportation costs, could significantly lower realised returns compared to expectations. Our analysis indicates that a 20 per cent increase in realised module prices from those assumed in the most competitive tariff bids could lower equity returns by around 45 per cent. Besides supply chain factors, the Government of India's decision to levy basic customs duty (BCD) on cell and module imports starting April 2022 is likely to prompt several developers to advance their module purchases to beat the deadline, which may further increase the upward pressure on module prices.

- **If challenges related to reliability of power purchase and timely availability of land and transmission capacity can be addressed, EIRR expectations in India could be lowered by around 350 basis points.** To understand how India's renewable energy sector compares with international markets, we assessed spreads between EIRRs and benchmark sovereign bond yields across markets, which isolated sectoral risks from underlying country and currency risks. Higher sectoral risks in India have kept return expectations 320 basis points higher than in the United States and 360 basis points higher than in China.

- **The industry market concentration for solar PV development increased notably in 2020 and H1 2021, because of a few players securing a large share of the capacity awarded, greater participation of CSPUs, and low capacity auctioned in H1 2021.** Despite new players entering the market, including Indian and international developers, market concentration reached the highest level seen in the last seven years. Churn rates (the extent of change in the top 10 developers with respect to the previous year) also rose, indicating that the players dominating capacity awards in the solar PV space are not consistently the same year-on-year.

- **Acquisitions of renewable power companies and assets have surged in 2021, topping USD 6 billion, reflecting opportunities for greater scale and consolidation.** Access to a robust secondary market helps developers enhance their ability to finance projects by recycling capital and reinvesting it in new projects. Acquisitions also provide a way for developers to realise higher returns by selling operating projects that have been de-risked through the construction phase, and an attractive investment route into renewables for new actors, such as financial investors or investment trusts.

1. Investment trends

The disruptions caused by the COVID-19 pandemic had a considerable impact on India's renewables investment spending in 2020, with capital expenditure of less than USD 10 billion[1]. However, as the economy gradually recovers, investments in renewables in 2021 are set to grow by more than 50%. Solar PV and wind continue to represent the majority of these investments, with around 70% of total spending on renewables in the last 5 years.

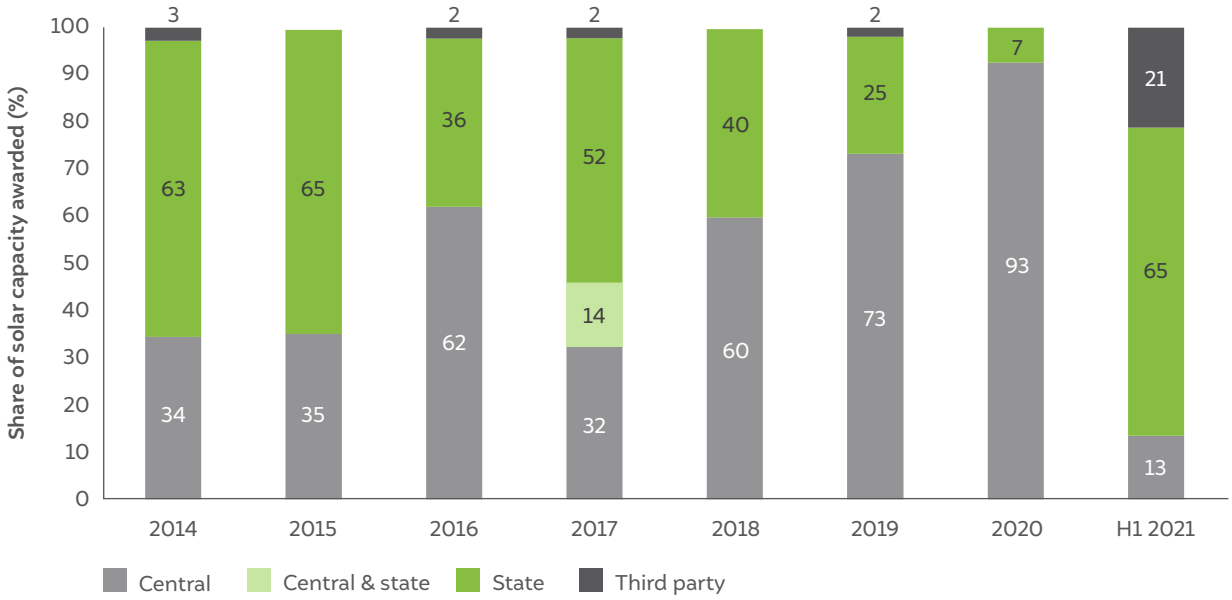
The insights presented in the Clean Energy Investment Trends are derived from a database of utility-scale solar PV and wind projects sanctioned[2] between 2014 and H1 2021. The database indicates that solar PV capacity totalling 21.2 GW (including ~4 GW solar-wind hybrid capacity) was awarded in 2020, around 35% higher than the 15.7 GW solar PV capacity (including 1.4 GW solar-wind hybrid capacity) awarded in 2019. The pace of capacity awards dropped considerably to 2.6 GW[3] in the first half of 2021. With the Solar Energy Corporation of India Limited (SECI), a central government aggregator, accumulating yet to execute power sale agreements (PSAs) totalling ~20 GW by the end of 2020, new solar PV tendering from it dried up[4]. As a result, state tenders accounted for a greater share of capacity awarded and state off-takers dominated capacity awarded in H1 2021 (Figure 1).

The pace of award of plain vanilla wind capacity also dropped considerably, with no new projects awarded in 2020 (though hybrid capacity was awarded) and only 1.2 GW capacity awarded by SECI in H1 2021 (Figure 2). Challenges in securing suitable sites have dogged project development (see section 5). The tendering of wind projects by both state and central authorities was also sluggish during the period of analysis. The possibility of achieving lower tariffs through solar auctions could have played a role in the sluggish tendering of wind capacity and a greater focus on solar instead[4].


Image: iStock

1. Capital expenditures are measured as the ongoing capital spending in power capacity. Investment spending is spread out evenly from the year in which a new plant or upgrade of an existing one takes a final investment decision (i.e. when a project reaches financial close or begins construction) to the year in which it becomes operational. Source: IEA (2021b).
2. Project sanctioning refers to the demonstration of the intent to invest by a developer indicated by the successful award of capacity at an RE auction or an appropriate proxy in case of projects set up under the erstwhile feed-in-tariff regime or captive generation.
3. This figure excludes 6.4 GW capacity awarded under an APEGCL tender in February 2021. The capacity awarded was suspended in July 2021 and was pending a court hearing at the time of writing this report.
4. CEEW-CEF and IEA market intelligence.

Figure 1 State off-taker projects predominantly awarded in H1 2021

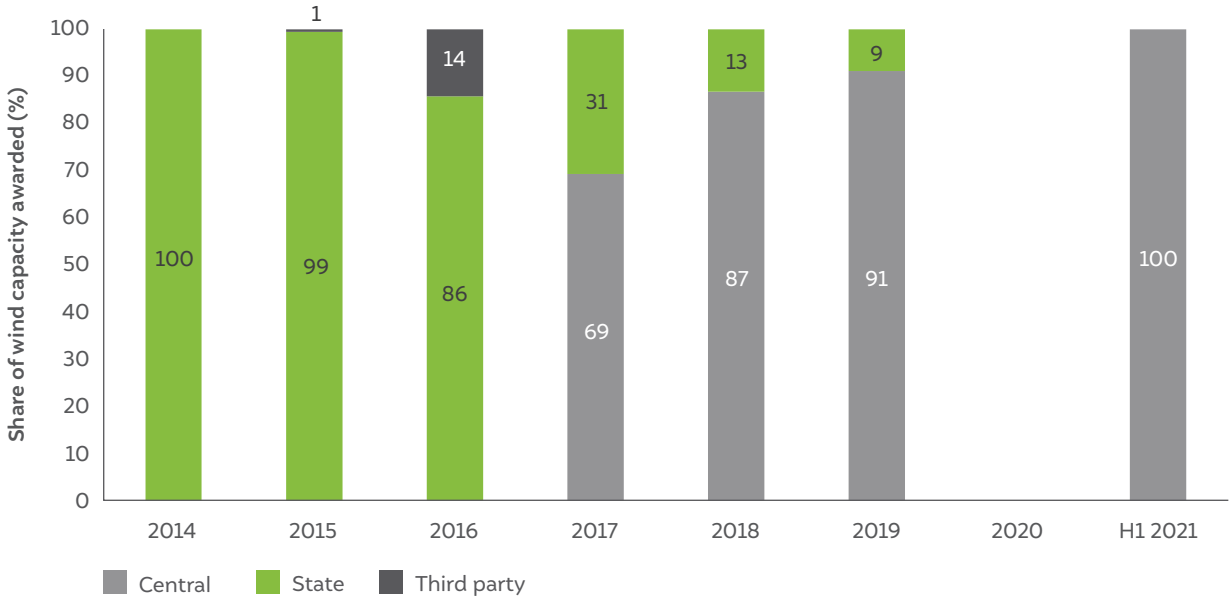


Source: CEEW-CEF and IEA analysis.

Notes:

1. Central = SECI or NTPC, State = state discoms; Central & state = both central and state agencies as off-takers; Third party = private discoms or captive generation; excludes solar–wind hybrids.
2. Third party share in H1 2021 refers to 300 MW auction conducted by Torrent Power Limited (distribution), Gujarat.

Figure 2 Central government off-takers dominate awarded wind capacity



Source: CEEW-CEF and IEA analysis.

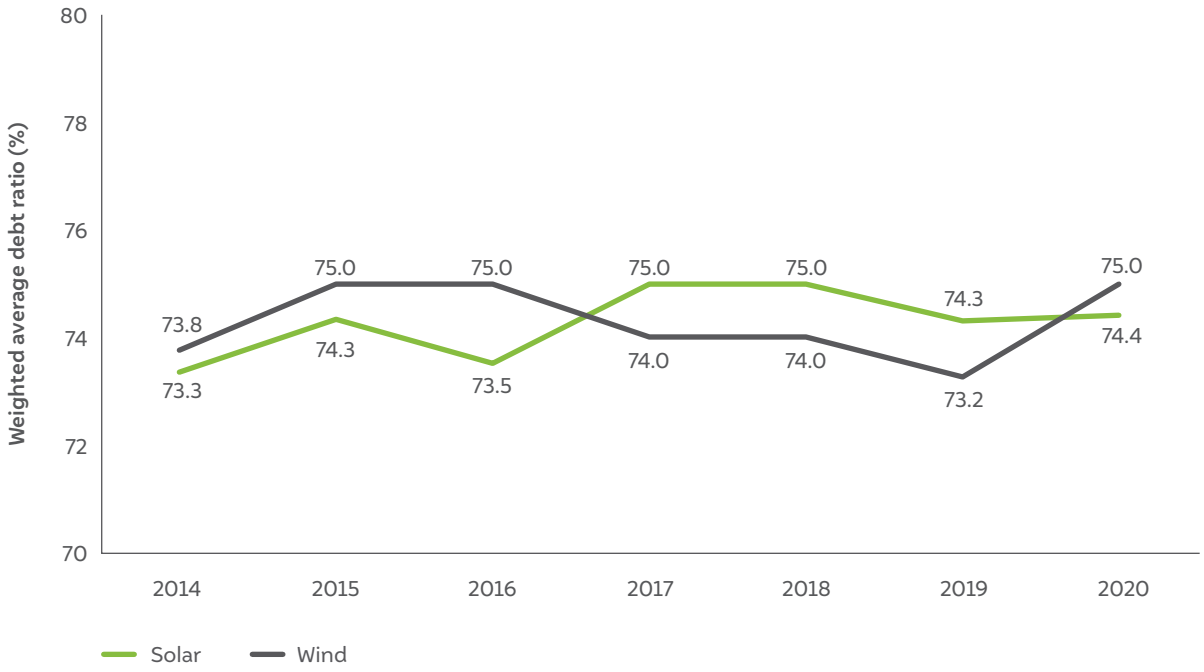
Notes:

1. Central = SECI or NTPC, State = state discoms, Third party = private discoms or captive generation; excludes solar–wind hybrids.
2. Excludes 728.8 MW of wind capacity awarded under *Gujarat Urja Vikas Nigam Limited (GUVNL) 1000 MW Grid Connected Wind Power Projects (Phase II-R)* in 2019 – for which power purchase agreements (PPAs) were not signed.
3. No new wind capacity was awarded in 2020.

2. Project-level terms of debt

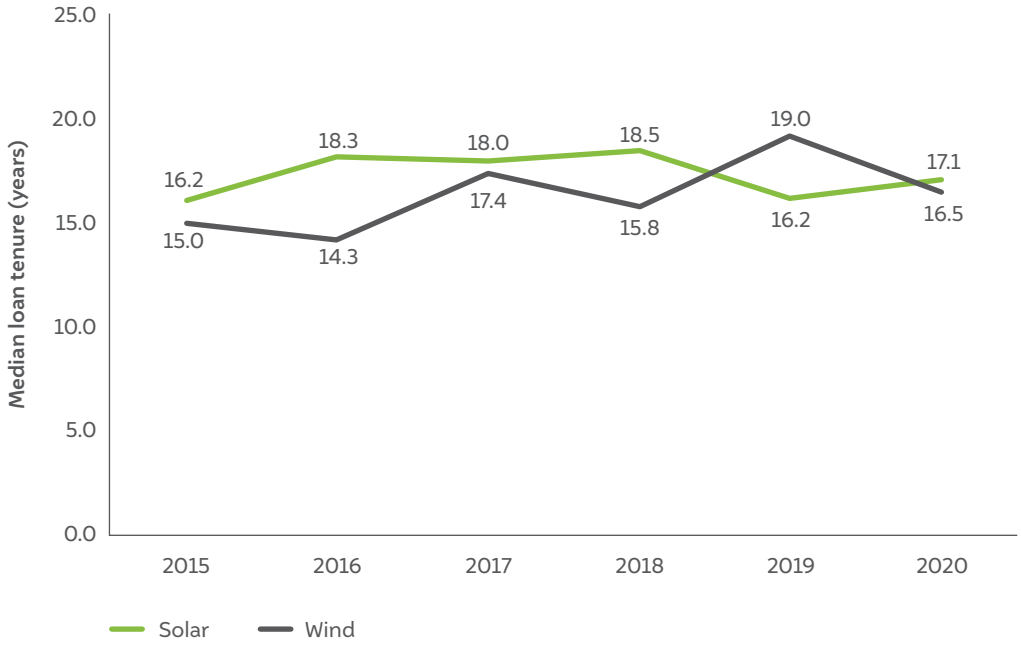
In 2020, the pricing of project-level debt improved slightly, enabled by an accommodative monetary policy and higher participation of central public sector undertakings (CPSUs) in tenders. RE projects continue to access long-tenure debt equivalent to 75 per cent of project costs (Figures 3 and 4).

Figure 3 Debt ratios close to 75 per cent are the norm for both solar and wind projects



Source: CEEW-CEF and IEA analysis.

Figure 4 Median loan tenures for solar and wind are in the 16-18-year range



Source: CEEW-CEF and IEA analysis.

Banks and non-banking financial companies (NBFCs) are the predominant sources of debt finance for greenfield RE projects in India[5]. These institutions examine project-level cash flow risks to determine the terms of debt offered to RE projects. These risk perceptions may be modulated by guarantees or collateral made available by project sponsors, as well as their credit histories. The terms of debt offered will vary depending on the project's riskiness. However, the following characteristics are commonly associated with greenfield RE loans (Dutt, Arboleya, and Gonzalez 2020):

- Long-tenure (Figure 4) floating-rate debt with periodic reset clauses.
- Loan tenures typically include a moratorium period of up to one year after the project's scheduled commissioning date. While interest accrues over this period, loan repayment starts after the expiry of this grace period.
- Debt-service reserve account (DSRA) requirements of typically one to two quarters. The DSRA is a cash reserve set aside to meet debt-servicing requirements for a specified number of months.
- Minimum debt-service coverage ratio (DSCR) requirements of 1.1, although the average DSCR varies. DSCR is the ratio of net operating income available to service the debt (both principal and interest) to the debt-servicing requirements.

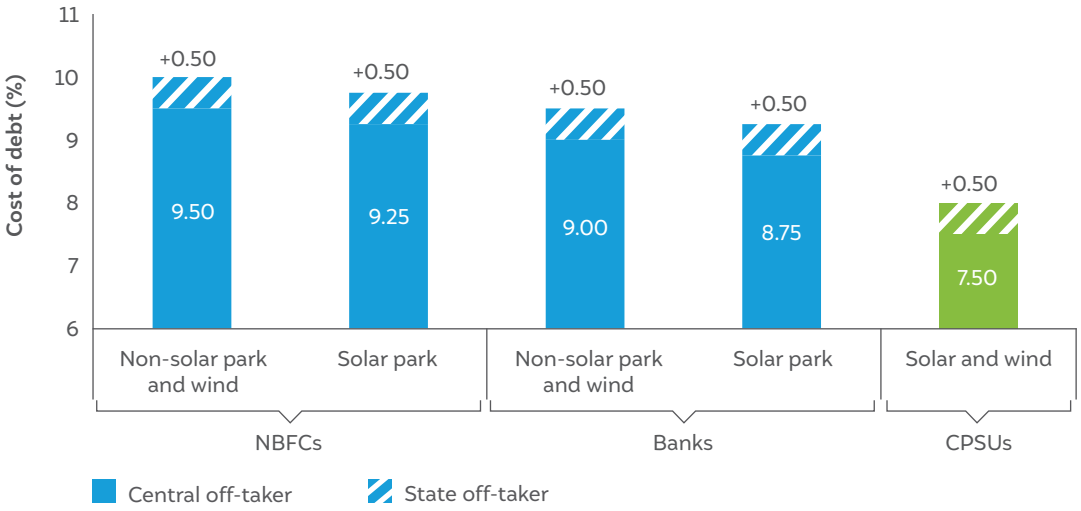
The final cost of debt is the sum of internal benchmark rates (usually the marginal cost of funds based lending rate (MCLR) for banks and the prime lending rate (PLR) for NBFCs) and the spreads over the benchmark rates offered to RE projects. Competition among financial institutions can also drive down the interest rates offered to RE projects.

Over much of the period of analysis, the Reserve Bank of India (RBI) maintained an accommodative monetary policy stance to support the domestic economy in the wake of the macroeconomic disruption caused by the COVID-19 pandemic (RBI 2020a), in line with accommodative monetary policies implemented by central banks globally. The RBI also implemented additional measures such as extending liquidity facilities to key financial institutions and relaxing prudential norms for stressed asset recognition (RBI 2020b). These measures exerted a moderating effect on economy-wide interest rates, as reflected in the benchmark rates of financial institutions[6].

To determine spreads over internal benchmarks, lenders typically assign composite scores to loan proposals. The major factors determining these scores are the creditworthiness of the off-taker, the type of site, and the creditworthiness of the sponsor, taking into consideration any additional corporate guarantees or collateral offered. In this regard, solar parks help ensure the timely availability of land and grid evacuation infrastructure. Controlling for other factors, projects set up on solar park sites command a small advantage (25 basis points) in borrowing costs relative to non-solar park sites (Figure 5). Further, the creditworthiness of off-takers also has a major bearing on interest rates. Controlling for other factors, signing a PPA with less creditworthy state discoms could add up to 50 basis points in borrowing costs relative to projects with central government entities or creditworthy state discoms as off-takers (Figure 5).

5. Market interactions indicate that NBFCs are the dominant source of finance to RE projects overall. However, anecdotal evidence suggests that abundant liquidity in the banking system over the period of analysis meant that banks could have played a greater role than their contribution in recent years.
6. The one-year MCLR of the State Bank of India, India's largest commercial lender by assets, stood at 7% over July 2020 - June 2021 (State Bank of India 2021). This averaged close to 8% over the previous twelve-month period.

Figure 5 CPSUs have access to the lowest-cost debt while market players pay a debt premium for projects with less creditworthy state off-takers



Source: CEEW-CEF and IEA market intelligence.

Note: The bar for CPSUs indicates the range for the cost of debt factored in, regardless of off-taker or type of site.

While domestic financial institutions are the major source of debt capital for the Indian renewables sector, some international IPPs as well as a few domestic IPPs access debt from international markets for greenfield projects. While this debt in foreign currency terms is generally considerably cheaper than that accessible in India, the gap narrows when factoring in hedging costs. Further, a number of CPSUs are now actively bidding for projects. These state-owned enterprises typically access the bond market for their capital requirements at costs close to those corresponding to the Government of India's sovereign borrowings (~6.0-6.5%) (Economic Times 2021). However, given the longer tenure of renewable energy projects compared to that of bond market borrowings, slightly higher costs of debt are factored into project-level financing assumptions. Figure 5 summarises the cost of debt assumptions factored into the analysis[7].

3. Project-level equity returns

While utility-scale solar and wind projects are largely financed through debt (Figure 3), equity accounts for around a quarter of project costs. Debt obligations are serviced first from project cash flows and are secured by covenants associated with debt repayment (refer to Section 2), thus creating greater certainty over debt repayment. Given the relatively junior position of equity in the cash flow waterfall, equity investors' returns expectations are higher than those for debt financiers.

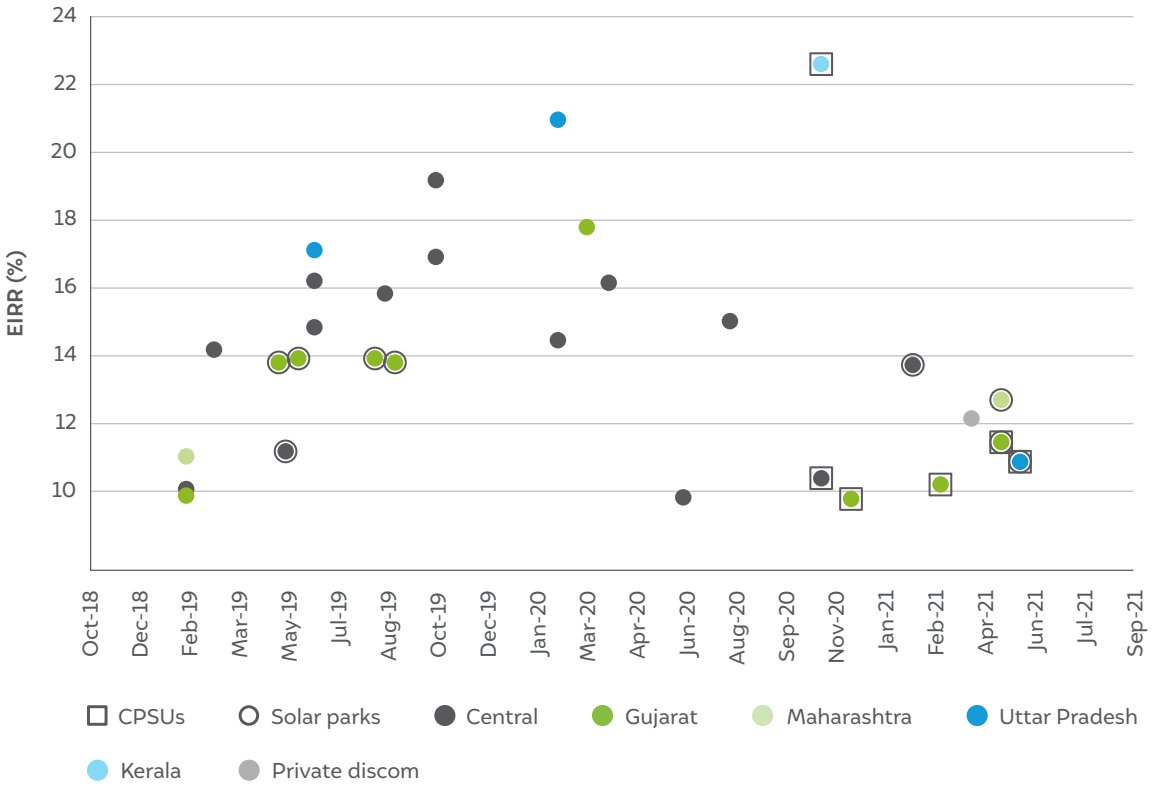
This section examines the project-level equity internal rate of return (EIRR) expectations factored into RE tariff bids. The EIRR expectations of plain vanilla tenders (i.e., exclusive solar or wind tenders without storage) is estimated through a discounted cash flow analysis factoring in the associated tariffs, estimated project costs, production parameters, and indicative terms of debt (Dutt, Arboleya, and Gonzalez 2020). Annexures 3 and 4 present the methodology and the input data assumed in the project-level cash flow model.

3.1 Aggregate EIRR expectations for plain vanilla tenders

The analysis of utility-scale solar PV projects in the *Clean Energy Investment Trends 2021* report indicates that EIRR expectations for these projects declined from 14.5 per cent in the second half of 2020 to 13.3 per cent in H1 2021 (estimated on a capacity-weighted average basis, based on awarded capacities). Factoring in implicit EIRRs of 15.3 per cent for H1 2020 from last year's report results in EIRRs of 14.9 per cent for the entirety of 2020. This is still slightly lower than our estimate of 15.2 per cent for 2019.

7. CEEW-CEF and IEA market intelligence.

Figure 6 EIRRs have generally fallen over the course of 2020 and 2021



Source: CEEW-CEF and IEA analysis.

Note: The Kerala State Electricity Board (KSEB) tender of November 2020 witnessed limited participation from developers and the tariff discovered (INR 2.97/kWh) was close to the ceiling tariff applicable to the tender. Thus, the equity IRR for that tender is an outlier.

The decline in EIRRs can be attributed to aggressive bidding by CPSUs and international IPPs for projects awarded in November and December 2020 resulting in the discovery of record-low tariffs of INR 2.00/kWh and INR 1.99/kWh. International IPPs benefit from access to cheaper credit from international markets, while CPSUs have the ability to secure cheaper debt as a result of their status as quasi-sovereign entities. Furthermore, discom expectations of low-priced renewable power coupled with rising input costs could have had a moderating effect on equity returns factored into tariff bids.

Enhanced participation of public-sector enterprises

The enhanced participation of CPSUs (which were awarded capacity in 6 out of 10 tenders) over the period of analysis stems from corporate decisions to green asset portfolios by adopting RE deployment targets (Table 1). This participation drove aggressive bidding across tenders and led to lower EIRR expectations from November 2020 onwards.


Image: iStock

Table 1 Current RE installed capacity and targets of NTPC, SJVN, and Coal India Limited

CPSU	Installed RE capacity (GW)	Capacity under implementation (GW)	RE Target
NTPC	1.35	2.84	60 GW by 2032
SJVN	0.1	0.15	5 GW by 2023 12 GW by 2030 25 GW by 2040
Coal India Limited	0.01	NA	3 GW by 2024

Source: CEEW-CEF and IEA analysis.

Notes:

1. Installed capacity and capacity under implementation are accurate as of March 2021.

2. RE capacity under implementation for Coal India Limited has not been disclosed in its annual reports.

NA: Not applicable.

Given the draft proposal by the government to permit CPSUs to factor in lower hurdle rates while bidding for projects, the continued participation of CPSUs in the future could exert a moderating influence on equity returns going forward (Dutta 2021). This raises the possibility of the potential crowding out of other developers with higher returns requirements.

Discom tariff expectations and rising input costs

The decline in solar and wind tariffs discovered in recent years has influenced discom expectations of the pricing of renewable power and their willingness to sign new contracts. The challenges faced by SECI in securing PSAs for ~20 GW of solar capacity awarded in 2020, including the 12 GW capacity awarded at INR 2.92/kWh under its manufacturing-linked tender, illustrate the potential pitfalls of high-tariff capacity awards. For example, SECI failed to secure off-takers for a ~6GW tranche out of the unsold inventory of 20 GW capacity priced at a pooled tariff of INR 2.66/kWh for over a year before signing a PSA with Odisha's GRIDCO for a portion of this capacity in July 2021 (Duggal 2021).

Lower pricing expectations coupled with the rising costs of PV modules and metallic commodities could also have contributed to a moderation in equity returns expectations (refer to Section 4 for a discussion on input costs). The imposition of 40 per cent basic customs duties (BCD) on module imports and 25 per cent BCD on solar cell imports starting April 2022 is set to raise input costs going forward. However, bidders have reportedly not factored in duties in the tenders analysed up to June 2021 and expect to procure modules before the BCD kicks in (Ranjan 2021) (Nair 2021)[8].

Equity IRR of wind power projects

The pace of wind project sanctioning remained subdued during the period of analysis amid limited tendering of new capacity. With solar auctions yielding lower tariffs, a preference for solar capacity by discoms could have played a role in the sluggish tendering of wind capacity[9]. In addition, challenges with the availability of sites for setting up projects could also have constrained the tendering of new capacity (refer to Section 5 for details). The solitary 1.2 GW SECI Tranche-X tender was awarded in March 2021, with no capacity throughout 2020. The EIRR expectations for this tender stood at 12.7 per cent, which is comparable to the 13.0 per cent average observed in 2019.

> **Wind EIRR expectations stood at 12.7% for H1 2021, with no wind capacity awarded in 2020.**

8. CEEW-CEF and IEA market intelligence.

9. ibid.

BOX 1 Assessing the relative attractiveness of the Indian RE sector

The EIRR expectations of solar PV projects in India appear high when compared to other countries. The average EIRR for utility-scale solar PV projects awarded in 2020 was over two times higher than, for instance, the corresponding figure for the United States — 14.9 per cent compared to 6.4 per cent. However, this comparison merits further unpacking.

When evaluating projects across countries, investors factor in multiple risks, including:

- **Country risk**: the extent of favourableness of economy-wide business conditions, including political stability, strength of the rule of law, ease of doing business and sovereign indebtedness.
- **Currency and inflation risk**: the risk of foreign exchange fluctuations, domestic inflation, convertibility rules and lower returns for international investors stemming from the depreciation of the local currency (in which project cash flows are denominated) relative to the reporting currency of the project developer.
- **Sectoral risk**: risks specific to the sector in which the investment is made. For the RE and power sector, this includes off-taker risk, land and transmission infrastructure risk, operational risk, and technology risk. Of these, technology and operational risks do not have a major bearing on sectoral risks as solar PV is a well-understood technology with an extensive track record and minimal operations and maintenance requirements.
- **Liquidity risk**: The risk of investing in an illiquid infrastructure asset – a RE project – as compared to liquid sovereign benchmark securities.

This box contextualises how EIRR expectations of utility-scale solar PV projects in India can be compared with those in other countries (the United States and China), that have cash flows denominated in different currencies. We do this by comparing the spread or difference between the EIRR and local currency sovereign bond yields. We also comment on the role of currency hedging for these long-term infrastructure projects in India, a market that lacks depth and liquidity, but is growing.

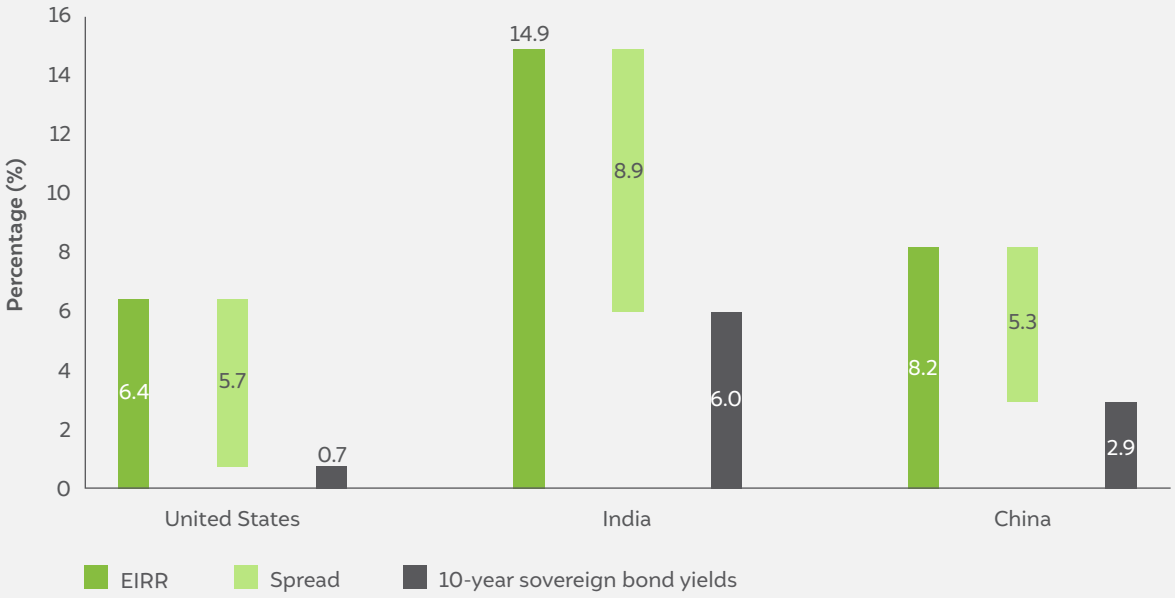
Comparing spreads from local risk-free rates

The local currency sovereign bond yield (e.g. 10-year government bond) factors in the country and currency risks associated with investing in RE projects. The 10-year sovereign bond yield averaged 6.0 per cent over 2020 in India, 0.7 per cent in the United States and 2.9 per cent in China (Bloomberg, 2021). The difference or spread between project-level EIRR expectations and the 10-year sovereign bond yields captures sectoral and liquidity risks (Figure 7).

Assuming similar perceptions regarding liquidity, technology, and operational project risks, the difference in spreads in India compared to international markets (320 basis points [bps] higher than the spread in the United States and 360 bps higher than in China) reflects higher off-taker risk as well as challenges with land availability and transmission constraints.

The implication is that investor returns expectations in India could be lowered by a magnitude corresponding to these spreads if challenges such as the poor financial condition of distribution utilities, and challenges associated with the timely availability of land and transmission can be addressed.

Figure 7 Higher spreads between EIRRs and sovereign bond yields in India indicate higher sectoral risks



Source: CEEW-CEF and IEA analysis.

Note: EIRRs and bond yields correspond to average values for 2020.

Incorporating hedging costs

Currency risk is a challenge for international investors as a part of the upfront investment costs are denominated in international currencies (eg. imported modules), while project cash flows are denominated in local currencies. This is a greater concern for foreign players investing in developing countries with borrowings associated with the RE assets being denominated in foreign currencies.

One way investors can safeguard themselves against currency risk is through hedging arrangements that help fix the exchange rate between local currency denominated cash flows and the international currency denominated borrowings. The investor pays for the protection that the hedging arrangement offers against currency risk for a particular period of time. This risk, along with off-taker risk, is the largest perceived risk for RE projects in India for foreign investors (Shrimali 2021).

The INR-hedging market is illiquid and generally provides hedging alternatives for no longer than a year with some medium-term exceptions; further, it is limited to a few hard currencies, and generally provides very simple hedging services, with substantial regulation (Tilotia 2020). It can also be very costly. Anecdotal evidence suggests that the cost of hedging in India can be around 300–400 bps (assuming a one-year forward swap contract that is periodically rolled over).

Providing longer-term and lower-cost hedging solutions would help boost foreign RE investments in India. Given that currency risk is, to a large extent, a result of domestic macroeconomic conditions, the Government of India plays an important role in terms of risk management. International efforts, like those of development finance institutions, are also focusing on ways to manage local currency risks for clean energy projects, in part through dedicated facilities backed by development finance institutions. Enhanced efforts on the part of both domestic and international actors could help reduce the overall cost of capital and subsequently enable RE deployment at a lower cost.

3.2 EIRR expectations for hybrid tenders

The contribution of solar PV and wind to India's power sector has risen steadily over the years. These sources now account for nearly 20 per cent of India's installed capacity and 10.5 per cent of total generation, which are twice the corresponding values in 2014. This trend is set to accelerate as India pursues its goal of installing 500 GW of RE capacity by 2030. In its *Stated Policies Scenario* (STEPS), the IEA estimates that wind and solar PV will account for more than 40 per cent in total installed capacity and around a quarter of total generation by 2030 (the Government of India announced a target of 500 GW by 2030 at COP26. However, the IEA's analysis is based on the previous target of 450 GW) (IEA, 2021).

However, such high variable RE penetration in the electricity system will entail a massive increase in balancing requirements. In STEPS, the hour-to-hour variation in wind and solar output will create growing pressure on the rest of the power system to balance supply and demand, with hourly variations in these RE sources set to increase more than threefold by 2030.

In response to the challenge of integrating larger quantities of variable RE into the grid, authorities across the world have introduced varied mechanisms, including short term markets to optimise balancing requirements or a more intense electricity trade between regions or states. In India, tendering authorities have innovated with tender design in the form of solar and wind hybrid tenders that seek to leverage the complementarities in their generation profiles to yield more predictable electricity generation overall. More complex tenders, which require the deployment of solar and wind in tandem with storage or other generation technologies have also been floated. These mechanisms indirectly shift the onus of balancing onto the developer.

In addition to plain vanilla solar and wind tenders, this report also analyses the returns associated with solar-wind hybrids. These tenders have specific requirements related to project performance and configuration that need to be satisfied, which have been factored into the analysis (Table 2).

Table 2 Underlying conditions for hybrid tenders

Tender name	Sanctioning date	Capacity	Capacity utilisation factor (CUF)	Oversizing[b]	Location
AEML Hybrid 250 MW 2019[a]	January 2020	Minimum solar (AC) or wind capacity of 33% of the contracted capacity	Minimum annual CUF of 50%	Allowed to oversize hybrid capacity (solar and wind combined) beyond the contracted capacity	Anywhere in India; solar and wind components to be located in the same state
Blended Wind 2,500 MW Tranche-IX	August 2020	Minimum wind capacity of 80% of the contracted capacity with no minimum capacity required for solar	Minimum annual CUF of 30%	Not allowed to oversize hybrid capacity (solar and wind combined) beyond the contracted capacity	Anywhere in India; solar and wind components to be either co-located or in the same vicinity
SECI Hybrid 1,200 MW Tranche-III 2020	December 2020	Minimum solar (AC) or wind capacity of 33% of the contracted capacity	Minimum annual CUF of 30%	Allowed to oversize hybrid capacity (solar and wind combined) beyond the contracted capacity	Anywhere in India; solar and wind components to be located in the same state

Source: CEEW-CEF and IEA analysis.

Notes:

a. An additional 350 MW was awarded under a greenshoe option for the AEML 350 MW hybrid auction in 2019, taking the total capacity awarded to 700 MW.

b. Oversizing refers to the installation of higher power generation capacity behind the meter compared to the contracted capacity to meet the minimum CUF requirements. However, the AC connectivity and power injection into the grid correspond to the contracted capacity.

Table 3 Site assumptions for hybrid tenders

Tender name	Location
AEML Hybrid 350 MW 2019*	Fatehgarh, Rajasthan (solar CUF - 28.9% @ 45% DC overloading; wind CUF - 32.9%)
Blended Wind 2,500 MW Tranche-IX	Gadag, Karnataka (solar CUF - 27.7% @ 45% DC overloading; wind CUF - 39.0%)
SECI Hybrid 1,200 MW Tranche-III 2020	Fatehgarh, Rajasthan (solar CUF - 28.9% @ 45% DC overloading; wind CUF - 32.9%)

Source: CEEW-CEF and IEA market intelligence.

*Note: For the AEML Hybrid 350 MW 2019 tender, an additional 350 MW was awarded under a greenshoe option, taking the total capacity awarded to 700 MW.

Power generation in a hybrid project, typically oversized beyond the contracted capacity, is constrained in terms of the maximum power (in MW) that can be injected into the grid. In other words, tender conditions require a hybrid project to back down or curtail power generation during time slots when the total solar and wind power injected (in MW) is higher than the contracted capacity. In addition, a hybrid project may generate energy in excess of that corresponding to the CUF declared at its commissioning. Tender conditions allow for the sale of this excess generation, solely at the off-taker's discretion and at 75 per cent of the PPA tariff for the tenders specified in Table 2. Since there is no certainty relating to the offtake of the excess generation, the analysis did not factor in any income for the excess generation.

A detailed step-by-step analysis of the AEML 350 MW hybrid tender is presented below to illustrate the process followed to calculate the returns expectations associated with all three hybrid tenders.

3.2.1 Choice of location

While a developer is free to locate the hybrid project anywhere in India, factors such as minimum CUF requirement, the appropriate solar–wind configuration, land and grid connection availability govern site selection. CEEW-CEF and IEA's analysis of returns associated with plain vanilla tenders in India indicates that higher returns may be realised at the same tariff using solar PV as compared to wind.

Industry interactions corroborated this finding – solar-heavy configurations are suitable for hybrid projects that generate at CUFs of up to 50 per cent. Developers favour the solar-rich state of Rajasthan to maximise generation and returns. Industry interactions further indicated that wind-heavy configurations are favoured for hybrid projects required to generate at higher CUFs. Thus, the preferred sites for these projects are located in the wind-rich states of Tamil Nadu, Karnataka, and Maharashtra.[10]

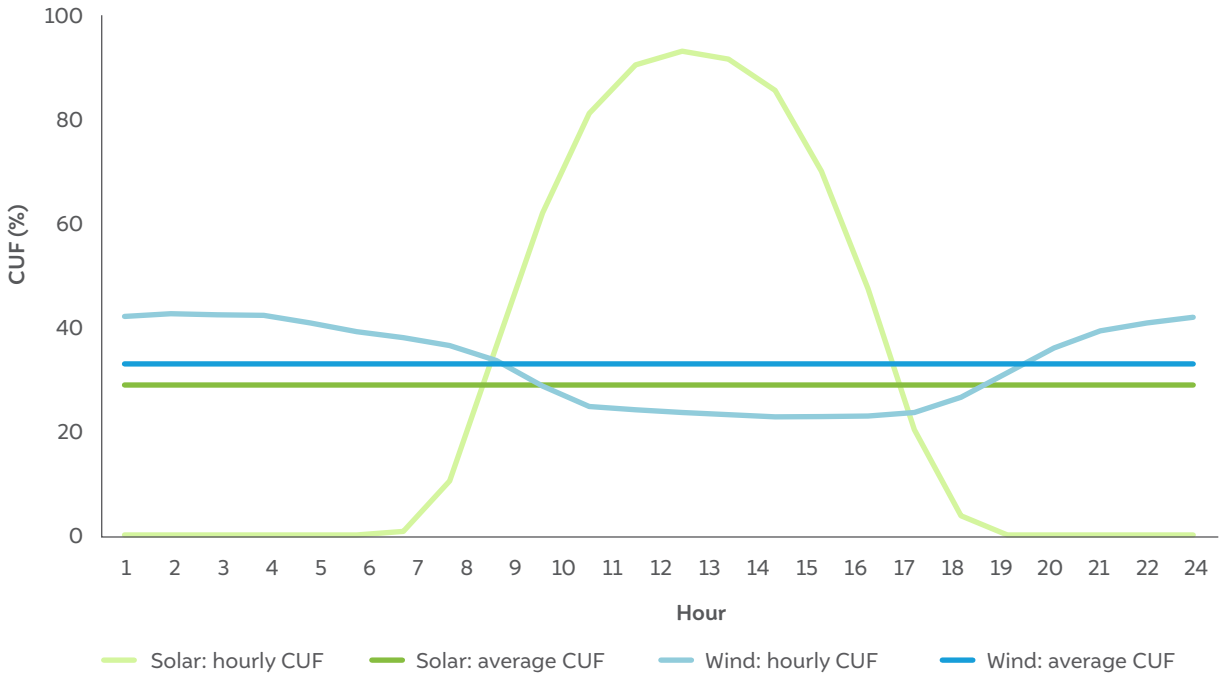
Industry interactions indicated the selection of the project locations for the lowest tariff bidders as mentioned in Table 3. This was corroborated by public records of transmission connectivity granted at these sites by Power Grid Corporation of India Limited – the central transmission utility that operates the Inter-State Transmission System (ISTS) – for generation capacities corresponding to those associated with the hybrid projects (Power Grid Corporation of India Limited 2021).

Determining the optimum configuration

Various combinations of solar and wind deployment can meet the performance conditions outlined in Table 2. The analysis assumes that the developer would select the specific configuration that maximises equity returns for actual deployment. Figure 8 shows the average daily CUFs of stand-alone solar PV and wind in Fatehgarh, Jaisalmer district, Rajasthan.

10. Sites in Gujarat, one of the most resource-rich Indian wind states, remain inaccessible due to the challenges described in section 5.

Figure 8 Solar and wind have similar average CUFs but very different hourly production profiles[11]



Source: CEEW-CEF and IEA analysis.

Given the performance requirements of the AEML 350 MW hybrid tender, solar-heavy combinations (with oversizing to meet tender performance requirements) should a priori be more profitable. However, increasing the extent of oversizing of solar PV to meet the CUF requirements of the tender leads to curtailment around mid-day, when hourly CUFs are near their maximum, negatively impacting equity returns. Thus, there is a point at which adding wind begins to be more profitable than adding solar PV, as additional solar PV would result in higher curtailment without significantly higher overall CUFs.

To identify the optimal combination of wind and solar PV to maximise returns for investors, we estimate returns for all possible configurations using an algorithm that performs the following functions:

i Computes hourly electricity generation for the selected configuration using site-specific generation profiles and estimates the resulting annual average CUF and curtailment (if any) to conform to tender requirements. Curtailed power generation is defined as the excess generation in time slots when the total solar and wind power injected is higher than the contracted capacity.

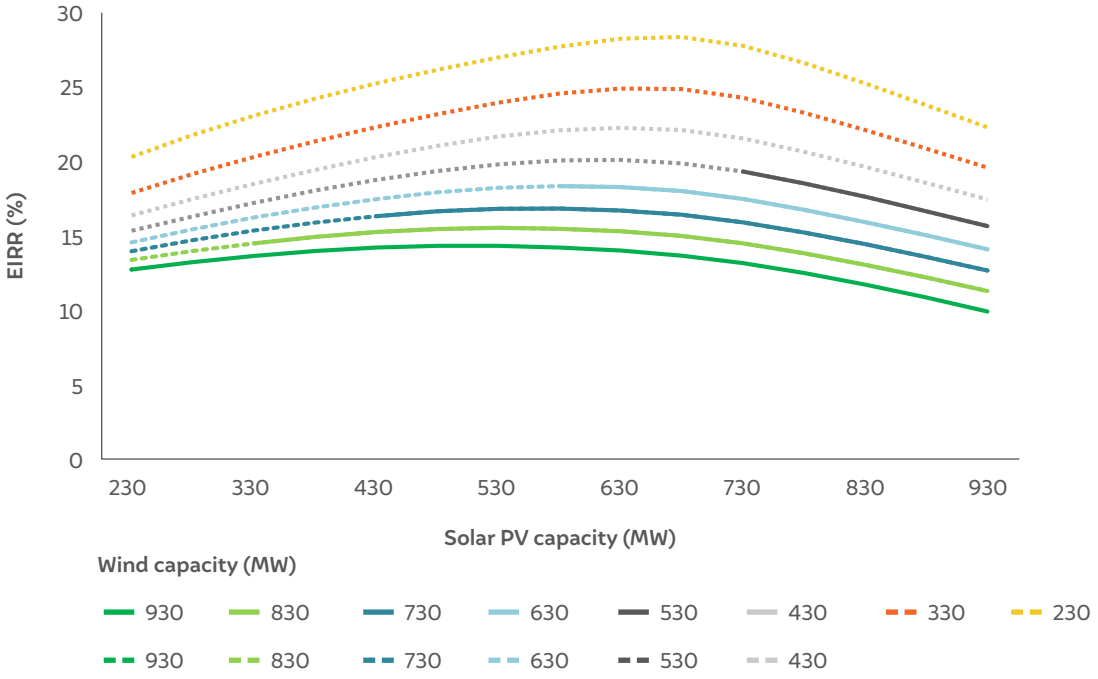
ii Selects configurations that satisfy the minimum average annual CUF requirements (50 per cent for this tender).

iii Computes returns for all configurations meeting tender requirements to arrive at the optimum configuration that maximises returns.

Figure 9 illustrates how the algorithm works. As solar-heavy configurations are expected to yield the highest returns, the analysis evaluates returns for various solar–wind combinations starting with combinations that factor in the minimum permissible capacity for wind (230 MW). The algorithm then progressively increases wind capacity and estimates returns for varying capacities of solar. Configurations with annual CUFs lower than 50 per cent are invalid and are represented by dashed lines. A minimum of 530 MW wind capacity is necessary to meet the minimum 50 per cent CUF requirement, which is then paired with 730 MW of solar PV capacity to arrive at the optimum project configuration.

11. When comparing CUFs for solar (at 45 per cent DC overloading) and wind generation in Rajasthan.

Figure 9 The maximum possible EIRR for a hybrid project depends on constraints set in the tender



Source: CEEW-CEF and IEA analysis.

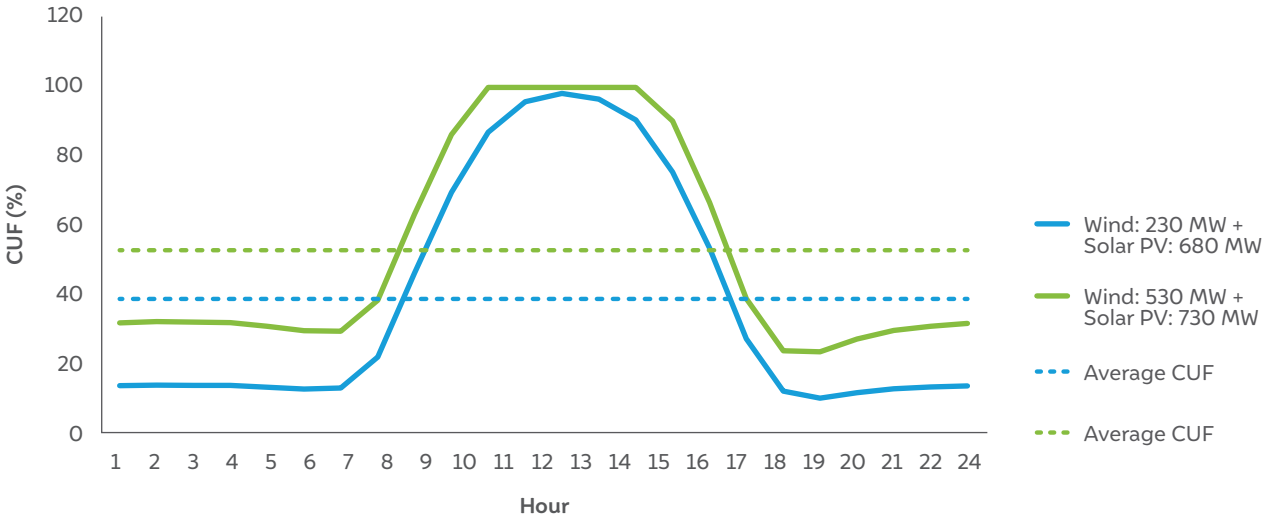
Notes:

1. The chart depicts all possible combinations for the AEML hybrid tender at a tariff of 3.24 INR/kWh.
2. Configurations with annual CUFs lower than 50 per cent are invalid and are represented by dashed lines.
3. In the case of lower CUF tenders with other conditions remaining the same, the solid lines would shift leftward in the chart.

For a given wind capacity, increasing solar PV capacity leads to higher EIRRs initially since solar generation is more competitive. Returns reach a maximum and then start declining as curtailment increases with higher solar capacity in the combination. For example, curtailment rises from 0.5 per cent to 13 per cent when solar PV capacity is increased from 530 MW to 930 MW with 230 MW wind capacity. Importantly, the point of maximum returns is reached earlier with higher wind capacity, as the curtailment effect begins prematurely. The chart indicates that returns are maximum (EIRR of 19 per cent) for a combination comprising 730 MW solar and 530 MW wind.

Figure 10 presents the hourly average production profiles of the AEML 350 MW hybrid project, which, on average, would experience around 4 per cent curtailment between 11:00 am and 3:00 pm every day.

Figure 10 Configurations meeting tender requirements could entail curtailment



Source: CEEW-CEF and IEA analysis.

3.2.2 Overall results for hybrid tenders

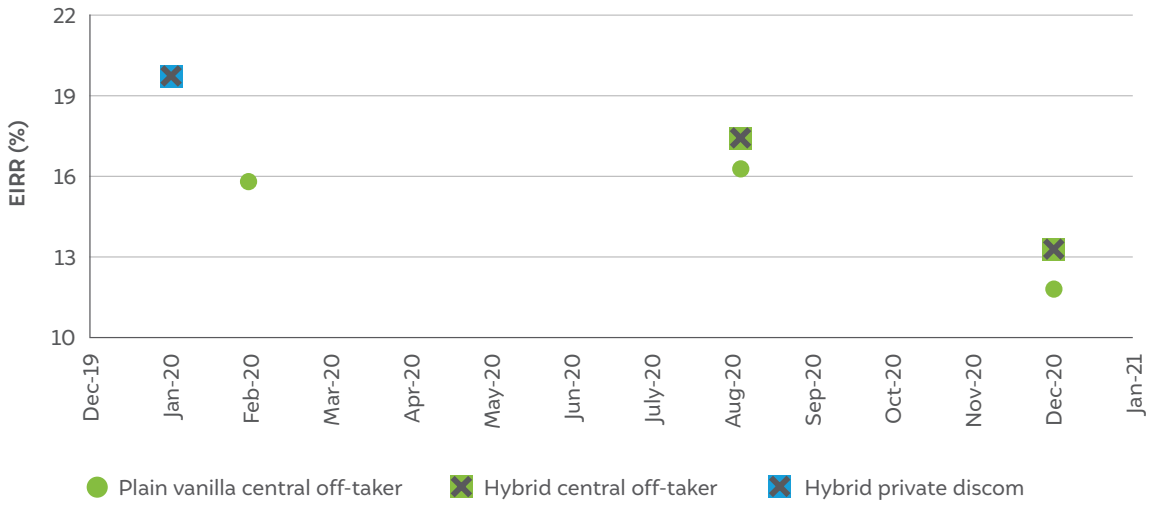
A priori, it is reasonable to expect higher EIRRs among hybrid tenders, given their more complex nature, lower competition, higher barriers to entry and higher realized tariffs (see Table 4). Our analysis reveals that under similar policy and market conditions (tenders awarded in the same month or closely spaced in time with the same off-taker). EIRR expectations for hybrid tenders with central government off-takers were between 110 to 150 basis points higher than that for comparable solar PV plain vanilla tenders.

The limited number of hybrid tenders make it challenging to draw generalised conclusions. The AEML tender was one of the initial hybrid tenders awarded, with developers relatively unfamiliar with bidding and executing hybrid projects at the time. It also had the highest average CUF requirements of the three tenders analysed, and the greatest need for oversizing. These factors could have resulted in a higher premium relative to comparable central-off-taker plain vanilla tenders, at around 400 basis points. However, both returns expectations and premiums over EIRR expectations for the comparable vanilla tenders were reduced in the next two hybrid tenders.

The Blended Wind 2,500 MW tender had very little flexibility, as a minimum of 80 per cent of wind capacity was required, with no oversizing allowed. As solar PV is more competitive than wind on an LCOE basis, the optimal configuration was found at the maximum possible solar capacity.

The SECI Hybrid 1,200 MW Tranche-III tender had a relatively small minimum CUF requirement, of 30 per cent. This allowed for solar PV heavy configurations, and might be why the underlying returns are so close to those of the plain vanilla peers.

Figure 11 EIRR expectations for hybrid tenders have converged with plain vanilla peers over time



Source: CEEW-CEF and IEA analysis.

Table 4 Hybrid tender input data and modelled results

Tender name	Awarded date	Min CUF (%)	Tariff (INR/kWh)	Awarded capacity (MW)	EIRR (%)	Solar Capacity (MW)	Wind Capacity (MW)	Oversizing
AEML 350 MW Hybrid 2019*	Jan 20	50	3.24	700	19.7	730	510	1.8
Blended Wind 2,500 MW Tranche-IX	Aug 20	30	2.99	160	17.4	32	128	1.0
SECI Hybrid 1,200 MW Tranche-III 2020	Dec 20	30	2.41	600	13.3	580	200	1.3

Source: CEEW-CEF and IEA analysis.

*Note: For AEML Hybrid 350 MW 2019 tender, 700 MW was awarded under greenshoe option.

4. Sensitivity of equity investor returns to changing risks

The previous section examined the returns expectations of equity sponsors for solar and wind projects at the time of the award. However, these could be different from the eventual *realised* returns.

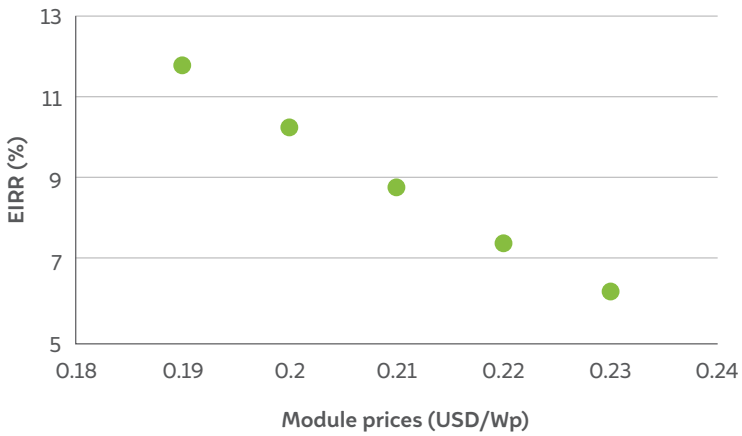
As shown in the *Clean Energy Investment Trends 2020* report, realised returns can be affected by payment delays or lower performance of renewables (where curtailment risk seems to be the largest volume-related risk perceived by investors). Last year's sensitivity analysis showed that, for example, a three-month delay over a five-year period could reduce the expected EIRR by 80 basis points. In addition, for every 2.5 per cent of solar PV production lost in the first five years the realized EIRR would lower by around 70 basis points compared to the expected EIRR.

Given current inflationary pressures, realised returns can also be affected by construction and equipment costs. Modules typically comprise around 50-60 per cent of total capex and thus, variations in realised prices from those assumed can have a material impact on realised returns. The period of analysis (July 2020 - June 2021) was characterised by considerable volatility in module prices. Prices started rising in mid-2020 due to disruptions to major Chinese facilities producing polysilicon, a key intermediate product in the solar PV value chain (Hall 2020) (Bloomberg Quint 2020). Prices stabilised towards the end of 2020, with bidders factoring in aggressive module pricing assumptions as India achieved record low solar tariffs in November and December. However, prices started rising again as the global economic recovery put pressure on supply chains. Firming commodity prices, higher freight costs amid a global container shortage, and solar PV-specific supply chain limitations (polysilicon and tempered glass shortages) drove up prices over the course of Q1 2021 (Nagaraj 2021; Bellini 2021). As a result, supply contracts agreed at USD 0.19/Wp in December 2020 were being renegotiated to USD 0.23/Wp barely one quarter later (Bhaskar 2021).

The Indian government's decision to levy BCD on cell and module imports from April 2022 is likely to prompt a number of developers to advance their module purchases to beat the April 2022 deadline (Hall 2021). Elevated demand could maintain upward pressure on the landed price of modules in India heading into 2022. These developments could translate to higher module prices than those factored in at the time of bidding and therefore these represent downside risks to realised EIRRs.

To quantify the extent of the downside, the sensitivity of realised returns to module prices is illustrated in Figure 12. Figure 12 captures the range of realised EIRRs for the GUVNL 500 MW tender for module pricing assumptions ranging between those assumed to be factored in at the time of bidding and an upper bound of USD 0.23/Wp - which was the prevailing price around June 2021, when the period of analysis concludes. As illustrated by the figure, there is a possible downside of around 47 per cent from the assumed EIRR (from 11.8 per cent to 6.3 per cent) corresponding to a 20 per cent increase in module prices (from 0.19 USD/Wp to 0.23 USD/Wp).

Figure 12 Sensitivity analysis of EIRR to module prices



Source: CEEW-CEF and IEA analysis.

Note: Sensitivity based on changes in module prices applied to the 500 MW solar PV tender run by GUVNL (Phase XI) in December 2020.

BOX 2 Implications of acquisitions and refinancing on project-level equity returns

Growing demand for sustainable investments and accommodative financial conditions are supporting a rebound in global acquisitions of renewables companies and projects in 2021, following a dip during the previous two years. Historically, most such transactions have been concentrated in the United States and Europe. Through early October 2021, India has been the third largest market for acquisitions in the renewable power sector, based on data from IJ Global, with reported financial closures topping over USD 6 billion – equivalent to over 40 per cent of the expected capital expenditures for new renewable plants in India this year.

Acquisition activity in India has rebounded strongly from 2020, when transactions declined to less than USD 1.5 billion. The upswing in 2021 is marked by Adani Green Energy's acquisition of SB Energy at an enterprise value of USD 3.5 billion, along with several other large corporate finance transactions. On the asset side, acquisitions of already operating projects (at under USD 1 billion) have so far remained somewhat below the level of the previous two years.

Such deals are indicative of the move towards greater scale and consolidation in India's solar PV and wind markets. Asset acquisitions also provide an exit opportunity for developers, allowing them to swiftly recover their capital and reinvest this in new projects. Having access to a robust secondary market remains important to help developers to extend their balance sheets. Depending on the cost of capital and return expectations of the buyer, it can also provide a way for developers to realise higher returns by selling operating projects that have been de-risked through the construction phase.

Based on reported transactions, we have assessed expected EIRRs for sellers and buyers from three representative utility-scale solar PV acquisitions over the past year, from projects that were commissioned in the CY 2017-18 timeframe. While such examples do not provide a complete picture of the financial performance implications of projects changing hands, they do provide indications of the return premium associated with taking on upfront development and construction, as well as the market expectations for returns from the purchase of operating projects.

The publicly available details of these three transactions are shown in Table 5, and assumptions for underlying transaction data (pertaining to costs, financial terms, etc.) correspond to those used for the project analysis in this report series. Other assumptions are spelt out in the annexures.

Table 5 Transactions included in the acquisitions analysis

Project (Capacity)	Seller	Acquirer	Date of financial close for acquisition	Reported transaction value (INR billion)	PPA tariff (INR/kWh)
Pavagada PV Plant (100 MW)	ACME Solar	Amplus (Indian subsidiary of Petronas)	10/09/2020	8.0	4.79
Shapoorji Pallonji Group Medak Solar PV Plant (75 MW)	Sterling and Wilson	Adani Green Power	30/03/2021	4.5	5.59
FRV Andhra Pradesh Solar Farm-I and FRV India Solar Park II (100 MW)	FRV	India Grid Trust	15/07/2021	6.6	4.43

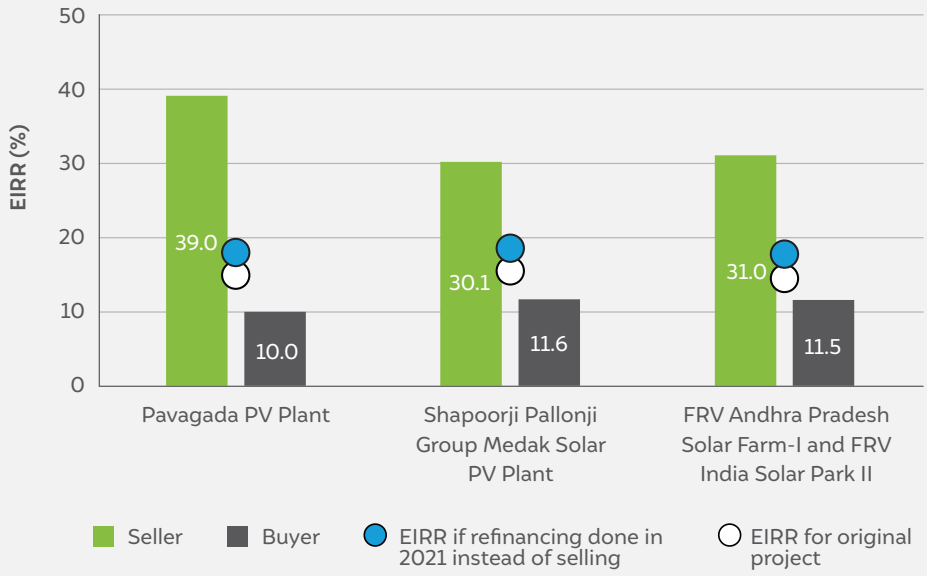
Source: Mercom (2020), Adani Green Energy (2021), IndiGrid (2021).

Note: The reported transaction value refers to enterprise value associated with the acquisition.

Asset sales are a means for project owners to realise higher returns than if these assets were held for the duration of their useful life (Figure 13). However, the higher returns associated with asset sales are realised over much shorter durations, which exposes sellers to reinvestment risk. At the same time, buyers generally realise returns lower than those realised by the seller and even those corresponding to the returns for project developers holding assets for the duration of their useful life. This reflects the lower risk profile of operational assets, which are not characterised by the execution risk typical to greenfield assets.

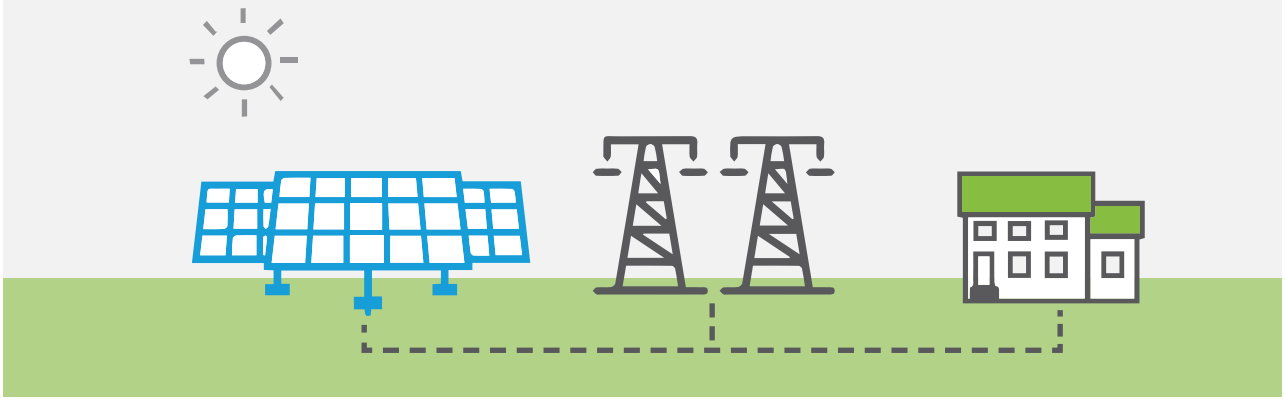
Another option for the project owner might be to refinance the existing construction debt with cheaper debt, if possible. With today's cost of debt notably lower than 3-4 years ago, and the construction risk already covered for an operational project, we estimate that the EIRR for the original project could be around 300-350 basis points higher by pursuing this strategy.

Figure 13 Expected EIRRs for select utility-scale solar PV projects awarded over 2016-17 and acquired over 2020-21



Source: CEEW-CEF and IEA analysis.

This simplified analysis raises a number of potential future research questions. Better understanding of the types and availability of returns for sellers in the secondary market can provide a useful valuation benchmark to help reduce uncertainty associated with project development. It can also provide a clearer route for companies and investors looking to enter the renewable power market, but who are less able to take on early stage development and construction risk.



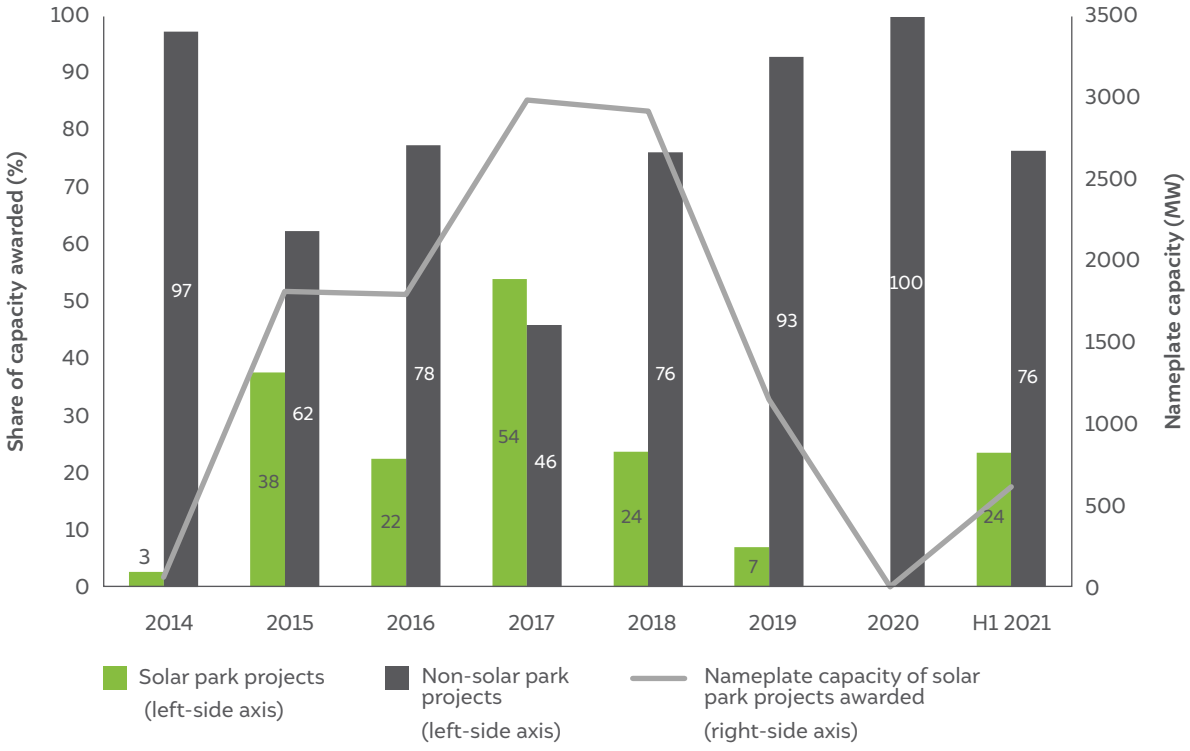
5. Land and ecological preservation–related issues

5.1 Land-related conflicts constraining RE park development

RE parks provide a plug-and-play solution (land, evacuation, and other supporting infrastructure in exchange for a fee) to investors for installing RE projects. The MNRE's focus has been on developing solar parks to improve solar developers' ease of doing business. In November 2020, the MNRE issued a concept note for developing wind/wind–solar hybrid parks to extend similar benefits to wind/wind–solar hybrid developers (Ministry of New & Renewable Energy 2020).

While land for setting up solar parks is generally identified in remote locations, acquiring this land from local communities has proved to be an onerous process (Aggarwal 2021). Disputes and litigation have held up the acquisition of land and thereby the construction of solar parks, particularly in Rajasthan, Gujarat, and Madhya Pradesh (Chari 2020). The same is evidenced by the diminishing share of solar parks in the overall capacity auctioned between 2017 and 2020 (Figure 14). Government agencies did not auction projects at solar park capacity in 2020. While this figure rose to 650 MW in H1 2021, it is still considerably short of the 3.0 GW auctioned in 2017.

Figure 14 Share of solar parks in overall capacity auctioned has diminished



Source: CEEW-CEF and IEA analysis.

5.2 New sites identified for wind and solar-wind hybrids

Wind resource potential in India is concentrated in two states – Gujarat and Tamil Nadu. These states account for nearly 47 per cent of India's cumulative installed wind capacity as of August 2021 (India Renewables Dashboard 2021).

However, developers have been facing challenges in acquiring land for wind projects, particularly in Gujarat. Changes in the state's land policies made

it challenging for project developers to lease state-owned land for wind auctions conducted by central agencies 2018 onwards. In response, the Government of Gujarat modified its land policy in January 2019. The state made it mandatory for wind and solar–wind hybrid projects to be developed in earmarked RE parks. It also made it mandatory for central agencies to consult with state agencies while tendering wind or solar–wind hybrid capacity to ensure the timely development of these parks (Government of Gujarat 2019; Prateek 2019).

In September 2020, the state allocated land for development of a 41.5 GW wind and hybrid RE park to key park developers as well as the SECI in the windy region of Kutch (Renewable Watch 2020). However, amendments to the policy issued at that time, imposed strict timelines on project commissioning for these park developers and the SECI, failing which, the land allocated would be taken back by the state (Government of Gujarat 2020). As per our industry consultations, factors such as high project costs due to difficult terrain, need for additional permissions and uncertainties around the timely construction of evacuation infrastructure may make it challenging for developers to locate projects in the park. Although the resolution of these uncertainties may attract wind/hybrid project developers to Gujarat in the future, no wind/hybrid projects are planned to be located in Gujarat (as of October 2021) for the auctions concluded in 2020 and H1 2021 (Power Grid Corporation of India Limited 2021). Further, finding suitable land for locating a wind/hybrid project is also a challenge in Tamil Nadu, due to the limited availability of state-owned land for projects.

Given the challenges in Gujarat and Tamil Nadu, new wind-project sites have been identified in other states of Karnataka, Maharashtra, and Rajasthan. Evacuation infrastructure has been developed by PGCIL at these sites (Power Grid Corporation of India Limited 2021). These favourable sites are located in Koppal, Gadag, and Karur in Karnataka, Kallam in Maharashtra, and Fatehgarh in Rajasthan. This has given developers alternative options for locating wind or hybrid projects.

5.3 Preservation of the Great Indian Bustard affecting RE projects in Rajasthan and Gujarat

An important consideration for developers while bidding for a tender is the cost of setting up the evacuation infrastructure. Developers typically locate the project in the vicinity of the delivery point into the transmission grid to minimise these costs. A recent order by the Supreme Court of India requires existing or upcoming power projects in certain regions of Gujarat and Rajasthan to be installed with underground transmission lines (Supreme Court of India 2021). This court order was made in response to concerns over dwindling populations of the Great Indian Bustard (GIB) – an endangered bird species that lives in parts of Gujarat and Rajasthan that are also favourable for setting up RE projects. The electrocution of these birds as a result of collisions with power lines has contributed to a reduction in their population.

The court order requires the shifting of existing low voltage transmission lines as well as the construction of new ones underground in the GIB habitat. Shifting transmission lines or constructing new ones underground entails additional costs for project developers that could affect the viability of projects in India's competitive RE sector. This has also affected the sanctioning of new solar capacity in the region. Based on consultations with the industry, constructing underground transmission lines typically costs twice as much as overhead lines (Priya 2021). Setting up underground transmission lines also entails additional complications associated with right-of-way issues (the permission for an individual or entity to enter private property and use it as a passage). Our stakeholder consultations revealed that developers may consider locating upcoming solar and solar–wind hybrid energy projects in states other than Rajasthan and Gujarat. However, the actual impact of this order will only be known in the coming months when the feasibility of moving the identified transmission lines underground is evaluated by a committee formed by the Supreme Court (Supreme Court of India 2021).

6. Industry landscape

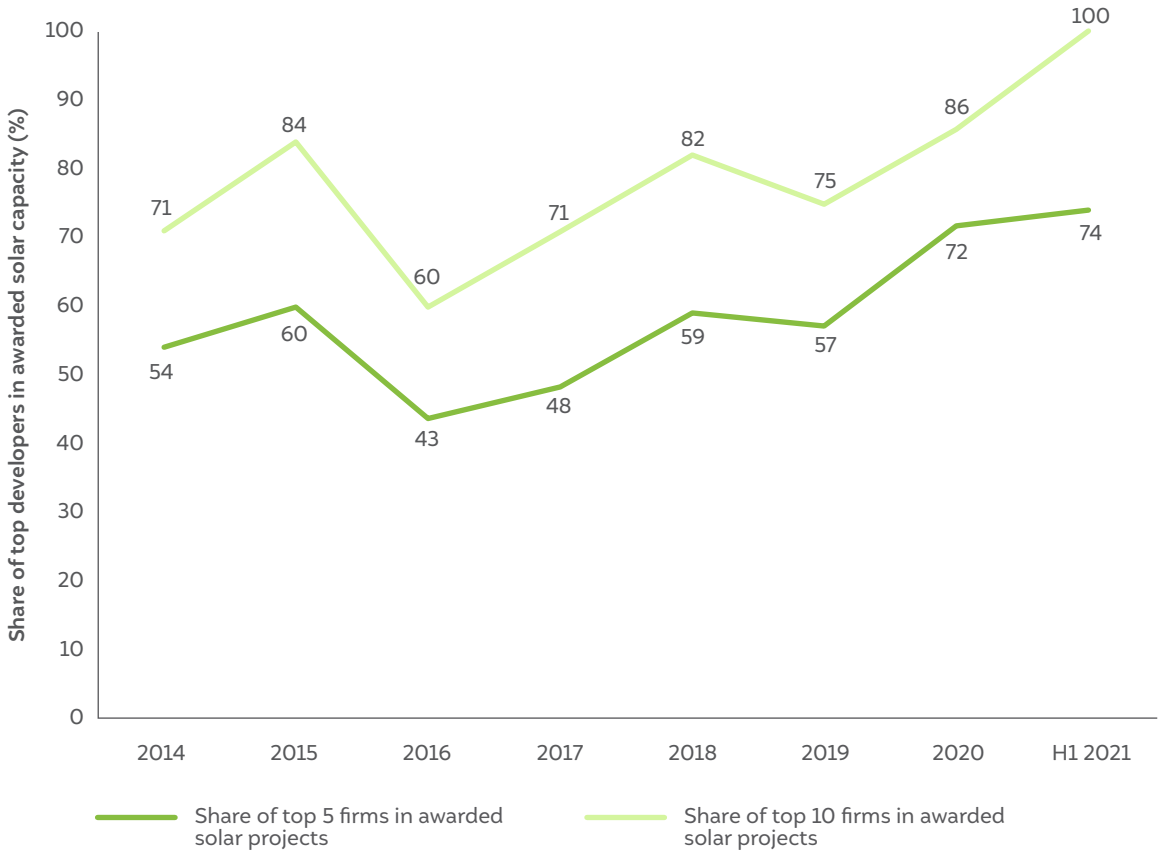
The *Clean Energy Investment Trends* series tracks the degree of competition in the RE sector through a 'market concentration' metric. 'Market concentration' is defined as the share of top developers in the total project capacity auctioned in a particular year (Dutt, Arboleya, and Gonzalez 2020).

India's solar PV market became highly concentrated in 2020 owing to the 8 GW manufacturing–linked tender awarded to two developers (through an option exercised by the two developers as part of the original tender awarded in December 2019). Market concentration further increased in H1 2021 with low capacity tendered and fewer players bidding in the auctions. The year 2020 and H1 2021 saw new players entering the market including Indian private-sector developers such as O2 Power and, HES Infra and international developers like Al Jomaiah Energy and Water Co. As they have access to low-cost debt (fully hedged basis), these international developers can bid competitively for capacity.

The auctions also saw participation from Indian CPSUs (mainly NTPC and SJVN) that have been able to access debt at 7.50–8.00 per cent, which is lower than the typical commercial debt rates of 8.75–10.00 per cent for private-sector developers in India (see Figure 5). This may be attributed to access to cheaper debt on account of their quasi-sovereign status. The continued participation of CPSUs could keep market concentration at elevated levels in the short to medium term.

For wind markets in India, market concentration could not be determined owing to tepid auctions in 2020 and H1 2021. However, a notable capacity of solar–wind hybrid was auctioned in 2020 with a high market concentration of 83 per cent and 100 per cent for the top five and top ten developers, respectively.

Figure 15 Market concentration for solar PV experienced an increase in 2020 and H1 2021



Source: CEEW-CEF and IEA analysis.

Note: Solar–wind hybrid projects are excluded.

Table 6 Top 10 developers by capacity awarded (2020)

Solar PV	Capacity awarded (MW)	Solar-wind hybrid	Capacity awarded (MW)
Adani	7,200	Adani	1,300
Azure Power	2,300	JSW Energy	810
EDEN Renewables	900	ReNew Power	400
O2 Power	780	Axis Energy	380
NTPC	760	Tata Power	225
ReNew Power	600	Vena Energy	160
Tata Power	600	AmP Energy	130
Axis Energy Group	400	Acme Solar	90
Green Infra Wind Energy	400		
IB Vogt	350		

Source: CEEW-CEF and IEA analysis.

Note: No wind capacity was auctioned during 2020.

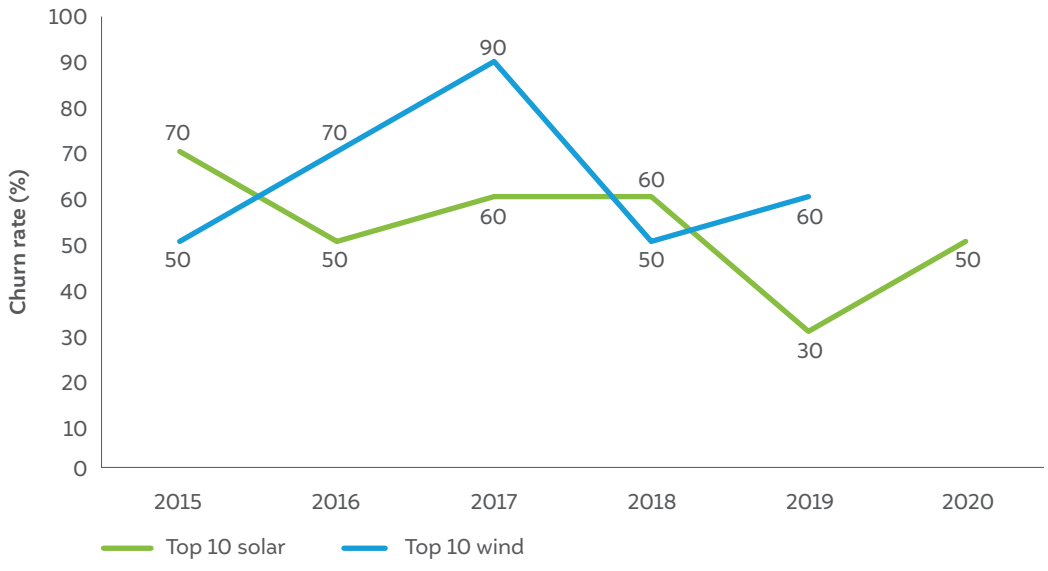
Table 7 Top 10 developers by capacity awarded (H1 2021)

Solar PV	Capacity awarded (MW)	Wind	Capacity awarded (MW)
TP Saurya	310	JSW Energy	450
SJVN	245	Adani	300
Rising Sun Energy	190	Ayana Renewables	300
Adani	150	EverGreen Power Mauritius	150
NTPC	150		
Torrent Power	150		
Sprng Energy	120		
Coal India	100		

Source: CEEW-CEF and IEA analysis.

Note: No solar–wind hybrid capacity was auctioned during H1 2021.

Figure 16 Churn rate increased for solar PV markets in 2020



Source: CEEW-CEF and IEA analysis.

Note: Solar–wind hybrid projects are excluded.

An interesting feature of India's RE industry landscape is that while a few developers secure the bulk of the capacity awarded each year, it isn't the same developers every year. The Investment Trends series defines the churn rate as the extent of change in the top 10 developers with respect to the previous year (Dutt, Arboleya, and Gonzalez 2020). For example, a churn rate of 30 per cent in 2019 means that 30 per cent of the top 10 developers of the previous year did not feature in the top 10 of 2019. Both 2020 and H1 2021 saw a higher churn rate in the solar PV markets, in part due to the entry of new international and CPSU players. Given the ambitious RE expansion plans of CPSUs, churn rates could reduce in the upcoming years with these companies taking the lead. As a result of limited project sanctioning, no churn rate has been indicated for wind for 2020.

The table shown below captures a list of leading companies in cumulative installed solar and wind capacity.

Table 8 Leading developers (cumulative installed capacity, up to June 2021)

Solar PV	Capacity (MW)	Wind	Capacity (MW)
Adani	4,723	Greenko Energy Holdings	3,192
Acme Solar Holdings	2,900	ReNew Power	2,912
ReNew Power	2,688	Sembcorp	1,750
Greenko Energy Holdings	2,175	Mytrah	1,469
Azure Power	2,102	Tata Power	932
Tata Power	1,765	CLP	925
NLC	1,370	Continuum Energy	807
NTPC	1,140	Hero Future Energies	806
Avaada Power	900	Torrent Power	649
Hero Future Energies	794	Adani	647

Source: CEEW-CEF and IEA compilation based on data sourced from company websites and annual reports.

Annexures

Annexure 1
Terms and definitions

Equity internal rate of return (EIRR)
The EIRR is the nominal internal rate of return for providers of equity capital at the project level. It is estimated through a discounted cash flow analysis of project cash flows net of payments to debt holders (Dutt, Arboleya, and Gonzalez 2020). In our analysis, we have estimated the post-tax EIRR – that is, the returns net of project-level taxes.

Debt service coverage ratio (DSCR)
This refers to the ratio of the net operating income available for servicing debt to the overall debt repayment obligation for that year (principal and interest); i.e., DSCR = net operating income/total debt service (Dutt, Arboleya, and Gonzalez 2020).

Churn rate
The churn rate is defined as the extent of change in the top 10 developers with respect to the previous year (Dutt, Arboleya, and Gonzalez 2020). For example, a churn rate of 30 per cent in a particular year means that 30 per cent of the top 10 developers of the last year did not feature in the top 10 of the current year.

Market concentration
The share of top developers in the total project capacity awarded in a particular year (Dutt, Arboleya, and Gonzalez 2020); e.g., market concentration of top five developers in year x = capacity awarded by top five developers / total capacity awarded in year x.

Annexure 2
EIRR by project type

The tables shown later capture EIRR expectations for solar, wind, and hybrid projects analysed for the period of 2020 and H1 2021. Tender details such as award date, tariff, capacity awarded, etc. are captured in Annexure 5. Annexure 3 details the methodology for project selection.

Table A1 Expected EIRRs for solar projects with central off-takers (%)

Aug-20	Nov-20	Feb-21
16.3	12.3	15.2

Source: CEEW-CEF and IEA analysis.

Table A2 Expected EIRRs for solar projects with state off-takers

State	Nov-20	Dec-20	Feb-21	Mar-21	May-21
Gujarat	–	11.8	13.8	12.2	13.2
Kerala	22.8	–	–	–	–
Maharashtra	–	–	–	–	14.3
Uttar Pradesh	–	–	–	–	12.7

Source: CEEW-CEF and IEA analysis.

Table A3 Expected EIRR for wind projects (%)

Mar-21
13.7

Source: CEEW-CEF and IEA analysis.

Note: Only one wind project was tendered during 2020 and H1 2021.

Table A4 Expected EIRR for solar-wind hybrid projects (%)

Jan-20	Aug-20	Dec-20
19.7*	17.4	13.3

Source: CEEW-CEF and IEA analysis.

*Note: The hybrid projects auctioned had central off-takers except for AEML Hybrid 350 MW auctioned in January 2020.

Annexure 3 Methodology

EIRR analysis

Project selection

Several inputs are taken into consideration when determining the EIRR expectations of project developers. For plain vanilla solar or wind projects, these typically include off-taker type (central or state), project location, and type of site (solar park or non-solar park). Additional considerations that affect offtake certainty, such as a ready counterparty to sign PSAs also impact returns expectations. On the other hand, for special tenders (e.g., hybrids, round-the-clock [RTC] energy, assured peak power) additional factors such as minimum CUF requirements and the extent of oversizing necessary also impact returns expectations.

The report analyses variations in EIRR according to the off-taker, project location and configuration, type of site, and various policy developments for both plain vanilla solar/wind and hybrid projects. However, due to limited clarity regarding the configurations associated with the RTC and assured peak power tenders, they have been excluded from the analysis. Table A5 captures the tenders excluded from the analysis.

Tariff selection and weighted average EIRR

Our EIRR analysis for each tender is based on the lowest discovered tariff (L1 tariff). This is primarily because the terms of debt finance associated with each bidder are not known. We factor in the most competitive terms of debt corresponding to the given tender conditions (based on off-taker and type of site) and bidder and assume that these terms of debt apply to the L1 tariff.

From the perspective of calculating the weighted average EIRR for the period of analysis, the EIRR corresponding to the L1 tariff is assumed to apply to the entire awarded capacity in that tender. This implicitly factors in the assumption that each winning bidder has access to debt on similar terms. Given the highly competitive nature of India's RE landscape, this assumption is likely to be a fairly close approximation of reality. The weighted average EIRR for the period of analysis is the capacity-weighted average EIRR across all plain-vanilla tenders.

Sensitivity analysis

The sensitivity analysis is based on making changes to one input of the base case expected EIRR analysis. Given the current inflationary pressures in global markets in general and in construction and equipment costs in particular, this year's sensitivity analysis is focused on the impacts of changes in module prices to EIRRs. Table A6 illustrates the sensitivity of realised returns to module prices in different tenders across 2020 and 2021.

Table A5 Tenders excluded from the analysis

Tender name	Date of award	Tariff (INR/kWh)	Reason
SECI, 1,200 MW ISTS RE Peak Power Supply, Tranche-VII, Pan India	31/01/2020	4.30	Hybrid tender that required a specific generation profile and has higher minimum CUF requirements
SECI, 400 MW RE Power RTC Supply to NDMC, New Delhi and Dadra and Nagar Haveli	08/05/2020	3.60	Solar, wind and storage hybrid tender with specific CUF requirements
Tata Power-D, 225 MW, Hybrid, Maharashtra	16/07/2020	2.59	Solar-wind hybrid tender with specific CUF requirements
SECI, 10 MW, Solar, Rajasthan	06/09/2020	2.58	Small-scale project

Source: CEEW-CEF and IEA analysis.

Table A6 Sensitivity analysis of EIRRs to higher module prices

EIRR depending on module prices	Awarded date	Module prices (USD/Wp)				
		0.19	0.2	0.21	0.22	0.23
NTPC, 1,200 MW, ISTS-connected, Solar, Pan India	Aug 20	–	–	–	16.3%	14.8%
KSEB, 200 MW, Solar, Kerala	Nov 20	–	–	–	22.8%	21.1%
SECI, 1,070 MW, Solar, Tranche-III, Rajasthan	Nov 20	12.3%	10.8%	9.4%	8.0%	6.7%
GUVNL, 500 MW, Solar, Phase XI, Gujarat	Dec 20	11.8%	10.3%	8.8%	7.5%	6.3%
NTPC, 190 MW, Solar, Nokh solar park, Jaisalmer, Rajasthan	Feb 21	–	15.2%	13.6%	12.1%	10.6%
Torrent Power Limited, 300 MW, Gujarat	Feb 21	–	13.8%	12.2%	10.7%	9.2%
GUVNL, 500 MW, Solar, Phase XII, Gujarat	Mar 21	–	–	–	13.5%	12.2%

Source: CEEW-CEF and IEA analysis.

Annexure 4 Assumptions

Performance parameters

Solar

The DC side of a solar project is typically overloaded to enhance its capacity utilisation. We assumed 45 per cent DC overloading in our analysis. Our industry consultations and the transmission connectivity documents by CTU helped us identify the location of projects under consideration. The following table summarises the AC CUF assumptions for these locations. The AC CUF for each location was derived based on solar power generation potential GIS data for various districts in each state and was then verified through inputs from market participants.

Table A7 Module performance parameters

State (District)	AC CUF (@45% DC overloading)
Rajasthan (Jaisalmer)	28.9%
Rajasthan (Jodhpur)	28.8%
Gujarat (Banaskantha)	28.7%
Karnataka (Gadag)	27.9%
Maharashtra (Dhule)	27.7%
Uttar Pradesh (Jalaun)	25.8%

Source: Global Solar Atlas - World Bank, CEEW-CEF and IEA market intelligence.

Notes: Projects under solar tenders that permit installation anywhere in India are assumed to be set up in Jodhpur, Rajasthan. For GUVNL (Gujarat) tenders, projects are assumed to be set up in Banaskantha, Gujarat. Solar-wind hybrid projects set up are assumed to be located in Jaisalmer (Fatehgarh), Rajasthan and Gadag, Karnataka. The analysis factors in an annual degradation in solar generation of 0.6 per cent per year.

Wind

The state of Karnataka (Gadag) was assumed to be the location for wind projects. Based on market intelligence, a CUF of 39 per cent was assumed. For solar–wind hybrid projects, the location was assumed to be Rajasthan (Fatehgarh, Jaisalmer) and Karnataka (Gadag) with a wind CUF of 32.9 and 39 per cent, respectively.

Capital costs

The capital costs exclude land-related costs as we assumed a land-leasing model for securing land for solar, wind or hybrid projects (except for solar park projects, where solar park charges apply).
Module pricing assumptions are based on industry consultations. These also indicate that developers associated with the projects analysed (up to June 2021) intend to procure modules before April 2022, and thus the corresponding tariff bids do not factor in BCD.

Module costs

Table A8 Module costs

Time period	PV modules cost (USD/Wp)*	INR million/MWp
Jul 20–Oct 20	0.22	16.3
Nov 20–Dec 20	0.19	14.1
Jan 21–Feb 21	0.20	14.8
Mar 21–Jun 21	0.23	17.0

Source: CEEW-CEF and IEA market intelligence.

Notes: No basic customs duty was considered for the projects analysed. A currency exchange rate of 74.0 INR/USD was assumed.

*For SECI Hybrid Tranche-III 1,200 MW 2020 and AEML Hybrid 350 MW 2019 tenders, the module costs were assumed to be 0.18 and 0.21 USD/Wp, respectively. Module costs were assumed to be 0.22 USD/Wp for Blended WInd 2,500 MW Tranche-IX tender.

Solar park charges (applicable to projects set up in solar parks)

Table A9 Solar park charges

Solar park	INR million/MW
Raghanesda Solar Park	2.20
UP Solar Park	4.81
Dondaicha Solar Park	INR 10.6 million (payable over 25 years)

Source: Request for Selection (RfS) documents pertaining to the relevant tenders.

Notes: The RfS document for the Nokh Solar Park was not publicly available at the time of writing. Hence, capital and operating costs corresponding to non-solar parks were assumed though lower cost of debt associated with solar park projects was factored into the analysis.

Other CAPEX

Table A10 Other CAPEX

Other CAPEX	INR million/MW
Solar park	9.0
Non-solar park	14.0

Source: CEEW-CEF and IEA market intelligence.

Notes: Other CAPEX includes balance of system, civil works, mounting structures, preliminary and pre-operative expenses, and evacuation infrastructure up to the inter-connection point for non-solar park projects and up to the pooling substation in solar parks.

Other capex for the Raghanesda solar park stands at INR 19 million/MW.

Wind

Table A11 Capital expenditure

Parameter	Value (INR million/MW)
CAPEX	65

Source: CEEW-CEF and IEA market intelligence.

Notes: This figure excludes land acquisition costs, as a lease model has been considered in the analysis. For hybrid tenders, a wind capex of 63 INR million/MW was assumed for lower resource-rich sites in Rajasthan.

Operating costs

Table A12 Operating expenses

Parameter	Unit	Solar	Wind
O&M expenses	INR million/MW	0.5	1
Annual escalation	%	5%	3%
Land lease expenses	INR/acre	37,500	37,500
Annual escalation	%	5%	5%
Land requirements	Acre/MW	3.5	1.8

Source: CEEW-CEF and IEA market intelligence.

Table A13 Recurring costs in solar parks

Raghanesda Solar Park	UP Solar Park	Dondaicha Solar Park
O&M expenses of INR 100,000/MW with an annual escalation of 5 per cent	O&M expenses of INR 150,000/MW with an annual escalation of 6 per cent	O&M expenses of INR 233,000/MW with an annual escalation of wholesale price index
Land-related costs of INR 10,000/hectare/year escalating at 15 per cent every three years	Local area development charges of INR 100,000 for five years	Land lease rent of INR 89,000/MW

Source: RfS documents pertaining to the relevant tenders.

Note: The RfS document for the Nokh Solar Park was not publicly available at the time of writing. Hence, capital and operating costs corresponding to non-solar parks were assumed though lower cost of debt associated with solar park projects was factored into the analysis.

Financing parameters

In the case of private sector developers, project loans are assumed to be sourced from banks at interest rates specified in Table A14

Table A14 Interest rates for projects awarded between July 2020 and June 2021

Entity	Off-taker	Solar park	Non-solar park and wind
Bank	Central off-taker State off-taker	8.75% 8.75–9.25%	9.00% 9.00–9.50%
NBFC	Central off-taker State off-taker	9.25 % 9.25–9.75%	9.50% 9.50–10.00%
CPSU	Central off-taker State off-taker	7.50–8.00%	

Source: CEEW-CEF and IEA market intelligence.

Note: For the CPSU bidders, the cost of debt factored in for NTPCS is 7.5% and for SJVN is 8%.

Table A15 Other financing parameters

	Solar park	Non-solar park	Wind
Loan tenure	17 years (including a one-year moratorium on principal repayment)	17 years (including a one-year moratorium on principal repayment)	18 years (including a one-year moratorium on principal repayment)
Debt-equity ratio	75:25	75:25	75:25
Tax rate	17.16%	17.16%	17.16%
Minimum debt service coverage ratio	1.1	1.1	1.1
Debt service reserve account	6 months	6 months	6 months
Depreciation	Straight line	Straight line	Straight line
Receivables	Three months' receivables for state discom off-takers in UP and Kerala; no payment delays for central off-takers, state discoms in Gujarat, Maharashtra, and private discoms in Maharashtra and Guajrat		

Source: CEEW-CEF and IEA market intelligence.

Notes: For solar-wind hybrid tenders, a long tenure of 17 years was assumed (including one-year moratorium on principal payment) with similar other financing parameters.

Analysis on project-level equity returns in case of acquisitions and refinancing

- Except where otherwise indicated in reporting, it is assumed that the seller fully pays off the outstanding project debt, with a prepayment penalty of 2% of the remaining principal.
- The seller is assumed to pay a capital gains tax at 20% at the time of the transaction.
- The existing greenfield debt at the SPV is assumed to be refinanced upon acquisition. It is assumed to be upsized to a 70:30 debt-equity ratio at the time of acquisition, with the refinancing entailing an interest rate of 8.5% for the next 17 years.

Table A16 Assumptions for acquisition and refinancing transactions

Tender complete name	Year of operation	CAPEX (INR lakh/ MW)	CUF (%)	Cost of debt of seller (%)
Pavagada PV Plant	2018	520	26.5	12.5
Shapoorji Pallonji Group Medak Solar PV Plant	2017	550	22.7	13.5
FRV Andhra Pradesh Solar Farm-I and FRV India Solar	2018	520	26.5	12.5

Source: CEEW-CEF and IEA market intelligence.

Note: Medak solar PV plant assumes 20% DC overloading, while the other two projects assume 40% DC overloading.

Annexure 5
Investor participation at solar and wind tenders

Table A17 Summary of plain-vanilla tenders analysed

Tender complete name	Date of award	EIRR	Capacity tendered (MW)	Capacity bid for (MW)	Capacity awarded (MW)	L1 tariff (INR/ kWh)	Capex (INR lakh/ MW)
NTPC, 1,200 MW, ISTS-connected, Solar, Pan India	Aug 20	16.3%	1,200	1,700	1,170	2.43	376
KSEB, 200 MW, Solar, Kerala	Nov 20	22.8%	200	NA	200	2.97	399
SECI, 1,070 MW, Solar, Tranche-III, Rajasthan	Nov 20	12.3%	1,070	3,280	1,070	2.00	344
GUVNL, 500 MW, Solar, Phase XI, Gujarat	Dec 20	11.8%	500	NA	500	1.99	344
Torrent Power Limited, 300 MW, Gujarat	Feb 21	13.8%	300	NA	500	2.22	355
NTPC, 190 MW, Solar, Nokh solar park, Jaisalmer, Rajasthan	Feb 21	15.2%	190	NA	190	2.25	355
SECI, 1,200 MW, Wind, Tranche-X, Pan India	Mar 21	13.7%	1,200	3,200	1,200	2.77	650
GUVNL, 500 MW, Solar, Phase XII, Gujarat	Mar 21	12.2%	500	NA	500	2.20	387
GUVNL, 100 MW, Solar, Phase X-R, Raghanesda solar park, Gujarat	May 21	13.2%	100	NA	100	2.64	459
UPNEDA, 75 MW, Solar, Tikar, Makrecha and Banghauli solar parks, Uttar Pradesh	May 21	12.7%	75	NA	75	2.68	385
MAHAGENCO, 250 MW, Solar, Dondaicha solar park, Dhule, Maharashtra	May 21	14.3%	250	NA	250	2.51	342

Source: CEEW-CEF and IEA analysis.

NA = Not available.

References

Adani Green Energy. 2021. "Adani Green Energy To Acquire 75 MW Operating Solar Projects From Sterling & Wilson For Rs. 446 Cr". https://www.adanigreenenergy.com/newsroom/media-releases/Adani-Green-Energy-to-acquire-75-MW-operating-solar-projects-from-Sterling--Wilson-for-Rs-446-Cr, Accessed on 23-11-2021.

Aggarwal, Mayank. 2021. "Land Conflicts on the Horizon as India Pursues a Clean Energy Future." Mongabay. July 14, 2021. https://india.mongabay.com/2021/07/land-conflicts-on-the-horizon-as-india-pursues-a-clean-energy-future/.

Bellini, Emiliano. 2021. "New Surge in Downstream Demand Has Driven the Polysilicon Shortage to a Crisis Point." PV Magazine. April 23, 2021. https://www.pv-magazine.com/2021/04/23/new-surge-in-downstream-demand-has-driven-the-polysilicon-shortage-to-a-crisis-point/.

Bhaskar, Uptal. 2021. "Hike in Solar Panel Prices by Chinese Cos to Hit Projects." Mint. April 1, 2021. https://www.livemint.com/news/india/hike-in-solar-panel-prices-by-chinese-cos-to-hit-projects-11617213860784.html.

Bloomberg. 2021. Bloomberg Terminal. Accessed October 2021.

Bloomberg Quint. 2020. "A New Blow to the Solar-Energy Supply Chain." Bloomberg Quint. August 18, 2021. https://www.bloombergquint.com/business/solar-s-pricey-summer-may-get-worse-as-flood-shuts-china-factory.

Chari, Mridula. 2020. "How Solar Farms Fuel Land Conflicts." Mint. September 21, 2020. https://www.livemint.com/news/india/how-solar-farms-fuel-land-conflicts-11600612526037.html.

Duggal, Saumya. 2021. "SECI Finally Finds the First Buyer for Manufacturing Linked Tender – GRIDCO." Saur Energy. July 29, 2021. https://www.saurenergy.com/solar-energy-news/seci-finally-finds-the-first-buyer-for-manufacturing-linked-tender-gridco.

Dutt, Arjun, Lucila Arboleya, and Pablo Gonzalez. 2020. Clean Energy Investment Trends: Mapping Project-Level Financial Performance Expectations in India. New Delhi, Paris: Council on Energy, Environment and Water; International Energy Agency.

Dutta, Sanjay. 2021. "Power PSUs May Be Allowed to Take Bigger Risk for Green Energy Projects." The Times of India. September 12, 2021. https://timesofindia.indiatimes.com/business/india-business/power-psus-may-be-allowed-to-take-bigger-risk-for-green-energy-projects/articleshow/86141583.cms.

Economic Times. 2021. "NTPC to Raise Rs 2,500 Cr via Bonds on Wednesday." Economic Times. January 22, 2021. https://economictimes.indiatimes.com/markets/bonds/ntpc-to-raise-rs-2500-cr-via-bonds-on-wednesday/articleshow/80410585.cms?from=mdr.

Government of Gujarat. 2019. "Allocation Policy of Government Waste Land for Wind/Solar/Wind-Solar Hybrid Park." https://indextb.com/files/2021/7/0fe726f9-05c3-4f57-9a57-8337ad73d1ee_Allocation%20policy%20of%20Government%20waste%20land.pdf.

Government of Gujarat. 2020. "Government Waste Land Allotment Policy for Wind/Solar/Wind-Solar Hybrid Park." https://jmkresearch.com/wp-content/uploads/2020/10/Gujarat-Wasteland-policy.pdf.

Hall, Max. 2020. "Explosions at GCL Polysilicon Fab Have Reportedly Taken Down 10% of Global Production Capacity." PV Magazine. July 21, 2020. https://www.pv-magazine.com/2020/07/21/explosions-at-gcl-polysilicon-fab-have-reportedly-taken-down-10-of-global-production-capacity/.

IEA, 2021. India Energy Outlook 2021. Paris: IEA. https://www.iea.org/reports/india-energy-outlook-2021.

IJGlobal. 2021. "Transaction Data." IJGlobal. Accessed October 18, 2021. https://ijglobal.com/data/search-transactions.

IndiGrid. 2021. “IndiGrid completes acquisition of its First Solar Asset”. https://www.indigrid.co.in/pdf/Press_Release_FRV_Acquisition.pdf, Accessed on 23-11-2021.

Mercom. 2020. “Petronas’ Indian Arm Acquires 100 MW of Solar Assets from ACME at ₹8 Billion”. https://mercomindia.com/petronas-indian-arm-acquires-solar-assets/, Accessed on 23-11-2021.

Nair, Rahul. 2021. “Winning Tariff of ₹2.20/kWh in the GUVNL Solar Auction Hasn’t Factored BCD” Mercom. April 13, 2021. https://mercomindia.com/winning-tariff-guvnl-auction-hasnt-factored-bcd/.

Nagaraj, B S. 2021. “Solar Module Prices to Remain High Until Second Half of 2021: Chinese Manufacturers” Mercom. April 26, 2021. https://mercomindia.com/solar-module-prices-high-second-half-of-2021/.

Power Grid Corporation of India Limited. 2021. “Status of Allocation of Bay(s) at the Existing or the Proposed ISTS Sub-stations for Stage-II Connectivity.” https://webapps.powergrid.in/ctu/u/l-page.aspx?d=MiKSdegaUTE=.

Prateek, Saumy. 2019. “In a Welcome Move, Gujarat Modifies its Land Laws to Set up Wind and Solar Hybrid Parks.” Mercom. January 29, 2019. https://mercomindia.com/gujarat-modifies-land-laws-wind-solar-parks/.

Priya, Sanjay. 2021. “Great Indian Bustard and the Renewable Energy Sector - How to Save Both” Mercom. July 09, 2021. https://mercomindia.com/gib-renewable-energy-save-both/.

Ranjan, Rakesh. 2021. “SJVN Wins GUVNL’s 100 MW Solar Auction.” Mercom. May 07, 2021. https://mercomindia.com/sjvn-wins-guvnls-100-mw-solar-auction/.

Renewable Watch. 2020. “Clearing the Way. Gujarat’s New Policy Aims to Ensure Land Availability, but Has Strings Attached.” Renewable Watch. October 05, 2020. https://renewablewatch.in/2020/10/05/clearing-the-way/.

Reserve Bank of India. 2020a. “Minutes of the Monetary Policy Committee Meeting May 20 to 22, 2020”. January 05, 2020. https://www.rbi.org.in/Scripts/BS_PressReleaseDisplay.aspx?prid=49909.

Reserve Bank of India. 2020b. “Statement on Developmental and Regulatory Policies.” August 06, 2020. https://www.rbi.org.in/commonman/English/Scripts/PressReleases.aspx?Id=3236.

State Bank of India. 2021. “Marginal Cost Lending Rates.” Accessed on 10-10-2021. https://sbi.co.in/web/interest-rates/interest-rates/mclr-historical-data.

Shrimali, Gireesh. 2021. “Financial Instruments to Address Renewable Energy Project Risks in India.” Energies 14, no. 19: 6405. https://doi.org/10.3390/en14196405.

Supreme Court of India. 2021. “I.A. NO. 85618 OF 2020 in WRIT PETITION (CIVIL) NO. 838 OF 2019 .” https://main.sci.gov.in/.

Tilotia, Akhilesh. 2020. “Hedging INR for the Long-term.” https://atilotia.com/2020/12/21/hedging-inr-for-the-long-term/.

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Acronyms

BCD	basic customs duty
CEEW	Council on Energy, Environment and Water
CEEW-CEF	Centre for Energy Finance at the Council on Energy, Environment and Water
CPSU	Central Public Sector Undertaking
CTU	central transmission utility
CUF	capacity utilisation factor
DSCR	debt service coverage ratio
DSRA	debt service reserve account
EIRR	equity internal rate of return
EU	European Union
GIB	Great Indian Bustard
GIS	geographic information system
GW	gigawatt
IEA	International Energy Agency
INR	Indian National Rupee
IPP	independent power producer
IRR	internal rate of return
ISTS	inter-state transmission system
LCOE	levelised cost of energy
MCLR	marginal cost of funds-based lending rate
MNRE	Ministry of New and Renewable Energy
MW	megawatt
NBFC	non-banking financial company
PGCIL	Power Grid Corporation of India Limited
PLR	prime lending rate
PPA	power purchase agreement
PSA	power sales agreement
PV	photovoltaic
RBI	Reserve Bank of India
RE	renewable energy
RTC	round-the-clock
SECI	Solar Energy Corporation of India
UN	United Nations
USD	United States Dollar

Return expectations for solar-wind hybrid projects reveals higher initial EIRRs than those for plain vanilla tenders, though expectations have converged over time.

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