Clean Energy Investment Trends 2020

Mapping Project-Level Financial Performance Expectations in India

Edition authors: Arjun Dutt, Lucila Arboleya, and Pablo Gonzalez

Series editors: Kanika Chawla and Michael Waldron

Report | November 2020

Market concentration for solar PV and wind capacity sanctioned in 2019 stood at around 75 per cent.

Image: iStock

Clean Energy Investment Trends 2020

Mapping Project-Level Financial Performance Expectations in India

Edition authors: Arjun Dutt, Lucila Arboleya, and Pablo Gonzalez
Series editors: Kanika Chawla and Michael Waldron

CEEW Report
November 2020
ceew.in

Suggested citation: 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.

Cover image: iStock.

Peer reviewers: Findings of this report have been extensively peer reviewed by market participants.

Publication team: Alina Sen (CEEW), The Clean Copy, Twig Designs, and Friends Digital.

Organisations/initiatives: The **Council on Energy, Environment and Water** (CEEW) is one of Asia's leading not-for-profit policy research institutions. The Council uses data, integrated analysis, and strategic outreach to explain and change the use, reuse, and misuse of resources. It prides itself on the independence of its high-quality research, develops partnerships with public and private institutions and engages with the wider public. In 2020, CEEW has once again been featured across nine categories in the *2019 Global Go To Think Tank Index Report*. It has also been consistently ranked among the world's top climate change think tanks. Follow us on Twitter @CEEWIndia for the latest updates.

The **CEEW Centre for Energy Finance** (CEF) is an initiative of the Council on Energy, Environment and Water (CEEW), one of Asia's leading think tanks. CEF acts as a non-partisan market observer and driver that monitors, develops, tests, and deploys financial solutions to advance the energy transition. It aims to help deepen markets, increase transparency, and attract capital in clean energy sectors in emerging economies. It achieves this by comprehensively tracking, interpreting, and responding to developments in the energy markets while also bridging gaps between governments, industry, and financiers.

International Energy Agency: The International Energy Agency provides authoritative data, analysis, and recommendations across all fuels and all technologies, and helps governments develop policies for a secure and sustainable future for all. The IEA was created in 1974 and examines the full spectrum of issues including energy security, clean energy transitions, and energy efficiency. It is a global leader in understanding pathways to meeting climate goals, reducing air pollution and achieving universal energy access, in line with the UN Sustainable Development Goals. The IEA family of countries accounts for 75% of global energy consumption, and includes 30 Member countries and 8 Association countries -- Brazil, China, India, Indonesia, Morocco, Singapore, South Africa, and Thailand.

Council on Energy, Environment and Water, Sanskrit Bhawan, A-10 Qutab Institutional Area, Aruna Asaf Ali Marg, New Delhi - 110067, India

International Energy Agency, 9 rue de la Fédération, 75739 Paris Cedex 15 France

The authors

Edition authors: Arjun Dutt, Lucila Arboleya, and Pablo Gonzalez
Series editors: Kanika Chawla and Michael Waldron

KANIKA CHAWLA | kanika.chawla@ceew.in

Kanika Chawla is a policy specialist working at the intersection of renewable energy and financial markets. She is the Director of the CEEW Centre for Energy Finance and also manages CEEW's research and outreach in renewable energy policy, regulation, markets, and socio-economic value.

MICHAEL WALDRON | Michael.WALDRON@iea.org

Michael Waldron is a Senior Energy Investment Analyst who leads the investment team and the World Energy Investment report at the International Energy Agency. His work focuses on assessing the implications of energy investment and financing trends for meeting energy security and sustainability goals.

ARJUN DUTT | arjun.dutt@ceew.in

Arjun Dutt is an Associate at the CEEW Centre for Energy Finance. His work is geared towards enhancing the flow of affordable finance towards clean energy in emerging economies. This includes analysing the risks constraining the flow of capital towards clean energy and developing suitable interventions to de-risk investments.

LUCILA ARBOLEYA | Lucila.ARBOLEYASARAZOLA@iea.org

Lucila Arboleya is an Energy Economics and Financial Analyst at the International Energy Agency, focusing on clean power investments, financing costs of renewables and policies to attract capital for the clean energy transition in emerging market and developing countries.

PABLO GONZALEZ | Pablo.GONZALEZ@iea.org

Pablo Gonzalez is an Invesment Analyst at the International Energy Agency. His work focuses on investment, financing and modelling in the electricity sector, with a special focus on renewables, grids and storage.

Contents

Image: iStock

Tables

Figures

Boxes

Equity IRR expectations for solar park projects are around 20-260 basis points lower than those for non-solar park projects.

Image: iStock

CEEW-CEF and IEA Clean Energy Investment Trends

To achieve its clean energy ambitions, India's policymakers, industry actors, and financiers must act in concert. For investments in clean energy to scale, policy measures must address the investment risks perceived by financiers and developers.

The Clean Energy Investment Trends is a joint project of the Council on Energy, Environment and Water Centre for Energy Finance (CEEW-CEF) and the International Energy Agency (IEA). By monitoring market activity and identifying market and financing trends, the project seeks to provide a practical guide to stakeholders for understanding how the interaction between risks and regulations is shaping investment flows. The insights generated from the analyses of financing and market trends could be used to inform future policy action geared towards enhancing investment flows.

Themes examined in the *Clean Energy Investment Trends 2020* report

Interest to invest in the Indian renewable energy sector remains strong, even amid the ongoing Covid-19 pandemic. Over 12 GW of utility-scale renewables projects were sanctioned at the peak of a nationwide lockdown in the second quarter of 2020[1]. Financial performance expectations are crucial – even as the economic downturn has curbed investment around the world, the relatively resilient return picture around renewable power assets and equity securities, is creating new opportunities for investors to allocate capital towards the sector. Still, a number of risks and barriers remain towards realising the much higher levels of investment needed to align with a sustainable pathway.

To shed light on these issues, the *Clean Energy Investment Trends 2020* report examines the appeal of utility-scale solar photovoltaics (PV) and onshore wind in India by analysing project-level equity returns expectations over 2019 and the first half of 2020. Further, it examines key sensitivities of returns and challenges in attracting capital stemming from issues related to policy uncertainty, the financial health of state distribution companies (discoms), volume risk, and land-related constraints. In addition, the report also offers an update on key renewable energy debt financing and market trends.

Key findings

The ongoing COVID-19 pandemic has caused social and financial turmoil that have upended markets and created new risks for energy investments in India. In the years preceding the pandemic, the country saw large investment flows into renewable power, with capital spending up by almost 60 per cent in the five years through 2019 (IEA, 2020c). In 2020, the pandemic has disrupted clean energy supply chains, further weakened the financial position of discoms, and taken a toll on investment flows. These dynamics have added new layers of risk to ongoing challenges related to land acquisition, contract renegotiation, and equipment pricing uncertainties in light of potential new trade measures in the case of solar PV and limited supplier options in the case of wind. Thus, financing uncertainties have grown for both utility-scale solar and wind. At the same time, structural barriers to investment persist for less bankable segments such as distributed solar PV.

Nevertheless, interest to invest has continued despite the global economic slowdown, with the sanctioning[2] of over 15 GW of new utility-scale solar PV and wind capacity via competitive tenders through the first half of the year, almost equivalent to the total amount sanctioned competitively in 2019. Capacity sanctioned in the first half of 2020 was boosted by 8 GW awarded as a result of an option exercised by Adani Green Energy and Azure Power in June 2020 to expand

> **Aggregate equity IRR expectations for solar on average rose from around 14% in the first half of 2019 to around 16% over the course of the second half of 2019 through to mid-2020.**

1. Includes 8 GW related to an option exercised by two developers in June 2020 corresponding to a tender awarded in Dec 2019. All references to years in this report refer to calendar years.
2. Project sanctioning refers to a firm commitment to invest in capacity either awarded through competitive auctions or in the form of captive generation (these are not awarded competitively). Unless specified, project sanctioning also includes captive generation projects.

allocations under SECI's manufacturing-linked tender (2 GW each was awarded in December 2019).

Our analyses of utility-scale solar PV and wind projects sanctioned from the beginning of 2019 to mid-2020 and tariff awards in the same period suggest that the financing terms for projects, and the risks and returns proposition facing developers, have begun to shift. Estimates of equity returns expectations have edged upwards on aggregate, whereas sponsors continue to expect higher returns to compensate for greater off-taker and land acquisition risks. Project debt terms have remained relatively stable, but more accommodative monetary conditions have not translated into lower borrowing costs as they have in some other parts of the world. These indicators point to growing uncertainty over India's ability to attract a diversity of private finance from domestic and international sources to affordably meet its ambitious renewable energy targets in the years ahead.

The *Clean Energy Investment Trends 2020* analysis identified the following key trends:

- **The availability and pricing of project debt finance have remained relatively stable over the period of analysis, with differences arising mainly due to off-taker risks.** Utility-scale solar PV and onshore wind projects continue to be highly leveraged, with average debt-to-equity ratios of around 75:25. Lenders were willing to extend loans for long tenures (16–18 years) at interest rates of around 10–11 per cent for these projects. Where risks were perceived to be higher, interest rates too were higher, by up to 50 basis points compared to projects with the most creditworthy off-takers, controlling for other factors.

- **Our estimate of the expected equity internal rate of return (EIRR) for solar PV projects stood at around 15% on a weighted average basis (by awarded capacity) over the course of 2019 and the first half of 2020, with considerable variations depending on off-taker risk, type of site, and in response to ongoing policy, regulatory, and market developments.**

  » Solar PV EIRRs increased from 14 per cent in

Equity IRR expectations are higher by 80-200 basis points for projects with state off-takers compared to those with central off-takers.

the first half of 2019, to 16–17 per cent over the second half of the year through mid-2020. This rise likely stems from policy and market uncertainty over potential contract renegotiation and the imposition or extension of duties on solar PV imports, further exacerbated by supply chain uncertainties caused by COVID-19 and delays in the signing of power purchase agreements (PPA) in 2020.

  » Within the estimated range of EIRR expectations, projects with more creditworthy off-takers were associated with lower returns. While EIRR expectations for projects with central off-takers and Gujarat discoms were at par, these were 80-200 basis points higher for projects in which the state off-taker utility presented a higher credit risk in 2019. However, even higher spreads were observed for projects between central and state off-takers in early 2020, perhaps reflecting higher risk aversion among investors as a result of the disruption caused by COVID-19 and uncertainty stemming from other ongoing policy, market, and regulatory developments.

  » Projects with better access to land and timely grid connections also had lower EIRR expectations. The EIRR for projects to be set up on solar park sites (which provide developers with ready land and evacuation infrastructure) were 20–260 basis points lower than the EIRRs for projects on developer-acquired land.

  » Limited tendering activity in wind power in 2019 precluded a comprehensive examination of equity returns in that sector. Projects analysed corresponded to those with more creditworthy off-takers (central agencies and Gujarat discoms) and estimated EIRR expectations averaged around 13 per cent. These were comparable to solar EIRRs for the same category of off-takers over the same time period. Moreover, the need to abide by tender-specific tariff caps in the face of rising equipment costs in 2019 due to limited supplier options could also have capped EIRR expectations.

- **An evolving level of competition within tenders has been an important determinant of equity returns expectations.** Several recent tenders have been characterised by low competition in terms of the amount of capacity bid compared to that tendered, likely as a result of prevailing policy, regulatory, and market uncertainties. Investors expected higher returns at these tenders.

- **At the same time, the market concentration of developers sanctioning new solar PV and wind capacity has remained high, edging up for solar PV.** The shift towards fewer, top developers reflects their greater risk-taking capacity and ability to navigate the uncertainty associated with policy, regulatory, and market changes.

  » While the top 10 solar PV developers (in terms of sanctioning capacity) have changed from one year to another over the 2015-2018 period, in 2019 this trend reversed—seven out of the top 10 solar PV developers in 2019 were the same as those in 2018. For wind, the churn rate was higher in 2019, perhaps indicative of waning interest to invest in wind capacity amid the heightened execution risks.

- **Developers prefer central government entities as off-takers.** Project sanctioning shifted strongly towards projects tendered by central government off-takers over 2019 and the first half of 2020. This was also because of greater capacity being tendered by central government entities compared to those by state entities, perhaps reflecting market preference for more creditworthy counterparties.

- **Payment delays and volume risks represent key downside risks that, if realised, can significantly undermine returns.** Given the competitive nature of India's renewable energy auctions, developers generally do not factor in these risks in their bids and underlying financial models. Yet, small negative variations in both factors can create considerable deviations between realised and expected returns, as illustrated by an indicative sensitivity analysis included in this report.

- **The timely availability of suitable sites for setting up renewable energy projects is emerging as an additional challenge for both solar PV and wind projects.** Land-related constraints have slowed the development of solar parks, with the share of new solar PV capacity sanctioned in solar parks down to less than 10 per cent in 2019 from over 50 per cent in 2017. In addition, challenges with land availability in wind-resource-rich states have delayed wind project development and brought new tendering to a standstill, particularly in the wake of changes in land policies in Gujarat.

- **Tender design is evolving in response to emerging challenges.** Around 60 per cent of the projects sanctioned in the first half of 2020 involve newer project arrangements, including the hybridisation of wind and solar PV and project development bundled together with a requirement to set up domestic solar PV manufacturing capacity. This trend reflects increasing innovation in tender design to address challenges such as the grid integration of renewables and land availability for projects, as well as a tool for the attainment of other policy objectives such as to support domestic manufacturing.

Still, such dynamics also raise uncertainties over the future pricing and the comparability of risks and returns metrics by developers, lenders, and analysts, necessitating more sophisticated tools and analysis to reliably gauge financing trends in the years ahead.

1. Investment trends

India's renewable power market witnessed steady investment flows throughout 2019 and considerable interest from developers in the first half of 2020. Investments in India's renewable power sector have steadily risen in recent years, reaching almost USD 18 billion in 2019 and surpassing capital expenditure in the thermal power sector for the fourth year in a row.[3] By August 2020, utility-scale solar PV installed capacity reached nearly 33 GW while wind stood at 38

3. Investments are measured as the ongoing capital spending in power capacity and include investments in large hydropower plants. 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 (2020b).

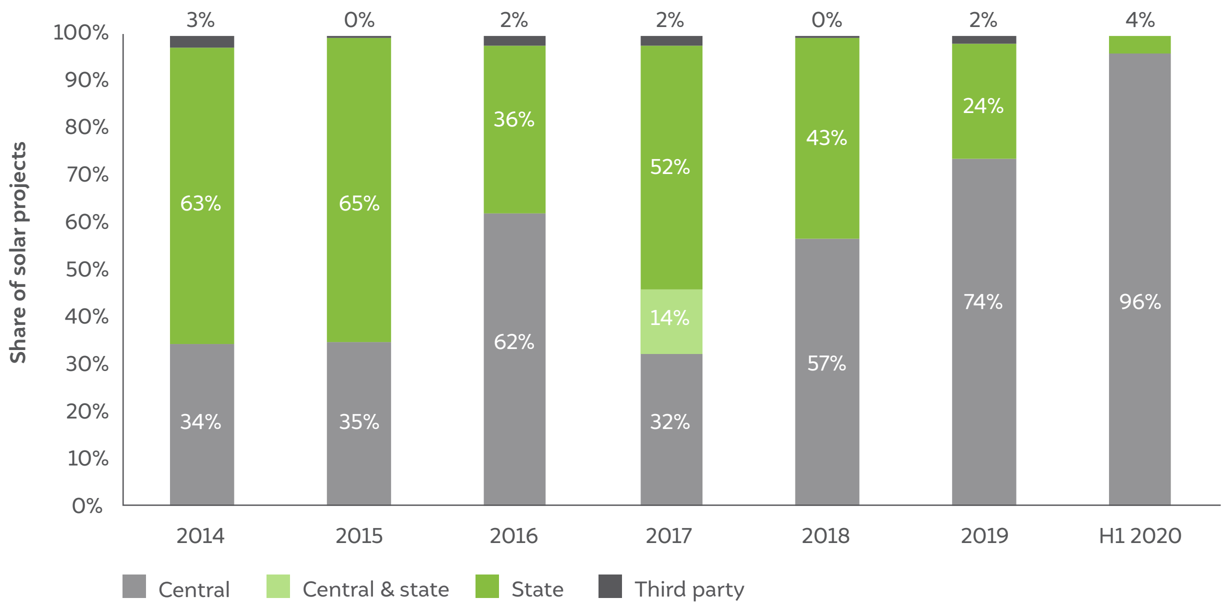
GW (MNRE 2020), despite a considerable slowdown in construction and shipping due to lockdowns and mobility restrictions enforced to curb the spread of COVID-19.

The *Clean Energy Investment Trends* series draws insights from a database of utility-scale solar PV and wind projects sanctioned between 2014 and the first half of 2020. The database indicates that 15.7 GW of solar PV capacity (including 1.4 GW solar–wind hybrid capacity) was sanctioned in 2019 – 28 per cent more than the 12.3 GW sanctioned in 2018 (including 840 MW solar–wind hybrid capacity). In the first half of 2020, 15.3 GW of solar PV capacity (including 1.6 GW solar-wind hybrid) was sanctioned. The sharp increase in the first half of 2020 was driven in part by 8 GW sanctioned in June 2020 as a result of two firms exercising an option to expand their allocations under a manufacturing-linked tender awarded in December 2019.[4] Even excluding the capacity allocation under the manufacturing-linked tender in 2020, the capacity awarded in the first half of 2020 was around 4 per cent higher year-over-year compared to the first half of 2019, and around 77 per cent higher than the first half of 2018, demonstrating the resilience of investor interest in the sector. In contrast, sanctioned wind capacity declined from 6.9 GW in 2018 to 2.9 GW in 2019 and no wind projects were sanctioned in the first half of 2020. Challenges in land availability for projects in wind-resource-rich states, and the weak financial positions of original equipment manufacturers (OEMs) exacerbated by the cascading effect of the ensuing delays, have restricted activity in wind tenders (see Section 5).

Developers demonstrated a strong preference for creditworthy off-takers in 2019 and mid-2020 (Figures 1 and 2). Such counterparties are mainly central government entities such as the Solar Energy Corporation of India Limited (SECI) and NTPC Limited (NTPC; formerly known as National Thermal Power Corporation), as well as state distribution companies (discoms) with high credit ratings, such as those in Gujarat.

In this report, we analyse in detail how both debt and equity financing terms have varied at the project level, in terms of aggregates as well as by the type of off-taker and site. We examine key sensitivities of equity investor returns to payment delays, volume risks (e.g. curtailment, low electricity demand, underperformance of technology, etc.) and variations in capital costs. We then shift our attention to sector-wide issues, highlighting how land is emerging as a key constraint for India's energy transition and how project-level activity has affected the industry-wide competitive landscape.

Figure 1 Share of sanctioned solar projects with central government off-takers has risen

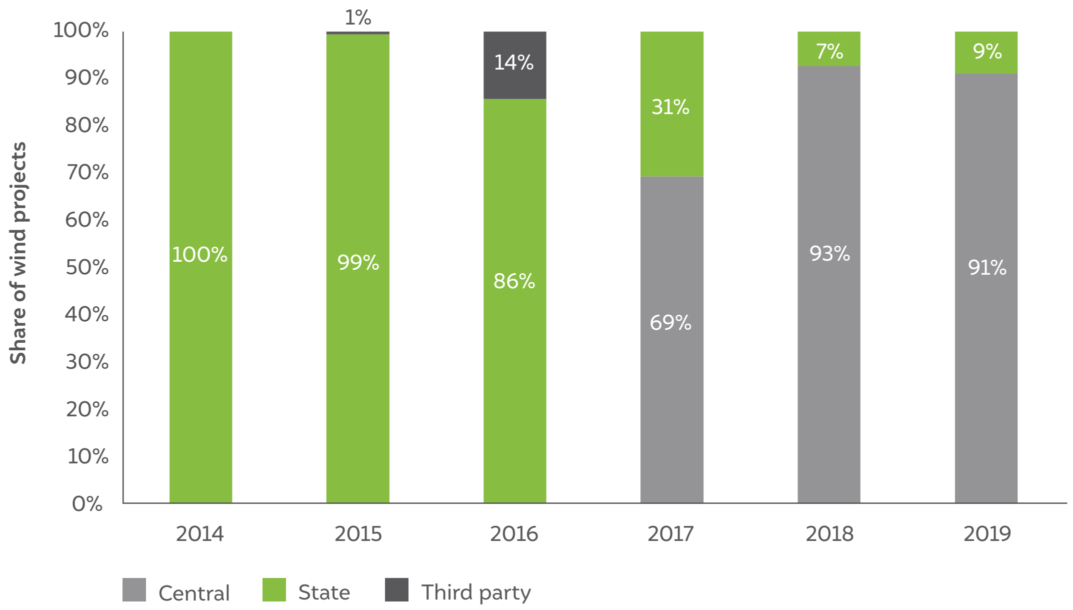


Notes: Central = SECI or NTPC, State = state discoms, Central and state = both central and state agencies as off-takers, Third party = private discoms or captive generation; excludes solar–wind hybrids.

Source: CEEW-CEF and IEA analysis.

4. The tender was managed by SECI and the two companies that exercised the option were Adani and Azure Power.

Figure 2 Central government off-takers dominate sanctioned wind projects



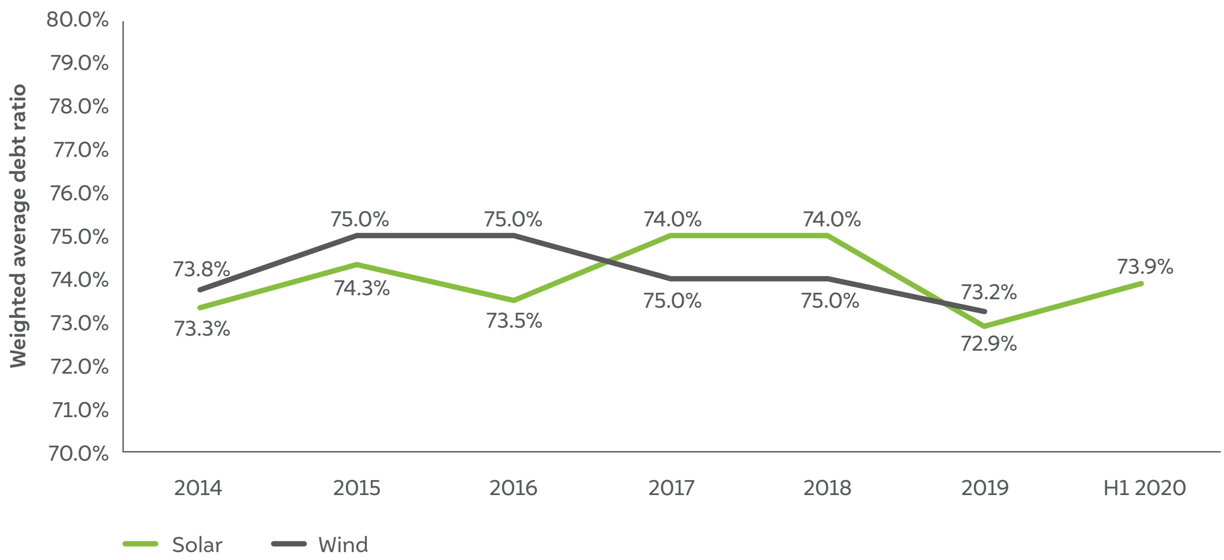
Notes: 1 Central = SECI or NTPC, State = state discoms, Central and state = both central and state agencies as off-takers, Third party = private discoms or captive generation; excludes solar–wind hybrids.
2 Excludes 728.8 MW of wind capacity awarded under GUVNL 1000 MW Grid Connected Wind Power Projects (Phase II-R) in 2019 – for which PPAs were not signed.

Source: CEEW-CEF and IEA analysis.

2. Project-level terms of debt

Solar PV and wind projects are capital-intensive infrastructure projects, financed largely through debt. On a capacity-weighted average basis, 74 per cent of solar PV capital costs were financed using debt in the first half of 2020; the figure was 73 per cent in the case of wind in 2019 (Figure 3). These indicate that debt ratios remained close to 75 per cent for both solar and wind.

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



Source: CEEW-CEF and IEA analysis.

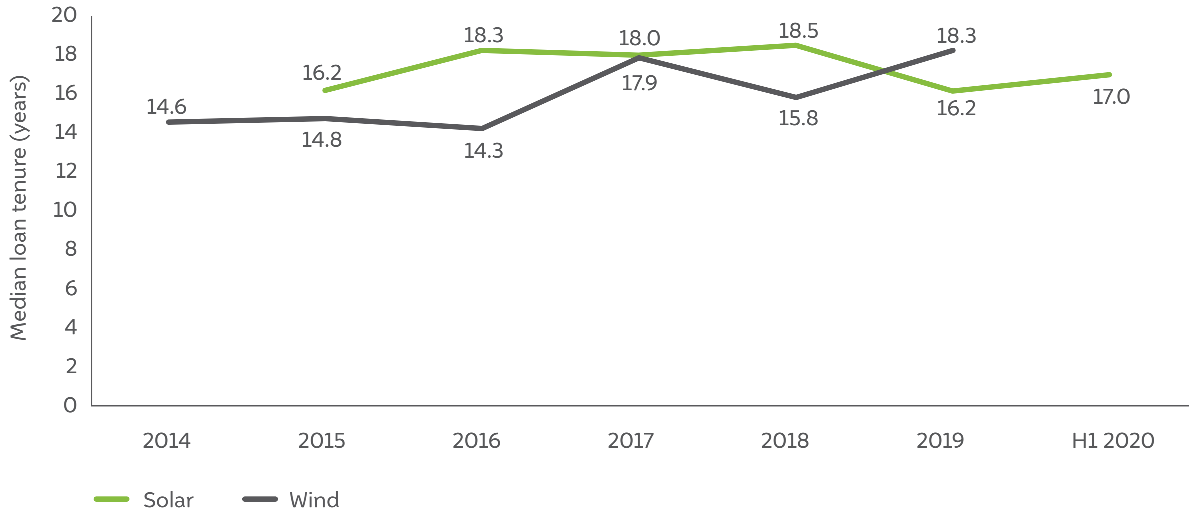
Debt financing for India's renewable energy projects largely comes from domestic financial institutions, banks, and non-banking financial companies (NBFCs).[5] The overall cost of debt for renewable projects depends upon both, financial institutions' internal benchmark rates (MCLR for banks, PLRs for NBFCs), as well as spreads over the benchmark rates offered for renewable loans.[6] Lending competition among financial institutions may also temper overall interest rates.

Expansive monetary policy and liquidity support for NBFCs amid the COVID-19 pandemic has had a moderating effect upon benchmark rates, which could persist at these levels in the near term (PIB 2020) (RBI 2020).[7] Further, as discussed in *Clean Energy Investment Trends 2019* (Dutt, Arboleya, and Mahadevan 2019), supportive policies and a maturing industry helped reduce risk perceptions and improve debt financing terms for solar PV and wind in India, enabling renewable investments at lower costs. This availability of long-term debt has been critical in supporting higher levels of investment in renewables given the highly leveraged nature of solar PV and wind projects.

Debt financiers assess the risks associated with project-level cash flows to determine the terms to be offered to a renewable project. These risks may be tempered by additional guarantees or collateral from the sponsor. The terms of debt vary considerably, depending on the project arrangement and risk management approach. However, the following characteristics are commonly associated with most renewables loans:

- Long-tenure debt for greenfield renewable energy projects is available for most projects (Figure 4).
- Loan tenures typically include moratorium periods of up to one year after the scheduled commissioning date of the project. While interest accrues over this period, loan repayment commences only after the expiry of this grace period.
- They typically require sponsors to establish debt service reserve account provisions for up to six months of debt repayment.
- They expect a minimum debt service coverage ratio (DSCR) of 1.1 generally. The DSCR represents the minimum share of net operating income that needs to be available to service the debt (for both principal and interest). Average DSCR requirements can vary. Some financiers indicated that average DSCR requirements for wind loans could be 5–7 basis points higher than those for solar loans, though there is limited empirical evidence of this due to low wind project sanctioning in recent years.

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



Source: CEEW-CEF and IEA analysis.

5. Companies that exercised the option were Adani and Azure Power. Are lenders to Indian renewable projects over the course of 2019 and the first half of 2020.
6. MCLR = marginal cost of fund based lending rate; PLR = benchmark prime lending rate.
7. The MCLR of the State Bank of India, India's largest lender by assets, decline by 90 basis points between January and September 2020 (SBI 2020).

Interest rates

One of the most important determinants of the perceived risks associated with project cash flows is the creditworthiness of the off-taker, the counterparty in the PPA. Central government off-takers (SECI, NTPC), due to their quasi-sovereign status, and Gujarat discoms are regarded as off-takers with superior creditworthiness by renewable debt financiers (Table 1).[8]

Table 1 State off-takers by integrated ratings of discoms

State	Discom name (ratings)
Gujarat	DGVCL (A+), UGVCL (A+), MGVCL (A+), PGVCL (A+)
Maharashtra	MSEDCL (A)
Uttar Pradesh	KESCO (B+), PVVNL (B), MVVNL (C+), PUVVNL (C+), DVVNL (C+)

Notes: Integrated ratings, awarded by the Ministry of Power, evaluate discoms on operational, financial, regulatory, and reform-related parameters. The states mentioned in Table 1 are those that constituted off-takers for renewable projects over 2019 and mid-2020. The table includes the ratings of all the discoms in each state.

Source: Ministry of Power 2019.

Debt financiers have extended loans to projects located in states characterised by a range of financial and operational discom performance, reflecting a continued interest in financing the renewable power sector. However, they expected higher interest rates for loans to projects involving less creditworthy off-takers, when controlling for other factors (Table 2). Interest rates for solar projects involving more creditworthy off-takers (central entities and Gujarat discoms) were up to 50 basis points lower, controlling for other factors.

In terms of lending to the solar PV sector, interest rates were slightly more competitive for projects located in

> Lending rates are higher by up to 50 basis points for projects with state off-takers compared to those with central off-takers, controlling for other factors.

Table 2 Average interest rates by off-taker and type of project site

Entity	Solar park	Non-solar park	Wind
SECI/NTPC/ Gujarat	10.50%	10.65%	10.65%
Maharashtra	-	10.75%	-
Uttar Pradesh	-	11.15%	-

Note: These figures refer to lending rates charged by leading NBFCs for renewable energy loans between Jan 2019 and June 2020. Market interactions indicate that NBFCs were the largest lenders to the Indian renewable energy sector over this period.

Source: CEEW-CEF and IEA market intelligence.

solar parks vis-à-vis those located on developer acquired or leased land, primarily due to lower land and evacuation infrastructure risks associated with solar park projects.

3. Project-level equity returns

Equity, the other principal financing instrument, accounts for around a quarter of the project costs of utility-scale solar PV and wind projects in India today. While these projects are financed predominantly through debt, where repayment and recourse terms are agreed upfront, the higher risk profile associated with equity – given its junior position in the cash waterfall relative to debt – combined with prevailing conditions in the Indian market, create relatively high returns expectations among shareholders. On the one hand, healthy equity returns are a strong signal for developers and investors to commit capital. However, perceived risks and barriers can heighten returns expectations and translate into higher financing costs, which can limit the pace of investment as well as the diversity of investors that participate in financing the sector.

This section examines EIRR expectations associated with renewable projects in India, first in aggregate terms and then those associated with specific project

8. Based on stakeholder consultations.

categories. We reverse engineer the expected EIRR of awarded projects through a discounted cash flow analysis given the awarded tariffs, estimated project costs, production parameters, and indicative terms of debt. 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 utility-scale solar PV

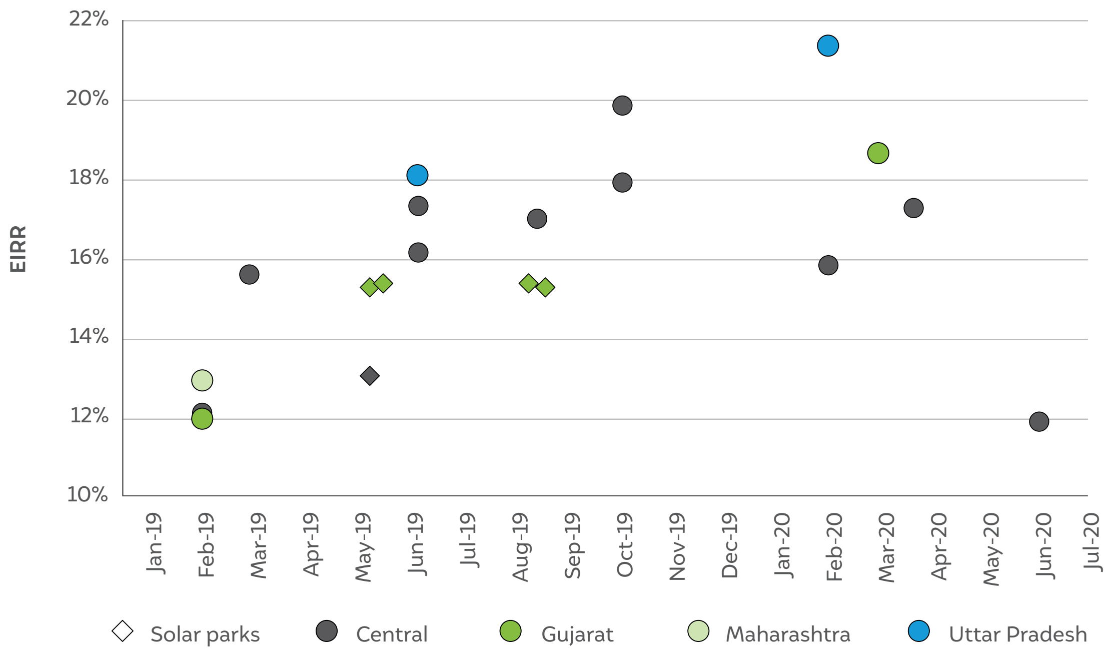
Our analysis of utility-scale solar PV projects awarded in 2019 and the first half of 2020 suggests that the implicit EIRRs of these projects were 15.2 per cent in 2019 and 15.3 per cent in 2020 (estimated on a capacity-weighted average basis, based on sanctioned capacities), around 1.4 times the cost of debt financing of 10.5–11.2 per cent during the period.

Expected EIRRs for solar PV projects rose over the period, from 14.5 per cent in the first half of 2019 to around 17.8 per cent in the second half of 2019 and 15.3 per cent in the first half of 2020 (Figure 5). Expected EIRRs continued to be high during months marked by high market uncertainty resulting from the COVID-19 pandemic. International developers pushed tariffs to a record low of INR 2.36/kWh in June 2020. This tender was extremely competitive with bids received amounting to 2.6 times the capacity tendered (see Table A14 in Annexure 3). The winning developers may have had access to cheaper sources of debt than that assumed in this report, which could have enabled them to factor in higher returns than those estimated.

Equity IRR expectations over the course of 2019 and the first half of 2020 averaged around 15 per cent.

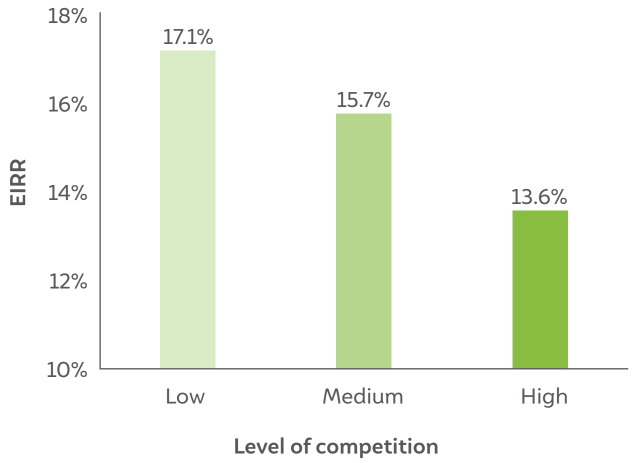
Competition within tenders was an important determinant of returns expectations (all else being equal). Tenders characterised by lesser competition were associated with higher EIRRs, while those marked by greater competition were on average associated with lower EIRRs (Figure 6; see also Table A11 in annexure for more details). Tenders over the period of analysis were subject to tariff caps, which were designed to limit the maximum tariffs realised. These tariff caps were included by both central and state tendering agencies, with the MNRE finally scrapping the requirement in March 2020 (Chatterjee 2020). Some of these tenders saw limited participation, with the ceiling price likely providing an insufficient level of remuneration in the face of heightened risk perceptions.

Figure 5 EIRR expectations have increased since early 2019



Source: CEEW-CEF and IEA analysis.

Figure 6 Higher tender competition was associated with lower EIRR expectations



Note: The level of competition is measured as the ratio of capacity bid to capacity tendered. Low level of competition corresponds to a ratio < 1.0; medium-level corresponds to a ratio between 1.0 and 2.0, and high competition corresponds to a ratio higher than 2.0.

Source: CEEW-CEF and IEA analysis.

Several developments may have contributed to growing risk perceptions:

- The Andhra Pradesh government announced its plans to renegotiate renewable tariffs for already contracted renewable capacity in mid-2019 (Kumar 2019). Though this announcement was made by only one state government, it adversely affected off-taker risk perceptions with respect to India's renewable sector as a whole.
- The Indian government announced its intention to levy basic customs duty (BCD) on solar PV imports in February 2020 (Ministry of Finance 2020). While the BCD would be a pass-through cost for projects awarded before its imposition (under the change in law clause), the timelines and amount of compensation to be awarded by regulators are uncertain.[9] Concerns around lengthy approval times and the inadequacy of compensation have raised concerns among developers facing the potential imposition of the BCD.[10]
- The Directorate General of Trade Remedies undertook a review investigation pertaining to the potential extension of safeguard duties in March 2020 and subsequently issued a notice extending them for another year from July 2020 (Ministry of Commerce and Industry 2020).[11] This further added to the uncertainty around costs and the duties applicable on module imports going forward as well as raised concerns regarding the payment of timely compensation for developers awarded capacity before July 2020 under the change in law clause.
- For projects awarded through SECI tenders, the central tendering agency signs PPAs with developers only if it can sign back-to-back power sales agreements (PSAs) with state discoms. Before 2020, SECI would sign PSAs for each tender separately and then sign PPAs with developers. In the case of solar projects awarded between January and June 2020, SECI is looking to sign PSAs for the entire 15.3 GW awarded at a pooled tariff with state discoms. This capacity includes the 8 GW awarded under the manufacturing-linked tender in June 2020, which was signed at a relatively high tariff of INR 2.92/kWh. However, the inability to sign PSAs for this entire awarded capacity has delayed the signing of PPAs for tenders awarded in 2020. This delay has created uncertainty among market participants.
- The COVID-19 pandemic has disrupted clean energy supply chains and exacerbated uncertainties about the timely sourcing of solar modules and other equipment (Ministry of New and Renewable Energy 2020). Furthermore, demand risk and concerns over the worsening of the financial health of discoms due to the crisis have likely boosted risk perceptions.

9. The change in law clause is a contractual provision in PPAs, which entitles developers to financial relief from higher costs stemming from changes in regulation, usually those pertaining to indirect taxes or duties, that impact project costs. Developers are provided relief under the change in law clause after approval from the relevant electricity regulator.

10. Based on stakeholder consultations.

11. The applicable safeguard duty is 14.9 per cent from July 30, 2020 to January 29, 2021 and 14.5 per cent from January 30, 2021 to July 29, 2021.

BOX 1 Innovation in tender design

One of the key emerging trends over 2019 and 2020 is innovation in tender design. This innovation is primarily directed towards addressing the challenges of renewable energy integration and supporting domestic PV manufacturing.

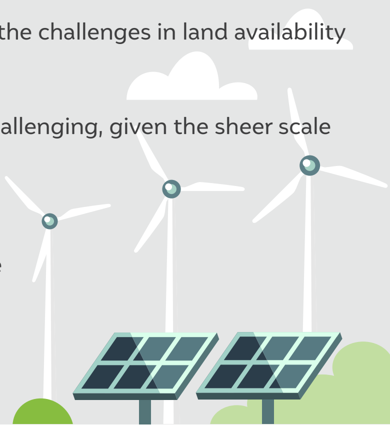
SECI has introduced several innovative tenders to support renewable energy integration:

- Solar–wind hybrid tenders reduce overall intermittency and improve utilisation of transmission infrastructure.
- Assured peak power supply tenders combine storage with solar–wind hybrid systems to ensure reliable power supply to meet peak power requirements.
- Round-the-clock energy tenders combine storage with solar–wind hybrid systems and specify high minimum capacity utilisation factor requirements (80 per cent annual, 70 per cent monthly). Projects may be located anywhere in India with multiple injection points into the grid. These improve transmission system utilisation and reduce intermittency.
- Round-the-clock storage-wind-solar-coal tenders require renewable energy, storage, and spare or under construction capacity to be located in the same regional load dispatch centre area and permits multiple delivery points into the grid. This improves the dispatchability of the delivered power and improves utilisation of transmission infrastructure.

The following tenders were introduced to support domestic PV manufacturing:

- *Central Public Sector Undertaking* (CPSU) scheme tenders: These tenders are for projects developed by state-owned entities that require the utilisation of domestically produced modules.
- Manufacturing-linked tenders: These tenders require the winner to undertake both project development and the setting up of new PV manufacturing facilities.
- In addition, floating solar tenders have also been introduced that respond to the challenges in land availability for ground-mounted utility-scale projects.

Going forward, renewable energy integration and land acquisition will remain challenging, given the sheer scale of India's renewable energy ambitions: 450 GW of renewable energy by 2030. Innovative tenders geared towards renewable energy integration and those addressing land-related challenges such as floating solar tenders could become even more common. In addition, given India's emphasis on creating a conducive ecosystem for PV manufacturing, we may see more tenders supporting domestic PV manufacturing.

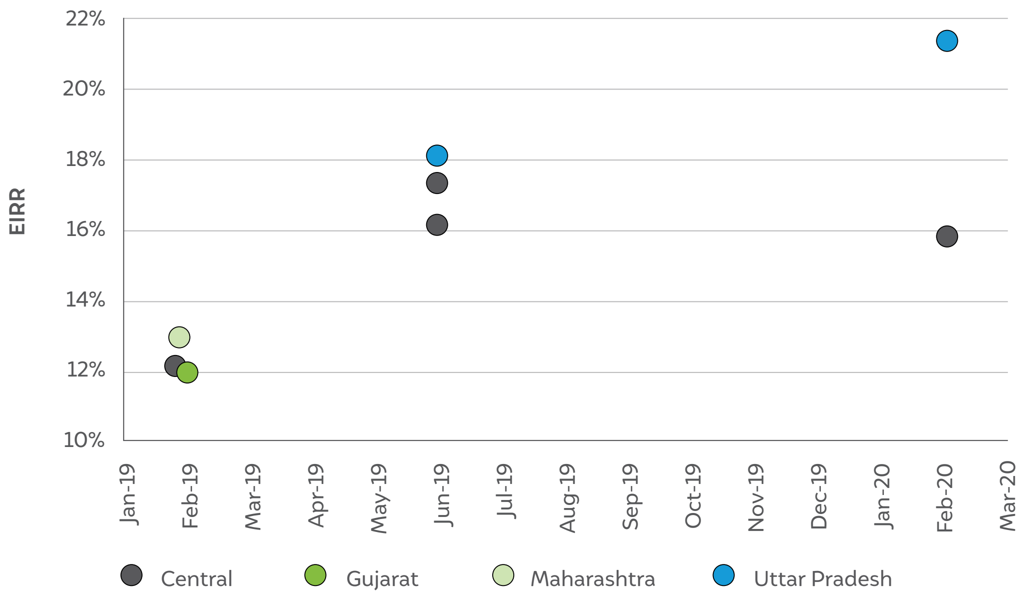


3.2 State versus central off-takers

To understand the underlying differences in returns expectations for projects involving central versus state off-takers, we compare projects awarded closely spaced in time (awarded in the same month). Though this limits the number of data points for comparison, it allows us to examine returns expectations under the same policy, regulatory, and market conditions, ensuring that these factors do not colour the comparisons.

Projects with the most creditworthy off-takers (central off-takers) had the lowest EIRRs, with creditworthy state discoms, such as those in Gujarat, having similar returns expectations (Figure 7). By contrast, less creditworthy states showed higher EIRR expectations (Table 3). The uncertainty induced by COVID-19, along with other policy and regulatory developments discussed in Section 3.1, may have heightened risk aversion among investors, translating into a much higher spread for state off-takers in 2020 (Table 3).

Figure 7 Central off-takers were associated with lower EIRR expectations than state off-takers



Source: CEEW-CEF and IEA analysis.

Table 3 EIRR expectations fell with increasing creditworthiness of off-taker

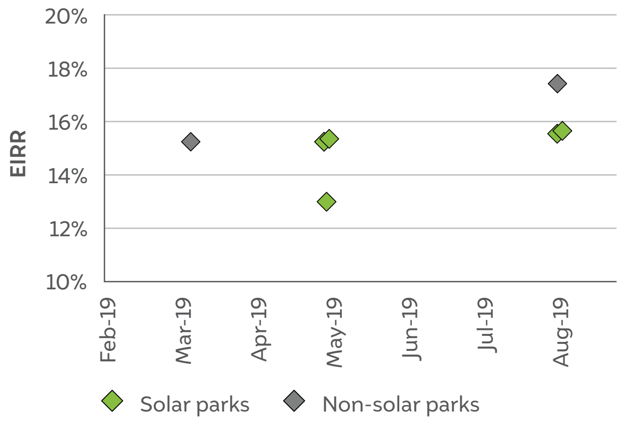
State off-taker projects			Central off-taker projects		
State	Month of award	EIRR	Month of award	EIRR	Spread state–central
Gujarat*	Feb 2019	11.9%	Feb 2019	12.1%	-0.2%
Maharashtra	Feb 2019	12.9%	Feb 2019	12.1%	0.8%
Uttar Pradesh	Jun 2019	18.1%	Jun 2019	16.1%	0.8–2.0%
			Jun 2019	17.3%	
Uttar Pradesh	Feb 2020	21.4%	Feb 2020	15.8%	5.6%

Note: GUVNL solar park projects had EIRR spreads of 230-240 basis points from central solar park projects in May 2019. However, this spread may have been inflated due to lack of investor interest in setting up projects at GUVNL solar parks - Raghanesda and Dholera. (Refer to Section 3.3 for details).

3.3 Solar park sites versus non-solar parks

This section examines variations in EIRR expectations based on the type of site: solar park versus non-solar park sites. To isolate other factors, we compare solar park and non-solar park projects awarded either in the same month or closely spaced (one or two months) in terms of timing of award. This enables an examination of returns under the same policy, regulatory, and market conditions, ensuring that these factors do not colour comparisons. Overall, projects to be installed in solar parks had lower EIRR expectations (Figure 8 and Table 4).

Figure 8 Projects in solar parks were associated with lower EIRR expectations



Source: CEEW-CEF and IEA analysis.

Return expectations for solar park projects were 20–260 basis points lower than those for comparable non-solar park projects (Table 4). Solar parks, which offer assured land and evacuation infrastructure to developers in exchange for a fee, help to manage land acquisition and transmission risks. The lower EIRR expectations associated with solar parks indicate how such mechanisms can help lower project cost of capital.

Variations in EIRR expectations among solar park projects

We also observed a wide variation in the expected returns at solar park sites – ranging from 13.0 per cent at the Dondaicha solar park to 15.3 per cent and 15.4 per cent at the Raghanesda and Dholera solar parks, respectively.

The divergence in EIRR may be attributed to differences in risk perceptions associated with various sites, given differences in the nature of the supporting infrastructure provided to developers at these sites. This is reflected in the solar park charges associated with each site (Table 5).

While Dondaicha has more comprehensive supporting infrastructure facilities, challenging site conditions at the Raghanesda and Dholera solar parks require the developer to undertake additional expenditure, especially in the case of Dholera (Sukumar 2020). The Dholera solar park is located close to the sea, and a portion of it floods during the monsoon and due to tidal variations (The Indian Express 2020). This entails considerable expenditure on civil works, which pushes up the cost of solar power generation relative to other sites. However, overall CAPEX (excluding modules) for all three solar parks is similar (summing up the corresponding entries in Table 5 in this section and Table A8 in Annex 3). Nonetheless, the higher risks associated with project development at the Raghanesda and Dholera solar parks translate to higher return expectations compared to at Dondaicha, resulting in lower investor participation in these tenders (table A14).

Table 4 EIRR expectations are lower for solar park projects compared to non-solar park projects

Solar park	Month of award	EIRR of the solar park project	Month of award of the comparable non-solar park project	EIRR of the non-solar park project	Spread
Dondaicha*	May 2019	13.0%	Mar 2019	15.6%	-2.6%
Raghanesda	May 2019	15.3%	Mar 2019	15.6%	-0.3%
Dholera	May 2019	15.4%	Mar 2019	15.6%	-0.2%
Raghanesda	Aug 2019	15.3%	Aug 2019	17.0%	-1.7%
Dholera	Aug 2019	15.4%	Aug 2019	17.0%	-1.6%

Note: The spreads for Gujarat solar park projects are computed relative to central non-solar park projects, given the lack of comparable non-solar park projects in Gujarat. This comparison was made considering the similar creditworthiness of Gujarat discoms and central tendering agencies. We compared solar park projects in May 2019 with non-solar parks projects from March 2019, to preclude the possible impact of Andhra Pradesh's PPA renegotiations on expected returns.

Table 5 Wide variations in solar park charges

Solar park	One-time solar park charges (INR million/MW)
Dondaicha Phase – I	4.75
Raghanesda Phase – III	4.03
Dholera Phase – V	2.01

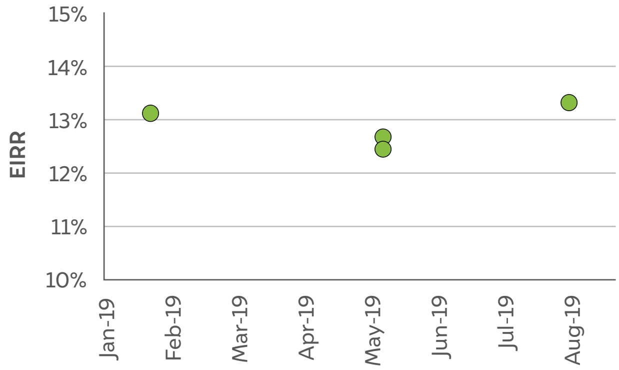
Source: Request for selection documents pertaining to the relevant tenders.

While Dondaicha has more comprehensive supporting infrastructure facilities, challenging site conditions at the Raghanesda and Dholera solar parks require the developer to undertake additional expenditure, especially in the case of Dholera (Sukumar 2020). The Dholera solar park is located close to the sea, and a portion of it floods during the monsoon and due to tidal variations (The Indian Express 2020). This entails considerable expenditure on civil works, which pushes up the cost of solar power generation relative to other sites. However, overall CAPEX (excluding modules) for all three solar parks is similar (summing up the corresponding entries in Table 5 in this section and Table A8 in Annex 3). Nonetheless, the higher risks associated with project development at the Raghanesda and Dholera solar parks translate to higher return expectations compared to at Dondaicha, resulting in lower investor participation in these tenders (table A14).

3.4 Aggregate EIRR expectations for utility-scale wind

The limited wind tendering activity in 2019 precludes a detailed examination of returns. While, EIRR expectations for wind were lower than those for solar (Figure 5) on average; only central entities Gujarat awarded projects. The estimated wind expected EIRRs are comparable to solar EIRRs for the same category of off-takers over the same time period. Further, the estimated EIRRs are perhaps reflective of the need to conform to applicable tariff caps despite higher equipment costs for projects awarded in 2019 relative to those in the past due to more limited supplier options. OEMs supplying turbines and other equipment were experiencing financial difficulties as a result of limited project deployment with the shift to competitive auctions in 2017. Further, delays in project execution for projects awarded in 2018 onwards have had a cascading effect on the entire sector, limiting the number of OEMs supplying turbines and other equipment (refer to Section 5.2).

Figure 9 EIRR expectations associated with wind projects



Source: CEEW-CEF and IEA analysis.

4. Sensitivity of equity investor returns to changing risks

While the previous section analysed the returns *expectations* of equity sponsors for solar and wind projects at the time of sanctioning, the *realised* returns could be different. Three prominent factors that affect realised returns include:

- **Off-taker risk.** Given the competitive nature of India's renewable energy auctions, developers generally do not account for payment delays on the part of discoms in their bids and underlying financial models.[12] However, the precarious financial position of several discoms, exacerbated by the economic disruption caused by COVID-19, is likely to place some projects at considerable risk of temporary revenue shortfalls or higher amounts of receivables. Long payment delays would translate into high working capital requirements and lower realised returns.[13]

12. Based on stakeholder consultations.
13. PPAs may include payment security mechanisms to mitigate these risks (e.g., requirements for discoms to issue a Letter of Credit).

- **Volume risk.** Renewable energy tenders offer a guaranteed price for the duration of the contract, but the volume of off-take is not explicitly enforced nor assured. This means that developers must account for this risk in their bids. Among the multiple sources of volume risk (curtailment, low electricity demand, underperformance of technology, faulty operation and maintenance, meteorological variations), curtailment risk seems to be of the greatest concern among investors. Due to its small share in the energy mix, renewables in India present a small to moderate risk for power system operation, but several states are already facing significant system integration challenges (IEA 2020a). These are a source of volume risk despite the must-run status conferred upon renewables from the perspective of power dispatch. While the central government supports greater interconnection across the country, requires the existing coal fleet to operate more flexibly and promotes affordable battery storage, unlocking a full and diverse set of flexibility options would require further market reform and investments, particularly in grid infrastructure. These needs come at a time when the long-term impact of the COVID-19 pandemic on economic growth, and therefore electricity demand, remains uncertain. Lower electricity demand may lead to lower available hours for all generators, with potential knock-on effects for renewables. These situations contribute to persistent volume risks that could affect the viability of some projects.
- **Capital expenses (CAPEX) assumptions.** Projects secured through tenders have an average gestation period of around 18 months from the date of award to commissioning. Equipment costs for solar and wind have declined over the past few years (IRENA 2020). Developers estimate equipment costs at the time of procurement while bidding for capacity. In the case of solar PV projects, actual module procurement occurs only 3–5 months before the commissioning date.[14] A more rapid decline in equipment costs than assumed by developers between the time of bidding and procurement of equipment can provide a boost to realised EIRRs.

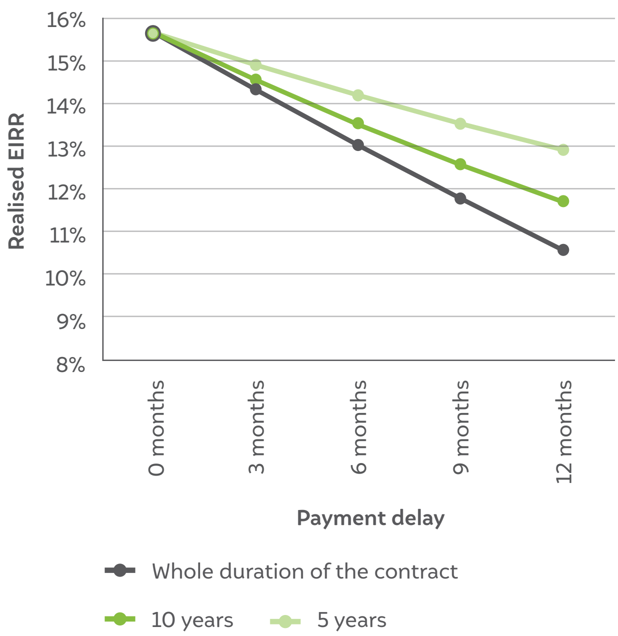
> Payment delays and volume risks, if realised, can significantly lower realised EIRRs compared to expectations.

Sensitivity analysis: payment delays, volume risk, and CAPEX scenarios

We conducted a sensitivity analysis to investigate the impact of payment delays, volume risks, and CAPEX variations on EIRRs (Figure 10). For the sake of simplification, we illustrate the impact of these factors on the median EIRR. Further, while we only present the returns for solar PV projects, a similar analysis also applies to wind.

Figure 10 illustrates the impact of payment delays on realised EIRR. The extent of the impact of payment delays on realised EIRR depends on two factors: the average delay in payments (number of months of receivables for developers) and the number of years for which the delay persists over the life of the contract. An average three-month delay over five years lowers the realised EIRR by 80 basis points compared to the expected EIRR. In the most extreme case, a 12-month delay over the duration of the contract could lower the EIRR by around 500 basis points.

Figure 10 Impact of variations in payment delays on realised EIRRs

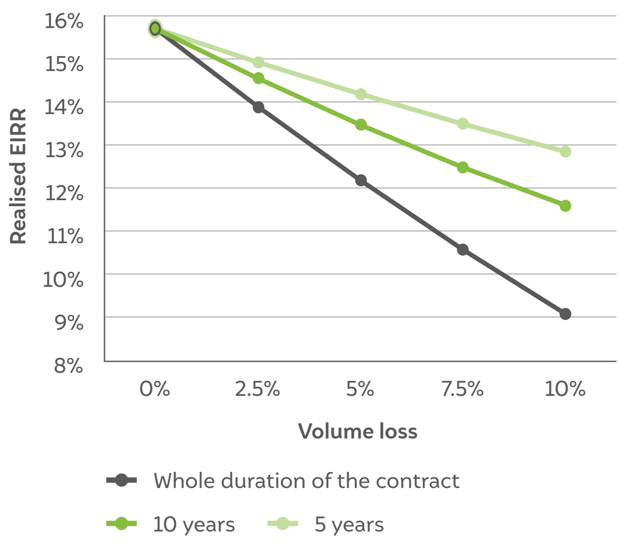


Source: CEEW-CEF and IEA analysis.

14. Based on stakeholder consultations.

Figure 11 illustrates the impact of volume risk on realised EIRR. We analysed volume risk using the same methodology as for payment delays. The EIRR for solar PV projects is impacted by around 70 basis points per every 2.5 per cent of total production lost in the first five years. If the same level of production loss persists through the lifetime of the project, the EIRR would decline by around 160 basis points per every 2.5 per cent of production loss.

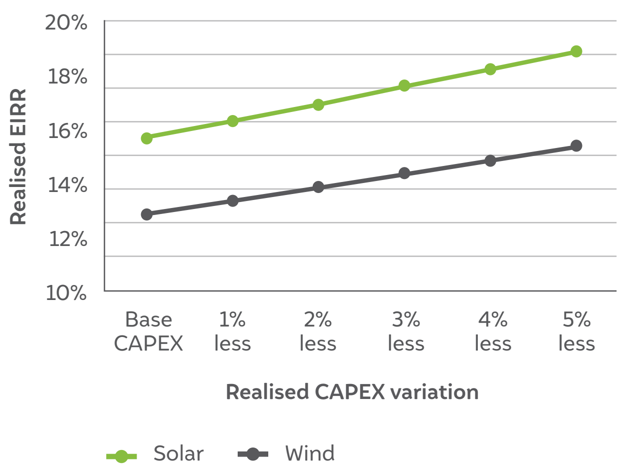
Figure 11 Impact of variations in off-take volumes on realised EIRRs



Source: CEEW-CEF and IEA analysis.

Figure 12 illustrates the impact of lower realised CAPEX (i.e. a larger drop in capital expenses) as compared to assumptions factored in at the time of bidding (assumptions as per our model). Every 1 per cent reduction in realised CAPEX increases the realised EIRR by around 60 basis points in the case of solar and 50 basis points in the case of wind.

Figure 12 Impact of variations in realised CAPEX on realised EIRRs



Source: CEEW-CEF and IEA analysis.

5. Land-related constraints could slow the pace of India's energy transition

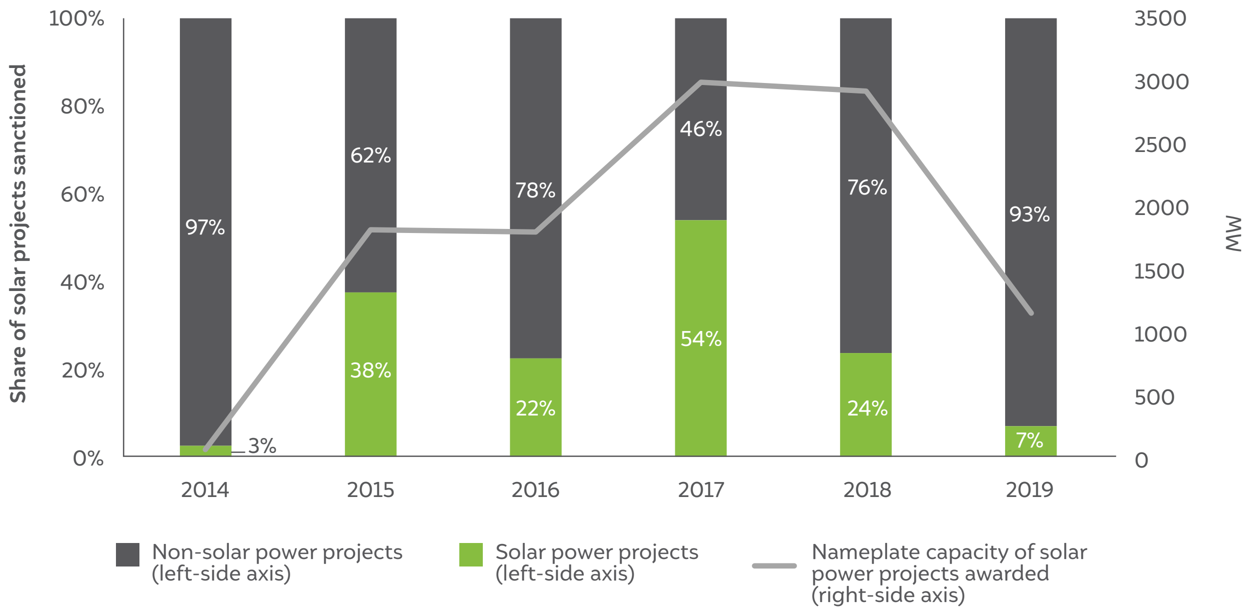
The timely availability of suitable sites for setting up renewable projects is emerging as a critical challenge for India's energy transition with evidence for both solar and wind deployment.

5.1 Diminishing share of solar parks in sanctioned capacity

Solar parks greatly improve the ease of doing business by offering developers a plug-and-play model for setting up projects. As a policy tool, these have been instrumental in accelerating the uptake of solar energy in India as well as in attracting foreign investors (Chawla et al. 2018). However, challenges associated with land acquisition have held back solar park development. This has translated to a decline in the share of projects located in solar parks in overall capacity awarded from 2017 onwards (Figure 13). Moreover, the capacity sanctioned for development in solar parks declined by around 60 per cent in absolute terms from 2018 to 2019. No capacity was awarded in solar parks in the first half of 2020.

Image: iStock

Figure 13 Diminishing share of solar parks in overall capacity sanctioned



Source: CEEW-CEF and IEA analysis.

5.2 Unavailability of suitable sites hampering wind deployment

Unlike solar resource, which is widely distributed throughout India, wind resource is geographically concentrated. The states of Gujarat and Tamil Nadu offer the best resource potential and account for around 45 per cent of India's cumulative wind installed capacity (Indian Wind Power 2020). Following sharp declines in tariffs after the introduction of power procurement through competitive auctions, setting up projects in these wind resource-rich states became essential for project viability.

Developers have been facing challenges in acquiring land for capacity awarded under auctions conducted by central agencies from the SECI Tranche-III and Tranche-IV tenders onwards, which were awarded in February and April 2018 respectively.[15] Changes in land policies for renewables projects in Gujarat made it challenging for developers to lease state-owned land for projects tendered out by central agencies. Further, these changes also limited applications for land allocation to entities that were awarded letters of award by central tendering agencies. This precluded land acquisition by land aggregators or wind OEMs on behalf of developers, which had been the pre-existing practice in land acquisition. This made land acquisition an onerous process, particularly for foreign developers.

With state-owned land unavailable for projects awarded under non-state government tenders, developers had to either set up projects on expensive privately-owned land, which adversely impacted their financial viability, or delay the financial closure and commissioning of projects. Land acquisition is also a challenge in Tamil Nadu, where state-owned land for wind projects is scarce and setting up projects on expensive privately owned land could make projects unviable. Delays in setting up wind projects have had a cascading effect on the sector, with several OEMs facing financial difficulties.

While investor confidence has suffered in India's wind sector, Gujarat's land policies have been modified since then to provide designated sites for projects tendered by central agencies (Chandrasekaran 2019). After the above modifications were issued by the Gujarat government, SECI awarded 970 MW in the latest tranche (Tranche-IX) of wind bidding. It remains to be seen how much capacity out of these newly awarded projects is set up in Gujarat, illustrating the impact of the recently amended land policy in Gujarat.

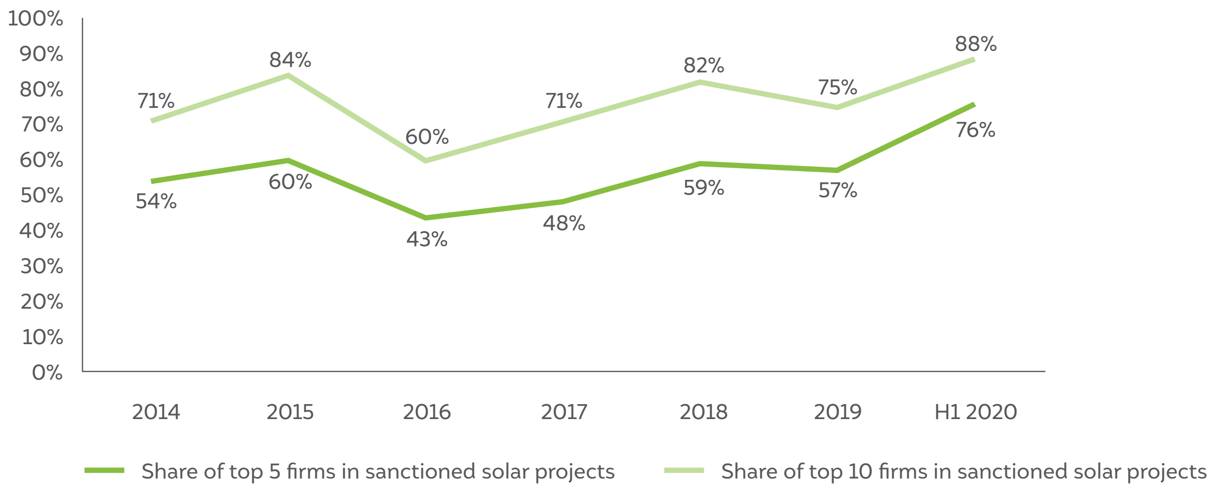
15. Based on stakeholder consultations.

6. Industry landscape

The *Clean Energy Investment Trends* series tracks the competitive landscape in the renewable sector through the 'market concentration' metric. We define 'market concentration' as the share of top developers in the total project capacity sanctioned in a particular year.

Market concentration in the sanctioning of new solar PV and wind capacity continued to remain high in 2019 and the first half of 2020 (Figures 14 and 15). The award of 8 GW of capacity under SECI's manufacturing-linked tender to two developers translated to heavier concentration in the first half of 2020. Access to debt finance on favourable terms gives the top developers an advantage in structuring competitive bids in renewable energy auctions (Tables 6 and 7). In addition, these developers also have greater risk-taking capacity, which perhaps enabled them to better navigate the uncertainty associated with policy, regulatory, and market developments over the course of 2019 and the first half of 2020.

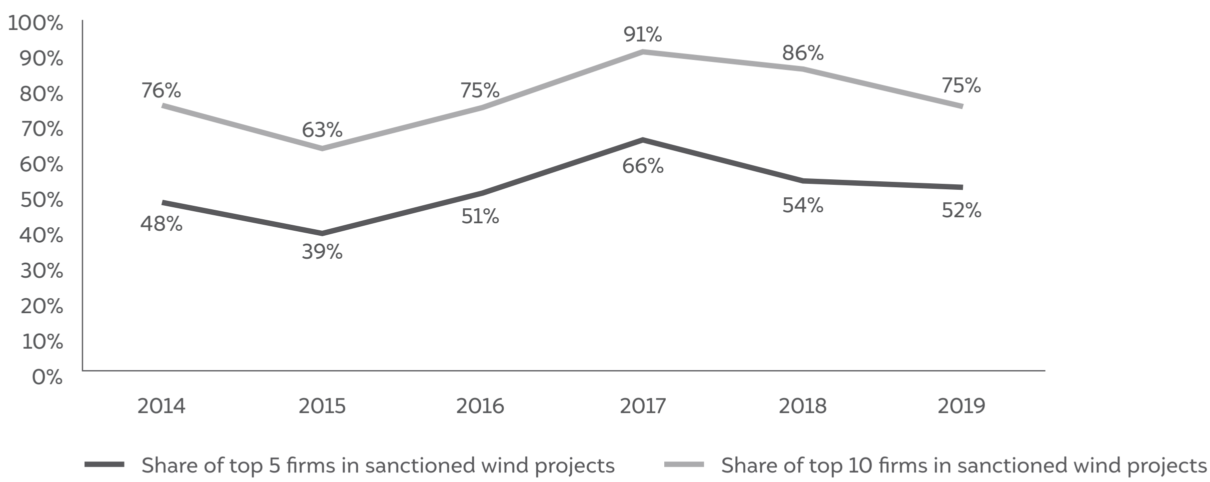
Figure 14 **Solar PV markets remained heavily concentrated**



Note: Solar–wind hybrid projects are excluded from this analysis.

Source: CEEW-CEF and IEA analysis.

Figure 15 **Wind energy markets remained heavily concentrated**



Notes: 1 Solar–wind hybrid projects are excluded from this analysis.
2 Excludes 728.8 MW of wind capacity awarded under GUVNL 1000 MW Grid Connected Wind Power Projects (Phase II-R) in 2019 – for which PPAs were not signed.

Source: CEEW-CEF and IEA analysis.

Table 6 Top 10 developers by capacity awarded (2019)

Solar PV	Capacity awarded (MW)	Wind	Capacity awarded (MW)
Azure Power	2670	Adani	380
Adani	2150	Renew Power	350
NTPC	1992	SB Energy	324
Renew Power	1415	CLP	251
Avaada Energy	940	Engie	200
Tata Power	780	Enel Green Power	189
SB Energy	630	Continuum Wind Energy	150
Acme Solar Holdings	550	Ecoren Energy India Private Limited	125
Mahindra Renewables	450	Powerica	101
UPC Renewables	450	Solenergi Power	100

Note: Excludes wind projects that have not signed PPAs.

Source: CEEW-CEF and IEA analysis.

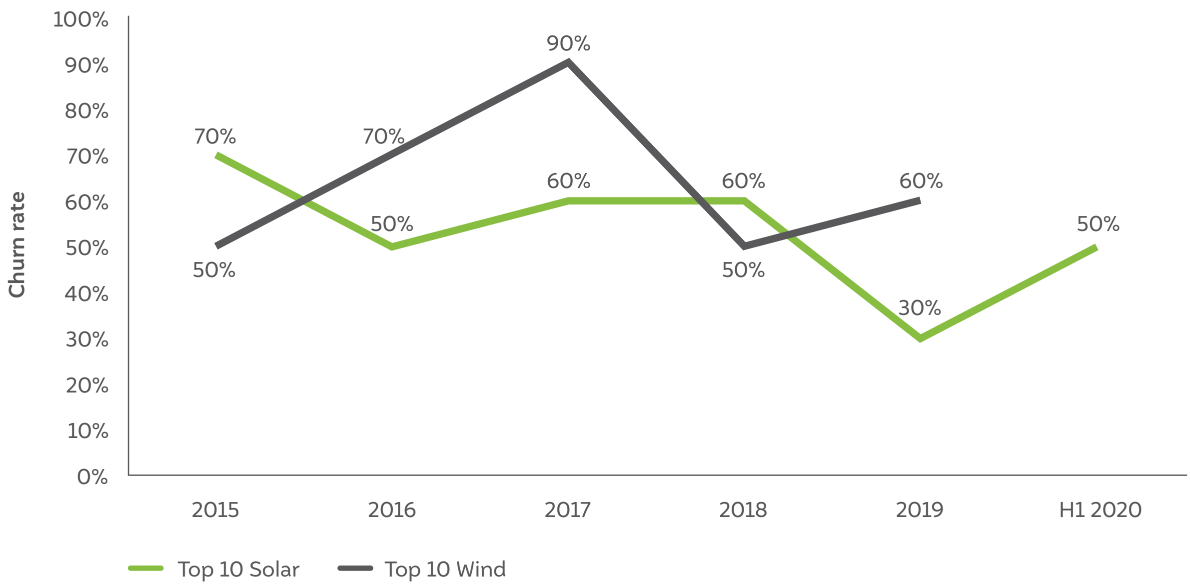
Table 7 Top 10 developers by capacity awarded (H1 2020)

Solar PV	Capacity awarded (MW)
Adani	6000
Azure Power	2000
SB Energy	1200
EDEN Renewables	600
Renew Power	600
Axis Energy Group	400
O2 Power	380
IB Vogt	350
Avaada Energy	320
CDC Group	300

Source: CEEW-CEF and IEA analysis.

While the top 10 developers account for a large share of the capacity sanctioned for both wind and solar, there is a churn in the companies occupying the top 10 positions each year. The churn rate is defined as the extent of change in the top 10 developers with respect to the previous year – for example, a churn rate of 40 per cent in a particular year means that 40 per cent of the top 10 developers of the previous year did not feature in the top 10 of the present year. The churn rate remained high for wind in 2019, perhaps indicative of waning interest in investing in wind capacity amid heightened execution risks stemming from the non-availability of suitable sites for setting up projects. In contrast, the churn rate for solar dipped considerably in 2019 (Figure 16). Though solar PV had its own set of associated risks, these were not as severe as those pertaining to land availability for wind projects. The top developers that are best placed to navigate market uncertainties and conform to tariff caps continued to dominate capacity awards. The entry of a few first-time bidders increased the churn in the first half of 2020.

Figure 16 Churn rate for the top wind and solar developers



Source: CEEW-CEF and IEA analysis.

Despite the year-over-year churn in top developers, a few companies have emerged as leaders in terms of cumulative installed capacity (Table 8).

Table 8 Leading developers (cumulative installed capacity, up to June 2020)

Solar PV	Capacity (MW)	Wind	Capacity (MW)
Acme Solar Holdings	2900	Renew Power	2957
Renew Power	2352	Greenko Energy Holdings	2318
Adani	2198	Sembcorp	1730
Greenko Energy Holdings	2175	Mytrah Energy	1350*
Azure Power	1809	Tata Power	932
Tata Power	1704	CLP	925
NLC	1370	Continuum Energy	757
NTPC	870	Torrent Power	611
Hero Futures Energy	716	Hero Futures Energy	584
Avaada Power	680	Inox Renewables	550*

**Projects awarded by SECI and NTPC in the year 2018 were assumed to not have reached commissioning due to land acquisition issues.*

Source: CEEW-CEF and IEA analysis.

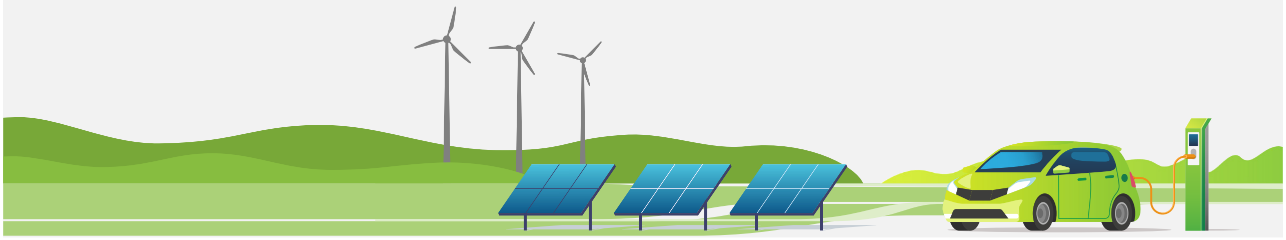
BOX 2 How does financing distributed energy resources differ?

While recent clean energy investment growth has come more from utility-scale renewables, distributed energy resources – such as rooftop solar PV, electric vehicle charging, and efficiency improvements – can play an important role in India's transition to a sustainable pathway. Financing can differ considerably from that for bulk power assets, with greater reliance on the balance sheets of consumers, micro, small, and medium enterprises (MSMEs), real estate, and renewable energy service companies (RESCOs), which may face tighter credit terms and a higher reliance on equity. Financial development constraints mean that only around 15 per cent of MSMEs have formal access to credit, relying instead on the more expensive, and less transparent, informal market for lending (Financial Express, 2020).

In distributed solar PV, around 65 per cent of the investment over the past five years has been concentrated in projects serving commercial and industrial buildings, many of which are subject to relatively high electricity tariffs (WEI, 2020b). Debt financing terms depend on the degree of self-ownership compared with ownership by third parties, as well as the remuneration model (e.g., net metering compared with energy savings from self-consumption). For projects that are self-owned and part of new buildings, the capital structure of real estate developers points to a wide potential range of debt shares (20–40 per cent; (Damodaran, 2020)). While this suggests a much higher reliance on equity than in utility-scale assets, equity returns for real estate are also lower. In the case of third-party-owned projects, financing depends primarily on the developer (e.g., Amplus Solar, Cleantech Solar, Sunsource Energy, and Tata Power Solar), with only some of these overlapping with utility-scale development. Utility ownership remains nascent, but it has the potential to grow as discoms recognise the value of integrating distributed solar into their portfolios.

In recent years, domestic lending capacity has been reinforced by development financing: preferential lines of credit of USD 625 million have been earmarked for distributed PV development by the World Bank in collaboration with the State Bank of India, and another USD 100 million has been designated by the Asian Development Bank in collaboration with the Punjab National Bank (IEA, 2018). While disbursal of these rooftop loans is currently under way, an acceleration in investment is yet to be seen.

Overall, a better understanding of the distributed solar financing landscape requires addressing data gaps, in terms of asset-level financing, corporate actors involved in project development, as well as the credit worthiness of smaller businesses and households. Analysing solar auction tariffs of renewable energy service companies for government off-takers may also offer a starting point for future analysis of project-level returns.



Annexures

Annexure 1
Terms and definitions

Equity internal rate of return (EIRR)
The EIRR is the internal rate of return for providers of equity capital at the project level. It is estimated through a discounted cash flow analysis on project cash flows net of payments to debt holders. 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.

Churn rate
Percentage change in the top 10 developers (in terms of sanctioned capacity) with respect to the previous year; e.g., a churn rate of 40 per cent in a particular year means that 40 per cent of the top 10 developers of the previous year did not feature in the top 10 of the present year.

Market concentration
Share of top developers in the total project capacity sanctioned in a particular year; e.g., market concentration of top five developers in year x = capacity sanctioned by top five developers / total capacity sanctioned in year x.

Annexure 2
List of EIRR by project type

Tables A1–A3 summarise the estimated expected EIRRs for solar and wind tenders analysed over the course of 2019 and H1 2020. Table A14 further specifies details pertaining to these tenders, while Annexe 3 provides details on the methodology for identifying tenders for analysis.

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

Feb-19	Mar-19	May-19	Jun-19	Aug-19	Oct-19	Feb-20	Apr-20	Jun-20
12.1%	15.6%	13.0%	16.1%	17.0%	17.9%	15.8%	17.3%	11.9%
			17.3%		19.9%			

Source: CEEW-CEF and IEA analysis.

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

State	Feb-19	May-19	Jun-19	Aug-19	Feb-20	Mar-20
Gujarat	11.9%	15.3%, 15.4%		15.3%, 15.4%		18.7%
Maharashtra	12.9%					
Uttar Pradesh			18.1%		21.4%	

Source: CEEW-CEF and IEA analysis.

Table A3 Expected EIRRs for wind projects

Feb-19	May-19	Aug-19
13.1%	12.5%	13.3%
	12.7%*	

**Note: Wind projects were all tendered by central off-takers except the GUVNL 1000 MW grid-connected wind power projects (Phase II-R) (EIRR of 12.7%).*

Source: CEEW-CEF and IEA analysis.

Annexure 3 Methodology

EIRR analysis

Project selection

Several factors collectively determine the EIRR expectations of developers. Factors such as the off-taker, project location, and type of site (solar park versus non-solar park) affect the performance, cost, and financing of projects and impact returns expectations. In addition, the specific requirements of tenders may also alter returns expectations. Some of these requirements include stringent timelines for demonstration of land possession prior to project commissioning, varying minimum capacity utilisation factors (CUF) requirements, or multiple possible deployment configurations (both applicable to hybrid tenders), and different modes of awarding capacity (reverse auction, green-shoe options, MoU route, etc). These specific requirements alter the performance parameters and costs associated with such renewable energy tenders and preclude comparability with awards of plain solar or wind capacity through a reverse auction mechanism.

This report aims to study variations in EIRR according to the off-taker, project location, type of site, and policy developments. To draw meaningful insights, it is important to ensure the general comparability of the projects analysed by controlling for tender-specific variations. Thus, this analysis excludes projects from the tenders listed in Table A4.

Tariff selection

The tariffs realised in renewable energy auctions typically occupy a narrow range. To determine the expected EIRR associated with a particular tender, we analysed the lowest successful tariff bid (L1 tariff). This follows from our assumptions pertaining to debt financing, for which we factored in the most competitive terms of debt applicable to specific categories of projects. These typically correspond to the lowest tariffs realised.

Sensitivity analysis

The sensitivity analysis draws on the base case expected EIRR analysis and modifies one input variable to analyse the effect on returns.

Payment delays

It is assumed that developers make up for shortfalls in cash flows stemming from payment delays through working capital loans. These working capital loans lower realised returns compared to their expected values.

Volume risk

Curtailment is modelled as a constant percentage annual loss of production during a certain set of years and thus a loss of revenue. Note that production loss is incremental to the annual degradation related to the operation of the renewable project.

CAPEX variations

Percentage variations are applied to the base CAPEX (expected at the time of bidding) to quantify its effect on the realised EIRR.

Table A4 Tenders excluded from the analysis

Tender name	Date of award	Tariff (INR/kWh)	Reason
MSEDCL 1350MW Mukhyamantri Agricultural Feeder Scheme Solar PV Projects	07/11/2019	3.14	Small-scale projects connected to agricultural feeders
MSEDCL 184MW solar PV projects	05/08/2019	3.05	Small-scale projects connected to agricultural feeders
MSEDCL 500MW ISTS Phase IV Solar Projects	18/12/2019	2.89	Requirement to identify 100 per cent of the land required before bidding
MSEDCL MSKVY Purchase of Solar Power via MoU Route	06/09/2019	3	Procurement not through competitive tendering
MSEDCL Purchase of Solar Power via MoU Route	21/11/2019	2.92	Procurement not through competitive tendering
MSEDCL Western Maharashtra (Ph-II-C) 50MW Solar Projects for Agricultural Feeders	27/12/2019	2.99	Small-scale projects connected to agricultural feeders
SECI 1.2GW ISTS Tranche-VII RE Peak Power Supply	31/01/2020	4.3	Hybrid tender, which required a specific generation profile and had higher minimum CUF requirements
SECI 1200 MW ISTS-connected Solar Wind Hybrid Projects (Tranche-II)	27/05/2019	2.7	Hybrid tender, specific CUF requirements
SECI 1500MW solar PV (Tranche-II) in CPSU Phase-II Scheme	08/11/2019	3.5	Required using domestically produced modules
SECI 2000MW Solar PV projects under CPSU Scheme Phase-II (Tranche-I)	26/09/2019	3.5	Required using domestically produced modules
SECI 400MW RE Power RTC Supply to NDMC, New Delhi and Dadra and Nagar Haveli	08/05/2020	2.9	Hybrid tender, specific CUF specifications
SECI 7GW ISTS solar PV linked with 2GW (per annum) solar manufacturing plant under Global Competitive Bidding	13/12/2019	2.92	Developer required to undertake PV manufacturing, staggered commissioning till 2025
SECI 7GW ISTS solar PV linked with 2GW(per annum) solar manufacturing plant under Global Competitive Bidding - GREENSHOE OPTION	09/06/2020	2.92	Developer required to undertake PV manufacturing, staggered commissioning till 2025
HPPC 300MW Grid-connected Solar PV Power Projects	16/08/2019	2.73	Tariff renegotiated downwards
TPC-D 150MW Grid-connected solar PV capacity	10/10/2019	2.83	Private discom off-taker

Source: CEEW-CEF and IEA analysis.

Annexure 4 Assumptions

Performance parameters

Solar

DC overloading is a common practice in the Indian solar energy sector. We assumed 40 per cent DC overloading in our analysis. The following table summarises the AC CUF assumptions for projects located in various states. The AC CUF for each state was derived based on solar power generation potential GIS data for the top 50 percentile districts in each state and was verified through inputs from market participants.

Table A5 Module performance parameters

State	AC CUF (@40% DC overloading)
Rajasthan	27.7%
Gujarat	27.6%
Madhya Pradesh	26.3%
Maharashtra	26.2%
Uttar Pradesh	24.0%

Notes: Projects under solar tenders that permit installation anywhere in India are assumed to be set up in Rajasthan. One central tender required projects to be set up in Madhya Pradesh; The analysis factors in an annual degradation in generation rate of 0.6 per cent.

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

Wind

The states of Gujarat or Tamil Nadu were assumed to be the locations for the projects. Based on market intelligence, a CUF of 39 per cent was assumed. Degradation in generation at the rate of 0.1 per cent per annum was assumed.

Capital costs

Land leasing was assumed to be the methodology for securing land for renewable energy projects (except for solar park projects, where solar park charges would apply). Thus, capital expenditure excluded land acquisition costs.

Solar

While developers typically factor in assumed module prices applicable at the time of procurement, given the limited visibility on developers' pricing assumptions for future time frames, we have assumed that the module price at the time of project award as the input price. Table A6 summarises these assumptions, while tables A7 and A8 list out other components of capital expenditure.

Module costs

Table A6 Module costs

Time period	PV modules cost (USD/Wp)	USD/INR	INR million/ MWp
January 19 - December 19	0.22	71	15.6
January 20 - June 20	0.21	75	15.8

Note: Safeguard duty of 15 per cent was considered for projects procuring modules before July 2020. The date of module procurement is assumed to be three months before scheduled commissioning.

Source: CEEW-CEF and IEA market intelligence.

Table A7 Solar park charges

Solar park	One-time solar park charges (INR million/MW)
Dondaicha Phase – I	4.75
Raghanesda Phase – III	4.03
Dholera Phase – V	2.01

Source: RfS documents pertaining to the relevant tenders.

Table A8 Other CAPEX

Other CAPEX	Value (INR million/MW)
Solar park	8.0*
Non-solar park	11.0

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 and Dholera solar park stands at INR 9 million/MW and 111 million/MW respectively.*

Source: CEEW-CEF and IEA market intelligence.

Wind

Table A9 Capital expenditure

Parameter	Value (INR million/MW)
Capex	60

Note: This figure excludes land acquisition costs, as a lease model has been considered in the analysis.

Operating costs

Table A10 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	0.6

Source: CEEW-CEF and IEA market intelligence.

Table A11 Recurring costs in solar parks

Dondaicha Solar Park (Phase I)	Raghnaseda Solar Park (Phase III)	Dholera Solar Park (Phase V)
• O&M expenses of INR 180,000 with annual escalation of 5 per cent	• O&M expenses of INR 198,000 with annual escalation of 5 per cent	• O&M expenses of INR 30,000 with annual escalation of 5 per cent
• Land-related costs of INR 8,000/acre/year	• Land-related costs of INR 4000/acre/year. Escalating at 15 per cent every three years	• Land-related costs of INR 4000/acre/year, escalating at 15 per cent every three years
	• Local area development charges of INR 80,000 for five years	• Local area development charges of INR 50,000 over eight years

Source: RfS documents pertaining to the relevant tenders.

Financing parameters

All projects are assumed to be financed by domestic Indian financial institutions as on the following terms.

Table A12 Interest rates

Entity	Solar park	Non-solar park	Wind
SECI/NTPC/Gujarat	10.50%	10.65%	10.65%
Maharashtra	-	10.75%	-
Uttar Pradesh	-	11.15%	-

Note: Working capital loans are assumed to be available at 100 basis points below the cost of long-term debt.

Source: CEEW-CEF and IEA market intelligence.

Table A13 Other financing parameters

	Solar park	Non-solar park	Wind
Loan tenure	17 years (including one-year moratorium on principal repayment)	17 years (including one-year moratorium on principal repayment)	18 years (including one-year moratorium on principal repayment)
Debt-equity ratio	75:25	75:25	75:25
Tax rate	25.17%	25.17%	25.17%
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

Source: CEEW-CEF and IEA market intelligence.

Annexure 5
Investor participation at solar and wind tenders

Table A14 Extent of competition in tenders analysed

Tender complete name	Date of award	EIRR	Capacity tendered	Capacity bid for	Capacity sanctioned	L1 tariff	Capex (INR lakh)
SECI 1.2 GW Solar Projects Auction (ISTS-III)	Feb-19	12.1%	1,200	1,500	1,200	2.55	356.5
MSEDCL 1000 MW Solar Projects Auction (Phase-II)	Feb-19	12.9%	1,000	1,900	1,000	2.74	356.5
GUVNL 500MW Grid Connected Solar PV Power Projects (Phase-IV)	Feb-19	11.8%	500	1,045	500	2.55	356.5
SECI 750 MW Rajasthan Solar Project Auctions	Mar-19	15.6%	750	2,370	750	2.48	323.7
GUVNL 700MW Raghanesda Solar Park (Phase-III R)	May-19	15.3%	700	600	500	2.65	343.9
GUVNL 1000MW Grid Connected Solar PV Power Projects located in Dholera Solar Park (Phase-V)	May-19	15.4%	1,000	300	250	2.75	376.6
SECI 250MW Grid Connected Solar PV Power Project at Dondaicha Solar Park (Phase-I)	May-19	13.0%	250	400	250	2.87	374.0
SECI ISTS-connected 1200MW Solar PV Projects (ISTS-IV)	Jun-19	17.3%	1,200	2,100	1,200	2.54	323.7
SECI 750MW Grid Connected Solar PV Projects in Rajasthan (Tranche-II)	Jun-19	16.1%	750	850	680	2.5	323.7
UPNEDA 500MW Grid Connected Solar PV Projects	Jun-19	18.1%	500	90	72	3.02	323.7
GUVNL 200MW Grid Connected Solar PV Projects in Raghanesda Solar Park (Phase-VI)	Aug-19	15.3%	200	100	100	2.65	343.9
GUVNL 750MW Grid Connected Solar PV Power located in 1000 MW Dholera Solar Park (Phase VII)	Aug-19	15.4%	750	50	50	2.75	376.6
SECI 1200 MW ISTS-connected solar power projects under Global Competitive Bidding (ISTS-V)	Aug-19	17.0%	1,200	600	480	2.53	323.7
NTPC 1200 MW ISTS Solar PV projects	Oct-19	19.9%	1,200	600	300	2.63	323.7
SECI 1200 MW Solar Power Projects ISTS-VI	Oct-19	17.9%	1,200	1,200	960	2.7	323.7
UPNEDA 500 MW Grid connected Solar PV Projects	Feb-20	21.4%	500	232	184	3.17	325.5

Table A14 contd...

Tender complete name	Date of award	EIRR	Capacity tendered	Capacity bid for	Capacity sanctioned	L1 tariff	Capex (INR lakh)
SECI 1200 MW ISTS-connected solar PV power projects ISTS-VIII	Feb-20	15.8%	1,200	3,500	1,200	2.5	325.5
GUVNL 500 MW Solar Phase-VIII	Mar-20	18.7%	500	430	350	2.61	325.5
NHPC 2000 MW Solar Auction	Apr-20	17.3%	2,000	3,780	2,000	2.55	325.5
SECI 2 GW ISTS Tranche IX Solar Tender	Jun-20	11.9%	2,000	5,280	2,000	2.36	325.5
SECI 1200 MW (Tranche-VI) Wind Power Auction	Feb-19	13.1%	1,200	2,325	1,200	2.82	600.0
GUVNL 1000 MW Grid Connected Wind Power Projects (Phase II-R)	May-19	12.7%	1,000	931.4	202.6	2.8	600.0
SECI 1200 MW ISTS-connected wind power projects (Tranche-VII)	May-19	12.5%	1,200	600	480	2.79	600.0
SECI 1800 MW ISTS T-VIII Wind Projects	Aug-19	13.3%	1,800	550.8	439.8	2.83	600.0

Source: CEEW-CEF and IEA analysis.

References

Chawla, Kanika, Michael Waldron, Arjun Dutt, Manu Aggarwal, Alberto Toril, and Yoko Nobuoka. 2018. *Clean Energy Trends: Evolving Investment Landscape for Grid-Connected Renewable Energy Projects in India*. New Delhi: Council on Energy, Environment and Water.

Damodaran. 2020. http://pages.stern.nyu.edu/~adamodar/ (accessed multiple times during March-August 2020).

Dutt, Arjun, Lucila Arboleya, and Barath Mahadevan. 2019. *Clean Energy Investment Trends: Evolving Risk Perceptions for India's Grid-Connected Renewable Energy Projects*. New Delhi; Paris: Council on Energy, Environment and Water; International Energy Agency.

Chandrasekaran, Kaavya. 2020. "Wind Energy Developers Dissatisfied with Gujarat's Land Offer", *ET Energyworld*, January 28, https://energy.economictimes.indiatimes.com/news/renewable/gujarat-frames-land-policy-for-green-energy-projects/67717498.

Chatterjee, Anupam. 2020. "Govt Removes Tariff Caps for Solar, Wind Power Auctions", *Financial Express*, March 7, https://www.financialexpress.com/economy/govt-removes-tariff-caps-for-solar-wind-power-auctions/1891366/.

Financial Express. 2020. "India's answer to its problem of $380 billion MSME credit gap lies in these type of lenders to step up," March 3, https://www.financialexpress.com/industry/msme-fin-indias-answer-to-its-problem-of-380-billion-msme-credit-gap-lies-in-these-type-of-lenders-to-step-up/1887426/

Global Solar Atlas 2.0. 2020. World Bank Group, https://globalsolaratlas.info.

Haryana Electricity Regulatory Commission. 2020. "Application under Section 86 (1) (b) and Section 63 of The Electricity Act, 2003", https://herc.gov.in/WriteReadData/Orders/O20200519.pdf.

IEA. 2018. *World Energy Investment 2018*. Paris: IEA, https://www.iea.org/reports/world-energy-investment-2018. IEA. 2020a. *India 2020* Paris: IEA, https://www.iea.org/reports/india-2020.

IEA. 2020b. *World Energy Investment 2020*. Paris: IEA, https://www.iea.org/reports/world-energy-investment-2020.

IEA. 2020c. *World Energy Outlook 2020*. Paris: IEA, https://www.iea.org/reports/world-energy-outlook-2020.

Indian Wind Turbine Manufacturers Association. 2020. *Indian Wind Power*. https://www.indianwindpower.com/pdf/Indian%20Wind%20Power%20April-May%202020.pdf.

Ministry of Finance, Government of India. 2020. "Union Budget 2020–21 Speech", https://www.indiabudget.gov.in/doc/Budget_Speech.pdf.

Ministry of Commerce and Industry, Government of India. 2020. "Initiation Dated 03.03.2020 of Review Investigation Regarding the Safeguard Duty Imposed Vide Custom Notification No. 01/2018-Customs (SG) Dated 30.07.2018 on Imports of 'Solar Cells Whether or Not Assembled in Modules or Panels' in India", http://www.dgtr.gov.in/sites/default/files/Seeking%20comments%20regarding%20Review%20Initiation.pdf.

Ministry of New and Renewable Energy, Government of India. 2020. "Time Extension in Scheduled Commissioning Date of RE Projects Considering Disruption Due to Lockdown Due to COVID-19", https://mnre.gov.in/img/documents/uploads/file_f-1587398024891.pdf.

Ministry of Power, Government of India. 2020. "State Distribution Utilities Seventh Annual Integrated Rating", https://pfcindia.com/DocumentRepository/ckfinder/files/GoI_Initiatives/Annual_Integrated_Ratings_ of_State_DISCOMs/7th_Rating_Booklet_Final_13-10-2019.pdf, Accessed on 28-9-2020.

Press Information Bureau, Government of India, 2020. "Finance Minister Announces Measures for Relief and Credit Support Related to Businesses, especially MSMEs, to Support Indian Economy's Fight against COVID-19", https://pib.gov.in/PressReleseDetailm.aspx?PRID=1623601.

Reserve Bank of India. 2020. "Minutes of the Monetary Policy Committee Meeting March 24, 26 and 27, 2020", https://www.rbi.org.in/Scripts/BS_PressReleaseDisplay.aspx?prid=49659.

Sukumar, C. R. 2019. "Andhra takes U-turn on PPAs, to move ERC", *The Economic Times*, July 26, https://economictimes.indiatimes.com/industry/energy/power/andhra-takes-u-turn-on-ppas-to-move-erc/articleshow/70392778.cms?from=mdr.

Kumar, Rishi V. 2019. "Renegotiation of PPAs in Andhra May Exert Cash-flow Pressure, Impair Investor Confidence: Ind-Ra", *The Hindu BusinessLine*, July 4, https://www.thehindubusinessline.com/news/national/renegotiation-of-ppas-in-andhra-may-exert-cash-flow-pressure-impair-investor-confidence-ind-ra/article28283666.ece.

The Indian Express. 2018. "Power generation at Dholera solar park to be costlier: Official", July 21, https://indianexpress.com/article/cities/ahmedabad/power-generation-at-dholera-solar-park-to-be-costlier-official-5268614/.

Acknowledgments

CEEW: CEEW's contribution to this report could not have been possible without the support and co-operation provided by multiple philanthropies to the CEEW Centre for Energy Finance (CEEW-CEF).

IEA: The IEA's contribution to this report was prepared within its Clean Energy Transitions in Emerging Economies programme, which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952363.

The report benefited from valuable inputs, comments, and feedback from various experts: Astha Gupta (IEA Consultant), Daniele Perugia (IEA), Gagan Sidhu (CEEW-CEF), Gireesh Shrimali (CEEW-CEF), Inchan Hwang (IEA), Nicole Thomas (IEA), Peter Zeniewski (IEA), Randi Kristiansen (IEA), Sree Sanyal (IEA), Szilvia Doczi (IEA), and Tim Gould (IEA).

The report was peer-reviewed by several renewable energy stakeholders including developers, financiers, and government agencies.

The authors would like to acknowledge the contribution of Ankita Nayak (CEEW-CEF) and Sangeeth Raja (CEEW-CEF) in collating the data underlying the analysis.

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
EIRR	equity internal rate of return
GW	gigawatt
IEA	International Energy Agency
MCLR	marginal cost of funds-based lending rate
MNRE	Ministry of New and Renewable Energy
MW	megawatt
NBFC	non-banking financial company
NPA	non-performing asset
NTPC	National Thermal Power Corporation
OEM	original equipment manufacturer
PLR	prime lending rate
PPA	power purchase agreement
PSA	power sales agreement
PV	photovoltaic
RBI	Reserve Bank of India
SECI	Solar Energy Corporation of India

Lower-return expectations are associated with renewable energy tenders characterised by higher competition.


Image: iStock

COUNCIL ON ENERGY, ENVIRONMENT AND WATER (CEEW)

Sanskrit Bhawan, A-10, Qutab Institutional Area
Aruna Asaf Ali Marg, New Delhi - 110067, India
T: +91 (0) 11 4073 3300

info@ceew.in | ceew.in | @CEEWIndia