



Clean Energy Investment Trends

EVOLVING LANDSCAPE FOR GRID-CONNECTED
RENEWABLE ENERGY PROJECTS IN INDIA

Report | June 2018

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ARJUN DUTT, MANU AGGARWAL, ALBERTO TORIL, AND YOKO NOBUOKA





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A report on 'Clean Energy Investment Trends: Evolving Landscape for Grid-Connected Renewable Energy Projects in India'.

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In over seven years of operations, The Council has engaged in more than 180 research projects, published well over 110 peer-reviewed books, policy reports and papers, advised governments around the world over 400 times, engaged with industry to encourage investments in clean technologies and improve efficiency in resource use, promoted bilateral and multilateral initiatives between governments on more than 50 occasions, helped state governments with water and irrigation reforms, and organised more than 210 seminars and conferences.

The Council's major projects on energy policy include India's largest energy access survey (ACCESS); the first independent assessment of India's solar mission; the Clean Energy Access Network (CLEAN) of hundreds of decentralised clean energy firms; India's green industrial policy; the \$125 million India-U.S. Joint Clean Energy R&D Centers; developing the strategy for and supporting activities related to the International Solar Alliance; modelling long-term energy scenarios; energy subsidies reform; energy storage technologies; India's 2030 renewable energy roadmap; clean energy subsidies (for the Rio+20 Summit); clean energy innovations for rural economy; community energy; and renewable energy jobs, finance and skills.

The Council's major projects on climate, environment and resource security include advising and contributing to climate negotiations (COP-23) in Bonn, especially on the formulating guidelines of the Paris Agreement rule-book; pathways for achieving INDCs and mid-century strategies for decarbonisation; assessing global climate risks; heat-health action plans for Indian cities; assessing India's adaptation gap; low-carbon rural development; environmental clearances; modelling HFC emissions; business case for phasing down HFCs; assessing India's critical minerals; geo-engineering governance; climate finance; nuclear power and low-carbon pathways; electric rail transport; monitoring air quality; business case for energy efficiency and emissions reductions; India's first report on global governance, submitted to the National Security Adviser; foreign policy implications for resource security; India's power sector reforms; resource nexus, and strategic industries and technologies; and Maharashtra-Guangdong partnership on sustainability.

The Council's major projects on water governance and security include the 584-page National Water Resources Framework Study for India's 12th Five Year Plan; irrigation reform for Bihar; Swachh Bharat; supporting India's National Water Mission; collective action for water security; mapping India's traditional water bodies; modelling water-energy nexus; circular economy of water; participatory irrigation management in South Asia; domestic water conflicts; modelling decision-making at the basin-level; rainwater harvesting; and multi-stakeholder initiatives for urban water management.

About IEA

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was-and is-two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 29-member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports.

The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context - particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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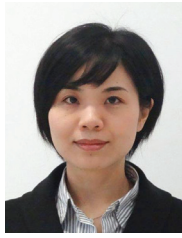
At The Council, Manu's work involves designing market-transformative insurance products, and restructuring regulatory and commercial contracts to de-risk renewables. Besides India, he is also assessing risks in the emerging economies of Asia and Africa. Manu leads The Council's work on the non-UNFCCC negotiations on emissions from international transport. He also closely monitors Indo-US energy and climate diplomacy.

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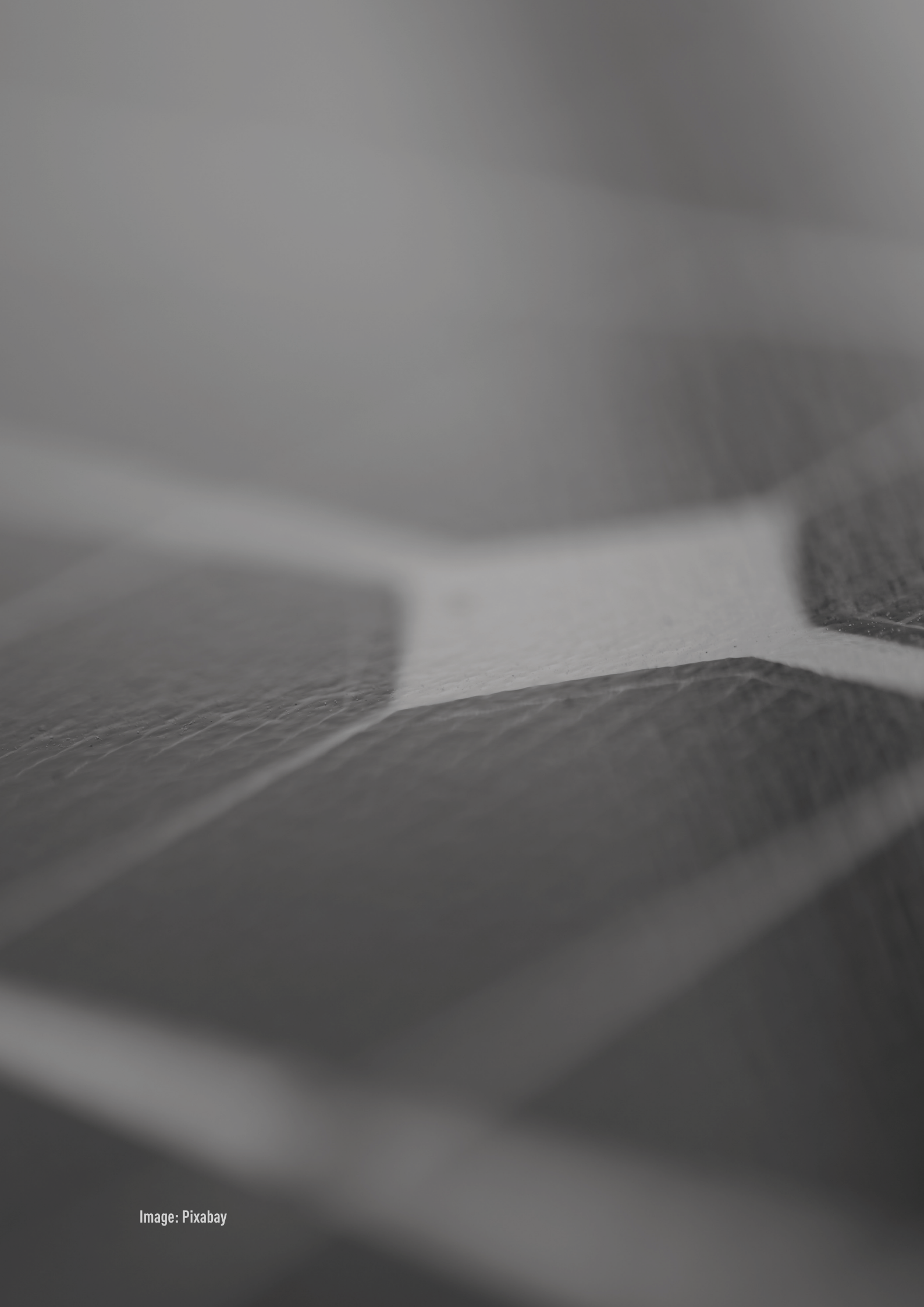
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Abbreviations

| | |
|---------------|---|
| DISCOM | distribution company |
| FiT | feed in tariff |
| GST | Goods and Services Tax |
| GW | gigawatt |
| IPP | independent power producers |
| MNRE | Ministry of New and Renewable Energy, Government of India |
| MW | megawatt |
| NTPC | National Thermal Power Corporation |
| PPA | power purchase agreement |
| PSA | power sale agreement |
| RBI | Reserve Bank of India |
| RE | renewable energy |
| SECI | Solar Energy Corporation of India |
| UDAY | Ujwal DISCOM Assurance Yojana |



Image: Pixabay

Clean Energy Investment Trends

About the Project

India's firm commitment towards the global clean energy transition is evident from its renewable energy (RE) deployment targets as well as the policy measures taken to facilitate RE deployment and its integration at higher shares. However, the achievement of India's RE ambitions is contingent upon policy signals translating into actual investment decisions at the scale and pace envisioned by policy makers and industry actors. It is imperative that the policy measures implemented by government actors and regulators effectively address the risks faced by developers and financiers, and do so in a manner that would also promote a cost-effective transition to a more flexible power system. At the same time, financiers and developers will need to respond to policy signals by committing the necessary capital and bringing the projects to market.

There is an urgent need for concerted action among these three sets of stakeholders – policymakers, industry actors, and financiers – that delivers the right investments at the right time in order to meet the clean energy transition goals.

Given the complexity and rapid evolution of the Indian market, a cross-cutting evaluation that regularly takes stock of current renewable energy financing and market trends, and that lays the ground for good policy advice is crucial for India to achieve its clean energy transition goals. In order to monitor and analyse the concerted action towards fulfilling India's RE ambitions, the Council on Energy, Environment and Water (CEEW) and the International Energy Agency (IEA) have undertaken a joint project to assess clean energy investment trends, with a focus on renewables and the power sector. This project seeks to provide stakeholders a practical guide for understanding the current clean energy investment environment in India and how the evolution of regulations and risks is impacting where finance is flowing (and where it is not). The results of this investigation would provide policy makers with insights to better manage risks and address regulatory challenges going forward.

Based on a granular analysis of project-level data and stakeholder consultations, the project uniquely seeks to triangulate and map the evolution of the risks and opportunities perceived by the three major actors in India's renewable energy sector that underpin all market activity:

Governments and regulators: Provide a clear, objective view of the macro drivers for investment and identify key risk areas and regulatory barriers;

Project developers and industry: Provide a succinct guide to investment flows, regulations, risks, key performance indicators and financing options at national and state level, which would aid in making investment decisions;

Financiers: Provide a unique market analysis that reduces transaction costs, facilitates due diligence and potentially expands the size of the market for both debt and equity.

What to look out for in future work?

Through this collaboration, and related works, CEEW and the IEA seek to provide greater clarity on the financing, regulatory, and risk environment for clean energy investment in India, which continues to lack a clear, integrated benchmark. The specific focus of the series is to build evidence-based narratives to understand and aid India's renewable energy transition.

Going forward, we intend to analyse the sources of finance, including the capital structures, of RE projects and other assets in the power sector. The capital structure and the terms of finance could vary considerably based on promoters, offtakers¹, and technology type. Moreover, variations in the capital structure and the terms of finance, in turn, could have implications for RE investments, including the competitiveness of bids. Trends pertaining to financing will be covered in future iterations of this trends report.

¹ Offtakers are the purchasers of power from generators.

Key Findings

India's renewable energy market, while young, is best characterised by its dynamism. In 2017, investment in renewable power, at nearly USD 20 billion, topped that for fossil fuel-based generating capacity for the first time.² India's solar photovoltaics (PV) capacity has grown eight times in the last four years, from around 3 GW in 2014 to 22 GW in May 2018. Similarly, in the onshore wind sector with 34 GW of operational capacity, India has the fourth largest installed wind capacity globally among countries. India is primed to become one of the largest renewable energy markets in the world in the coming years. The rapid pace of growth in the market and investments is accompanied by, and often a function of, the evolution of the industry landscape for renewable development and an enabling environment for projects.

This study analyses project-level data for solar and wind energy over the 2014-2017 period,³ which is closely aligned with the recalibration of India's RE ambitions and the revised target announcement of 175 GW of renewable energy by 2022. The analysis focused on the changing market landscape in the form of market concentration in investment decisions for solar and wind generating capacity, trends relating to the management of land acquisition and evacuation infrastructure risks and the role of solar parks, changes in average sanctioned solar and wind project sizes over time, and the evolution of offtakers for solar and wind projects from 2014 to 2017.

The analysis reveals four key trends:

There is evidence of greater market concentration among renewable developers, which is a function of financing, but there may be limits to higher levels of industry consolidation.

- Well-established industry players with access to favourable sources of finance through foreign sources of capital, balance sheet strength or by virtue of being state-owned enterprises have been instrumental in driving renewable energy deployment in India. The top 5 and top 10 players (in terms of share of projects sanctioned each year) have accounted for over 40% and over 60% respectively of the shares of sanctioned projects for both solar and wind generating capacity each year between 2014 and 2017. While reported shrinking profit margins amid the decline in power purchase tariffs could lead to further increases in market concentration, the design of tenders, which limit the capacity awarded to a specific parent company, could effectively limit this trend.



The top 5 and top 10 players (in terms of share of projects sanctioned each year) have accounted for over 40% and over 60% respectively of the shares of sanctioned projects for both solar and wind generating capacity each year between 2014 and 2017

- While only a few firms account for the majority of the sanctioned projects, these firms are not the same every year. At least half of the companies among the top 10 (in terms of shares of projects sanctioned in a particular year) have changed every year, indicative of the limits of the capacity of even the top players to finance new projects. Factors such as the diversification of bidding across locations and offtakers, as well as the size of individual bids, could also be contributing factors to the annual changes among the top developers.

²IEA (2018), World Energy Investment, OECD/IEA, Paris.

³See Annex 1 for discussion of the data and methodology.

Solar Parks are making India's renewable development more accessible to investors around the world, but stakeholders face persistent challenges in scaling up this unique model.

- Solar parks, in which government authorities offer developers a 'plug-and-play model' for project development through the organisation of land and evacuation infrastructure in exchange for a fee, have supported declines in renewable power pricing and investment decisions for new projects. This can be attributed to the ability of solar parks to efficiently manage land acquisition and evacuation infrastructure risks for developers. Solar parks have been successful in attracting investment flows, as evidenced by a rising share of solar parks in projects sanctioned between 2014 and 2017, as well as the oversubscriptions of tenders that provide solar park allocations. However, the slow pace of sanctioning for new solar parks and delays in their development due to persistent challenges associated with land acquisition and the setting up of internal infrastructure have affected the pace of tendering of new solar park projects. Solar parks have yet to reach their potential - only 16% of the 40 GW target for solar park projects by the end of fiscal year (FY) 2019-20 had been awarded by the end of 2017.
- The solar park model has been particularly attractive for international independent power producers (IPPs), given the relative lack of familiarity of such actors with the processes for obtaining approvals and permits for land acquisition in different Indian states. This preference for solar parks is evidenced by the pattern of investment flows of international IPPs. Over 2014-17, international IPPs accounted for around 45% of the sanctioned projects in solar parks.
- Nevertheless, the convenience offered by solar parks in resolving land acquisition and evacuation infrastructure risks for developers comes at a premium, with industry participants raising concerns over high solar park usage charges. As a result, only developers with access to relatively low-cost finance have invested in solar parks, where the benefit from the preferential cost of capital outweighs the premium paid for the park services. While solar parks have attracted a number of international developers, they may not yet have reached a level of maturity that is facilitating diversified investment from mainstream sources. To illustrate, around 35% of sanctioned projects in solar parks are from IPPs (registered in Mauritius, the largest country of origin among international IPPs investing in solar parks, where companies benefit from preferential taxation). Large private Indian developers and state-owned generators, which also have access to finance on favourable terms, account for the remainder of the projects sanctioned at solar parks.
- Large private Indian developers and state-owned generators, which also have access to finance on favourable terms, account for the remainder of the projects sanctioned at solar parks.

Ambitious targets and supportive policies have enabled bigger project sizes

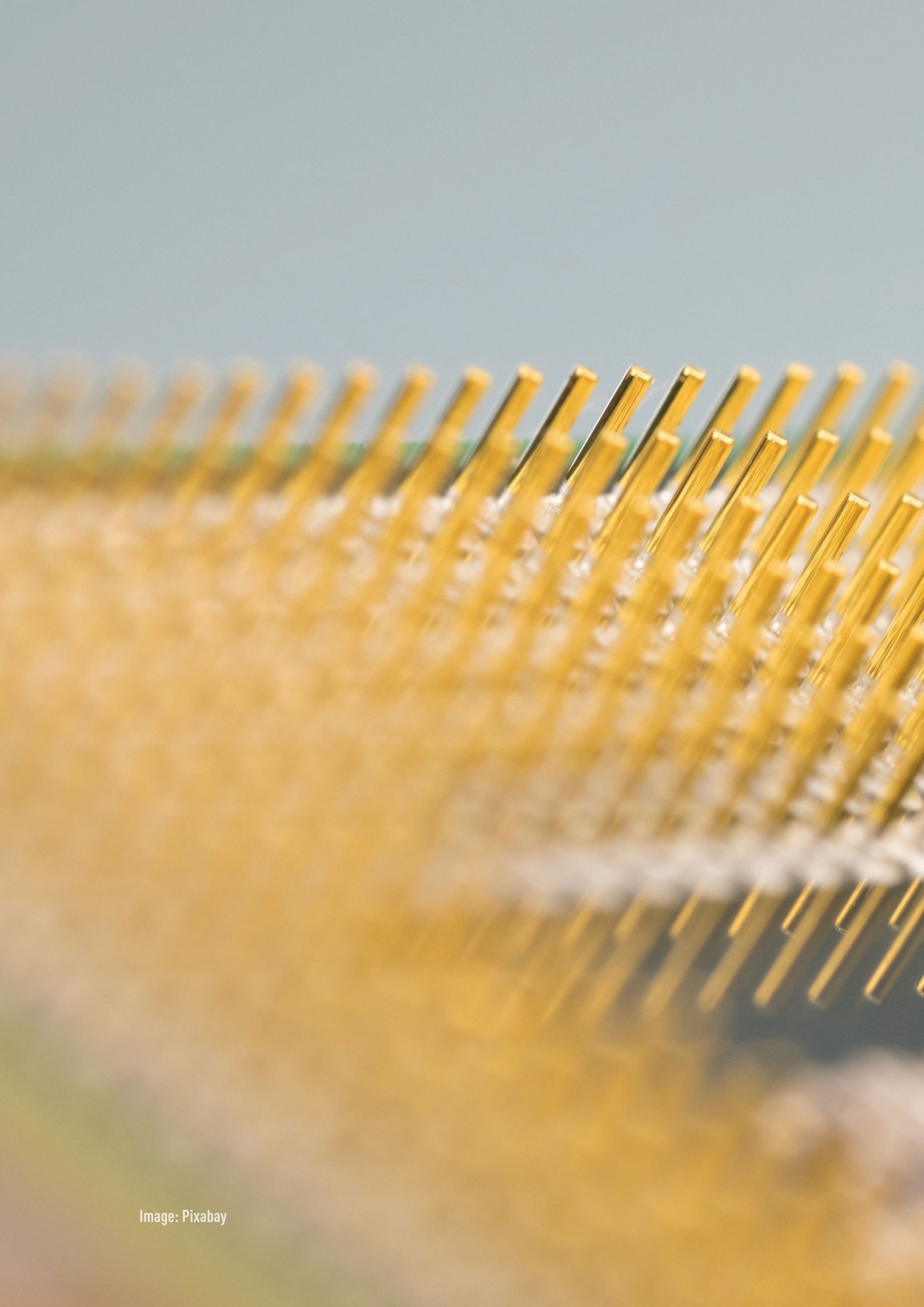
- The tendering of larger capacities and an overall supportive environment for renewable energy deployment in India have translated into an increase in the average project size for both solar and wind energy projects. Average project sizes increased four-fold to 110 MW for solar projects and five-fold to 130 MW for wind projects over the period 2014-2017, as developers capitalised on economies of scale. Solar parks have been instrumental in raising average solar project sizes. However, complexities around acquiring contiguous land (with high solar or wind potential) for non-park capacities continues to pose a challenge to the scaling of project sizes, on average, for both solar and wind.

The creditworthiness of offtakers, which affects the timeliness and reliability of payments for power purchase, is having a strong impact on renewable investment decisions.

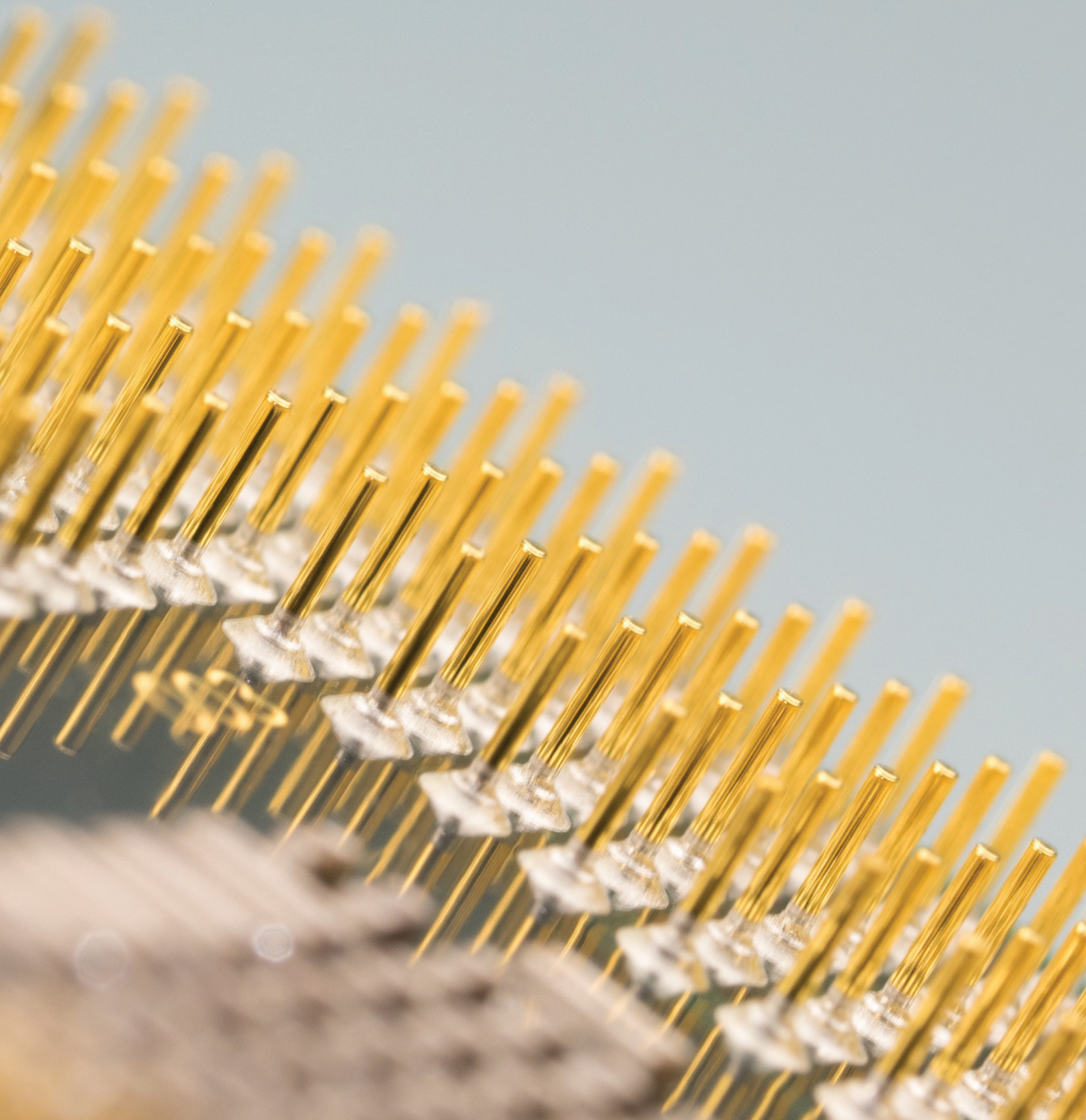
- The timeliness and reliability of payments for power purchase by state distribution companies (DISCOMs) remains a persistent risk for investments. There is a growing preference by developers and financiers for projects with creditworthy offtakers. This trend is reflected by a generally rising share of sanctioned solar and wind investments that are based on a power purchase agreement with central government entities (Solar Energy Corporation of India [SECI], NTPC), compared with those executed with DISCOMs alone. However, the year-to-year variation in this trend depends strongly on the actual tendering of capacity from the respective sources - for example, higher tendering activity by specific states in 2017 coupled with a slowdown in SECI tendering led to a lowering of the share of central offtakers in sanctioned solar projects. Among state offtakers, the preference for more creditworthy DISCOMs is also clear, with those characterised by favourable financial and operational metrics accounting for the largest share of sanctioned projects between 2014 and 2017.



There is a growing preference by developers and financiers for projects with creditworthy offtakers. This trend is reflected by a generally rising share of sanctioned solar and wind investments that are based on a power purchase agreement with central government entities



Market Concentration



Annual Market Concentration or Total Market Consolidation?

There is evidence of greater market concentration among renewable developers, which is facilitating financing, but there may also be limits to higher levels of industry consolidation.

Market concentration in this analysis has been defined as the total sanctioned nameplate capacity by a particular firm as a share of the overall projects sanctioned in that year. In estimating the share of projects for a particular firm, all projects sanctioned by its subsidiaries have been grouped together. For example, projects awarded to Parampujya Solar Energy Private Limited and Prayatna Developers Private Limited, both subsidiaries of Adani Green Energy Limited, have been considered as projects awarded to Adani. Tables 1 and 2 list the top 10 firms in descending order of sanctioned capacity for each of the years under assessment.

The definition of market concentration adopted in this report is different from the traditional metrics of market concentration such as the concentration ratio and the Herfindahl-Hirschmann Index (HHI), which reflect the extent of market dominance in terms of the pricing power enjoyed by firms in their respective industries.^{4,5,6} Although market concentration as defined here may not be a direct measure of market power, it does provide an indicator for the relative influence of top firms in driving investment decisions. By contrast, this report describes the concept of industry consolidation through the degree to which the total number of firms taking investment decisions is changing, due to developers entering and exiting the market, or mergers and acquisition activity.

Investment in both solar PV and wind generating capacity is characterised by the dominance of a few firms, with the top five and top 10 firms adding more than 40% and 60% of sanctioned capacity respectively each year for both markets. By comparison, some 40-80 firms for solar PV and some 20-50 firms for wind, depending on the year, drive the overall investments in new solar PV and wind capacity. Tables 1 and 2 list the top 10 firms in descending order of capacity added, for each of the years under assessment.

Table 1 - Market concentration in the sanctioning of new solar PV capacity

| YEAR | 2014 | 2015 | 2016 | 2017 |
|--------------|--|--|---|---|
| Top 10 firms | <ul style="list-style-type: none"> ■ Acme Solar ■ Azure Power* ■ ReNew Power ■ SunEdison Energy Holding (Singapore)* ■ Rays Power Infra ■ Welspun ■ Tata Power ■ First Solar* ■ Hero Future Energies ■ Torrent Power | <ul style="list-style-type: none"> ■ Adani ■ NTPC ■ Acme Solar ■ Greenko Energy* ■ Sky Power Southeast Asia* ■ Softbank Energy* ■ Azure Power* ■ Suzlon ■ Mytrah Energy* ■ ReNew Power | <ul style="list-style-type: none"> ■ Adani ■ ReNew Power ■ Acme Solar Holdings ■ Essel Green Energy ■ Hero Future Energies ■ Suzlon ■ Tata Power ■ Engie* ■ Azure Power* ■ Abdul Latif Jameel Energy* | <ul style="list-style-type: none"> ■ NLC India ■ Softbank Energy* ■ Azure Power* ■ Acme Solar ■ APGENCO ■ Hero Future Energies ■ Engie* ■ Mahindra Renewables ■ Solenergi Power* ■ Amplus Solar |
| Total firms | 48 | 37 | 75 | 38 |

*Note: Firms in this table refer to parent companies, with projects awarded to subsidiaries grouped together under the parent company. Firms marked with * are International IPPs.*

Source: CEEW and IEA analysis

⁴Tibor Scitovsky, *Economic Theory and the Measurement of Concentration*, 1955.

⁵US Department of Justice, *Herfindahl-Hirschmann Index*, available at <https://www.justice.gov/atr/herfindahl-hirschman-index>; accessed 31 May 2018.

⁶Stephen A. Rhoades, *The Herfindahl-Hirschmann Index* (Federal Reserve Bank of St. Louis, 1993).

Table 2 - Market concentration in the sanctioning of new wind capacity

| YEAR | 2014 | 2015 | 2016 | 2017 |
|--------------|--|--|--|--|
| Top 10 firms | <ul style="list-style-type: none"> ■ Welspun ■ ReNew Power ■ Atria Power ■ Greenko Energy* ■ Mytrah Energy* ■ Orange Renewable Power* ■ D J Energy ■ Continuum Wind Energy* ■ Lalpur Wind Energy ■ Ostro Energy* | <ul style="list-style-type: none"> ■ Ostro Energy* ■ Orange Renewable Power* ■ PTC India ■ ReNew Power ■ Axis Energy ■ Greenko Energy* ■ Mytrah Energy* ■ Hero Future Energies ■ NLC India ■ Sembcorp* | <ul style="list-style-type: none"> ■ Torrent Power ■ Skeiron Renewable Energy ■ ReNew Power ■ SITAC/EDF JV* ■ Hero Future Energies ■ Greenko Energy* ■ Tata Power ■ Gujarat Industries Power Company ■ Acciona Energy* ■ Adani | <ul style="list-style-type: none"> ■ Inox Renewables ■ Sembcorp* ■ ReNew Power ■ Ostro Energy* ■ Mytrah Energy* ■ Solenergi Power* ■ Orange Renewable Power* ■ Continuum Wind Energy* ■ KP Energy ■ Verdant Renewables |
| Total firms | 27 | 52 | 21 | 17 |

Note: Firms in this table refer to parent companies, with projects awarded to subsidiaries clubbed together under the parent company
Firms marked with * are International IPPs

Source: CEEW and IEA analysis

The concentration in investment decisions for both solar PV and wind generating capacity is unsurprising given that one of the major sources of competitive advantage in these markets is access to finance on favourable terms, with the cost of finance accounting for over 60% of solar and wind power purchase tariffs.^{7,8} In particular, those firms with access to favourable sources of finance through foreign private equity investments, lower cost foreign debt, balance-sheet strength, or by virtue of being state-owned enterprises are able to undercut the competition consistently and win bids.

Figures 1 and 2 illustrate the evolving market concentration of sanctioned solar PV and wind generating capacity, respectively. For solar PV, market concentration increased in 2015 with the announcement of the new 100 GW by 2022 target, with close to 85% of the total sanctioned capacity coming from just the top ten companies. However, concentration among developers dipped significantly the following year with many more players entering the growing market. Factors such as declining module prices, a decline in interest rates for solar projects, and greater interest in contracting for solar power by offtakers resulted in increased bidding activity. That said, increasing competition among developers crowded out some of the smaller players active in 2016 and resulted in just five companies sanctioning 50% of the new generating capacity in 2017. Further, market uncertainties around the impact of the goods and services tax (GST) and the imposition of trade duties on imported solar modules, and the related impact on tendered projects under construction, also contributed to increase in market concentration. The total number of companies sanctioning new capacity in 2017 was nearly half of the total firms active in 2016.



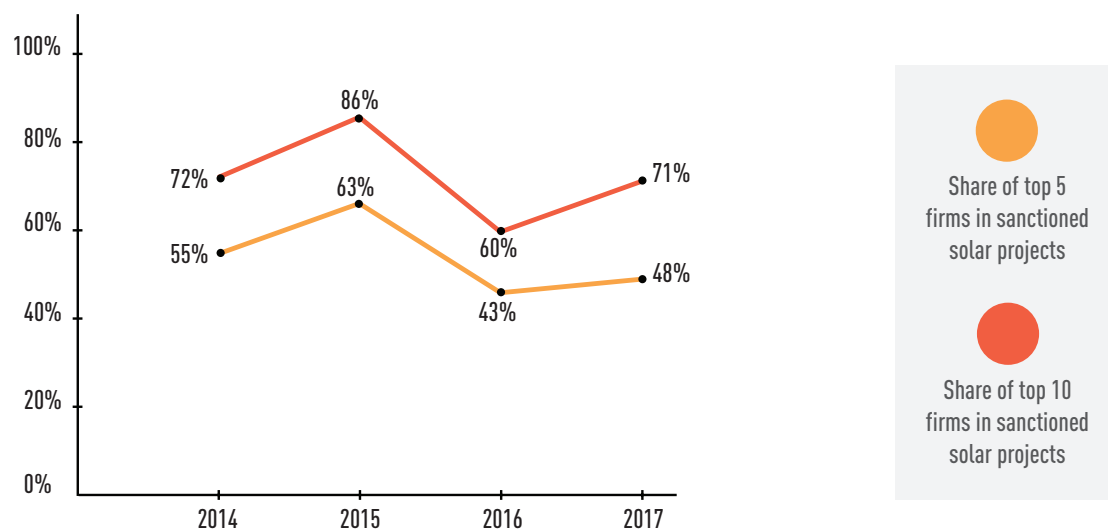
Firms with access to favourable sources of finance through foreign private equity investments, lower cost foreign debt, balance-sheet strength, or by virtue of being state-owned enterprises are able to undercut the competition consistently and win bids

⁷Kanika Chawla and Manu Aggarwal, Anatomy of a Solar Tariff (CEEW, 2016).

⁸CEEW, 'Analysing the falling solar and wind tariffs: Evidence from India', forthcoming.

Interestingly, the market concentration in 2017, after the fluctuations of previous years, is very similar to the concentration levels in 2014—even as the total number of firms participating in the sanctioning of new capacity declined by nearly 20%. Given this observed trend towards greater industry consolidation and the intensity of competition among developers within tendering processes, the market could become more concentrated in the future. However, the design of solar tenders by central and state government actors which limits the maximum capacity awarded to a single parent company (including subsidiaries) in any single bid, could limit future market concentration to some extent.⁹

Figure 1- Market concentration in the sanctioning of new solar PV capacity



Source: CEEW and IEA analysis

The wind sector saw a decline in market concentration in 2015, which was a reflection of the reinstatement of 80% accelerated depreciation benefits, which allowed developers to immediately write-off the costs of new wind power projects in the second half of 2014. This reopened the playing field for developers, leading to the participation of a greater number of firms in the sector. The rising market concentration in subsequent years is a reflection of industry consolidation¹⁰ as the transition to competitive auctions for wind projects significantly reduced the financial buffers and profit margins for developers. This effect contributed to the crowding out of several of the smaller players who did not enjoy the same access to capital or who were not able to improve their business processes in order to bid for larger lot sizes.

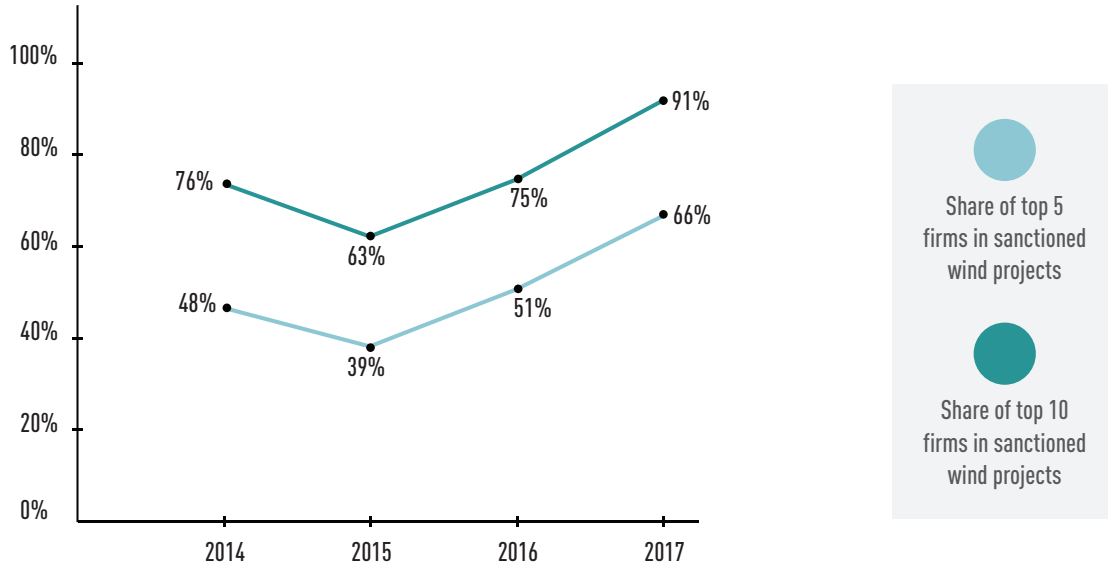
These observed trends could result in greater market concentration in the future. The level of concentration in the wind sector is even greater than in the solar PV sector, with the top ten companies contributing more than 90% of the sanctioned generating capacity in 2017. However, the total number of active firms has also been on the decline since 2015. In 2015, five firms contributed 40% of capacity addition, but 47 firms contributed the remaining 60%. In contrast, the total number of contributing firms in 2017 shrank to 17, pointing towards greater industry consolidation in addition to market concentration. This evolution occurred despite the design of the wind tenders, which limits the maximum capacity that can be awarded to a single parent company (including subsidiaries).¹¹



The level of concentration in the wind sector is even greater than in the solar PV sector, with the top ten companies contributing more than 90% of the sanctioned generating capacity in 2017

¹¹ SECI, "Rfs Document for Setting up of 2000 MW ISTS-Connected Wind Power Projects (Tranche-IV)", available at http://seci.co.in/web-data/docs/Rfs_Wind%20Power%20Developers_2000%20MW%20ISTS%20Connected-Tranche-IV%20final%20upload.pdf; accessed 31 May 2018.

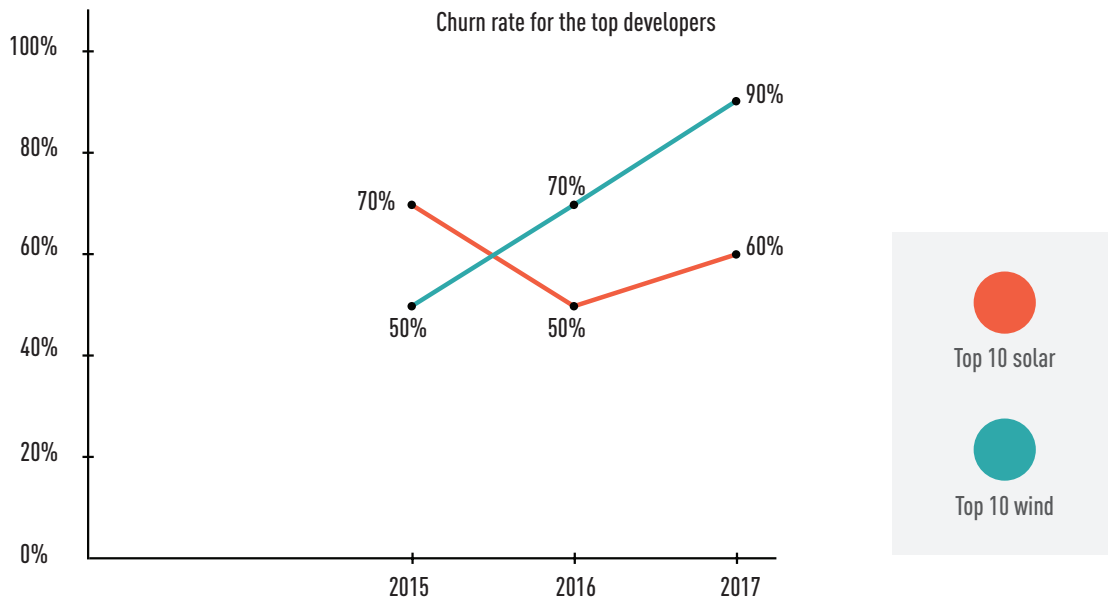
Figure 2 - Market concentration in the sanctioning of new wind capacity



Source: CEEW and IEA analysis

Among the leading firms, while a few companies feature regularly among the top developers of new capacity, they are not always the same (Figure 3). The churn rate is defined as the extent of change in the top 10 developers with respect to the previous year. For example, five firms from the top 10 bid winners in solar in 2014 lost their positions in the top 10 to five new firms in 2015. This is represented as a churn rate of 50% in 2015. The relatively high churn rate (greater than or equal to 50% every year for both wind and solar) is perhaps indicative of the limitations of the capacity of even the top firms to finance new projects every year, especially in the face of increasing market competition. In addition, firm-level portfolio considerations pertaining to the diversification of projects across locations and across offtakers could also have affected the bidding pattern of specific developers.

Figure 3 - The churn rate is quite high for the top developers



Source: CEEW and IEA analysis

The high churn rate seems to suggest that despite high levels of market concentration, there is limited industry consolidation as the biggest market contributors change year on year. This could be a function of a young market, with several players competing to capture a growing share of the market. However, it is interesting to note that in terms of total operating capacity, some firms are clear frontrunners (table 3).

Table 3 - Total installed capacity as of March 2018

| Solar Developers | Capacity in MW | Wind Developers | Capacity in MW |
|----------------------------|----------------|----------------------------|----------------|
| ■ Tata Power | 2132 | ■ ReNew Power | 2637 |
| ■ Adani | 1858 | ■ Greenko Energy Holdings* | 1205 |
| ■ ReNew Power | 1241 | ■ Tata Power | 1074 |
| ■ Greenko Energy Holdings* | 1218 | ■ Mytrah Energy* | 1000 |
| ■ NTPC | 878 | ■ CLP* | 924 |
| ■ ACME Solar Holdings | 874 | ■ Hero Future Energies | 576 |
| ■ Azure Power* | 818 | ■ Orange Renewables* | 567 |
| ■ Hero Future Energies | 553 | ■ Continuum Energy* | 388 |
| ■ NLC India | 440 | ■ Torrent Power | 311 |
| | | ■ Inox Renewables | 300 |

*Note: Firms marked with * are International IPPs*

Source: Company websites

Solar Parks



Solar Parks: Making India's renewable energy development accessible to the world

Solar parks are making India's renewable development more accessible to investors around the world, but stakeholders face persistent challenges in scaling up this unique model.

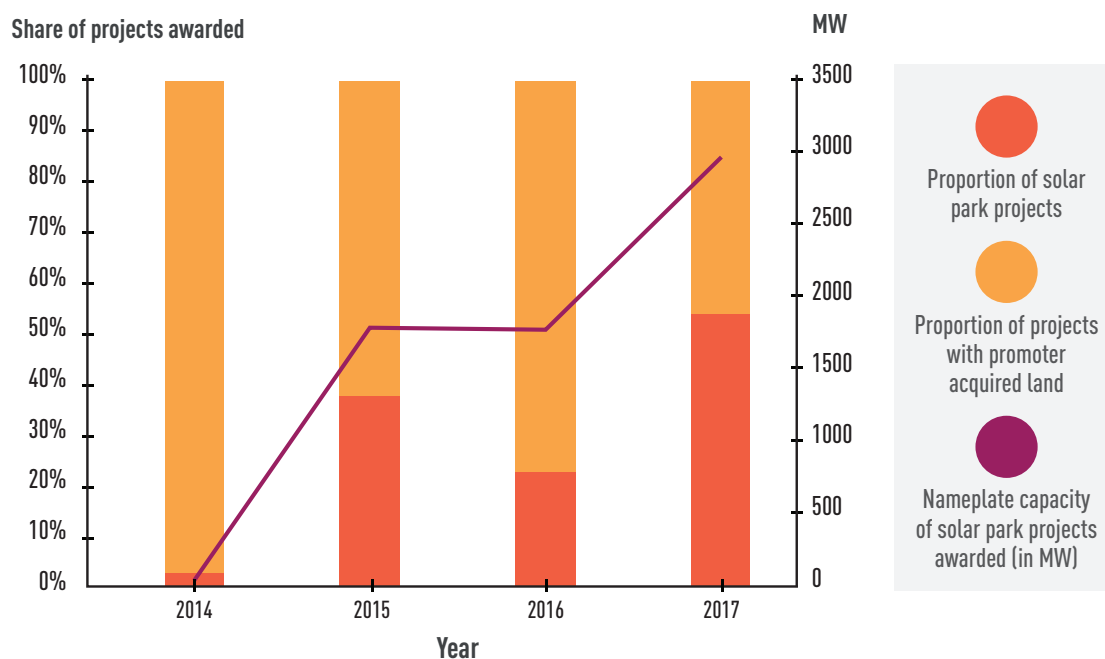
Land acquisition and the availability of evacuation infrastructure have been significant risks for solar and wind project developers.^{12,13} The Ministry of New and Renewable Energy (MNRE) solar park scheme is helping to manage these risks for developers. By contrast, wind projects have not received the same support, which is likely due to the already established position of wind in India's generation mix at the time of the recalibration of India's RE ambitions in early 2015.¹⁴ Moreover, the greater variability of wind resource makes site selection for wind projects harder than for solar projects.

In the case of solar PV projects, the provision by government authorities of land and evacuation infrastructure in exchange for a usage fee significantly lowers land acquisition and evacuation infrastructure risks for developers. The lowering of these risks, besides aiding the achievement of economies of scale through large project sizes in solar parks, has also contributed to the significant decline in power purchase tariffs, with the lowest prices for the solar PV sector as a whole observed in auctions that allocate solar park capacity. Figure 4 illustrates the share of projects tendered and awarded at solar parks compared with the overall solar projects awarded in the period 2014-2017.



Land acquisition and the availability of evacuation infrastructure have been significant risks for solar and wind project developers

Figure 4 - Share of solar park projects in overall solar PV projects awarded



Note: Solar park projects correspond to those awarded at solar parks sanctioned under the MNRE's solar park scheme as well as the Charanka solar park, which precedes the MNRE's solar park scheme, from 2014 to 2017.

Source: CEEW and IEA analysis

¹² Kanika Chawla, *Money Talks? Risks and Responses in India's Solar Sector* (CEEW, 2016).

¹³ Based on stakeholder interviews.

¹⁴ Wind installed capacity stood at around 23 GW at the end of FY 2014-15

There has been a sharp increase in the share of solar park projects with the commencement of project tendering at parks sanctioned under the MNRE's solar park scheme in 2015. The share of solar park projects rose from over 38% in 2015 to around 55% of total capacity awarded in 2017. However, there has been some inconsistency in park project tendering activity, as reflected in the decline in the share of solar park projects to near 20% in 2016. This inconsistency in project tendering at solar parks stems from the time lag in the creation of new solar parks, due to delays in land acquisition and in the setting up of internal infrastructure by government authorities.¹⁵ Given the central importance of land and evacuation infrastructure for project development, addressing the issues that are constraining the pace of sanctioning and development of solar parks will be critical factors in realising India's RE targets. Recognising the risk management and efficiency benefits of solar parks, India's Cabinet Committee on Economic Affairs approved in 2017 an upward revision to the targeted solar park capacity, from 20 GW to 40 GW by 2020.¹⁶ As per the revised plan, 20 GW of additional solar capacity in solar parks will be tendered by the end of fiscal year (FY) 2018-19 and the remaining 20 GW by the end of FY 2019-20.¹⁷ However, the pace of project tendering has been weaker than that foreseen under the plan (Table 4).



The share of solar park projects rose from over 38% in 2015 to around 55% of total capacity awarded in 2017

Table 4 - Stock take of MNRE's solar park scheme

| | Capacity (GW) | Percentage achievement (vs 2019-20 target) |
|---|---------------|--|
| 2019-20 target | 40.0 | |
| Sanctioned solar park capacity | 21.2 | 53% |
| Solar PV projects tendered and awarded within solar parks | 6.3 | 16% |

Sources: Sanctioned solar park capacity: Data as of 28-2-2018 based on Lok Sabha Starred Question no. 297 for 15-3-2018 regarding solar parks

Solar PV projects tendered & awarded within solar parks: As of the end of 2017, based on CEEW and IEA analysis

The sluggish pace of tenders and project sanctioning can be attributed to the slow pace of sanctioning and development of solar parks, among other policy-related uncertainties. A paltry 1.2 GW of new solar park capacity has been sanctioned under the scheme by the MNRE since the announcement of the revised solar park targets in March 2017.¹⁸

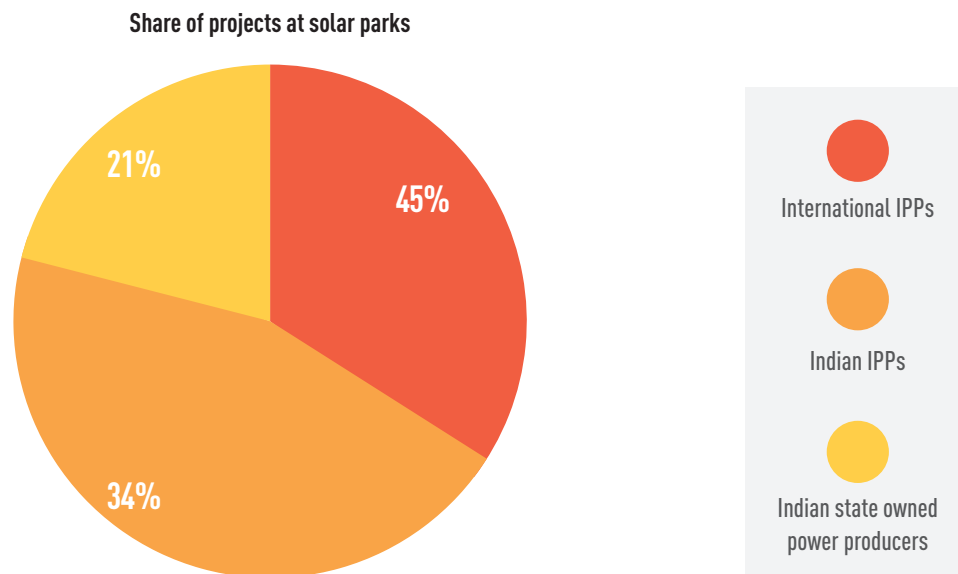
¹⁵ Based on stakeholder interviews.

¹⁶ Press Information Bureau, "Cabinet approves enhancement of capacity from 20000 MW to 40000 MW of the Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects", available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=158621>; accessed 28 May 2018.

¹⁷ MNRE, "Administrative sanction for implementation of the scheme for enhancement of capacity from 20000 MW to 40000 MW for Development of Solar Parks and Ultra Mega Solar Power Projects", available at <https://mnre.gov.in/file-manager/UserFiles/Scheme-for-enhancement-of-capacity-to-40GW-Solar-Parks.pdf>; accessed 28 May 2018.

¹⁸ Press Information Bureau, "Cabinet approves enhancement of capacity from 20000 MW to 40000 MW of the Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects", available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=158621>; accessed 28 May 2018.

Figure 5 - International IPPs account for the largest share of solar park projects



Note: These projects pertain to those awarded at solar parks between 2014 and 2017.

Source: CEEW and IEA analysis

The solar park model has been particularly attractive for international independent power producers (IPPs), given the relative lack of familiarity of such actors with the processes for obtaining approvals and permits for land acquisition in different Indian states.

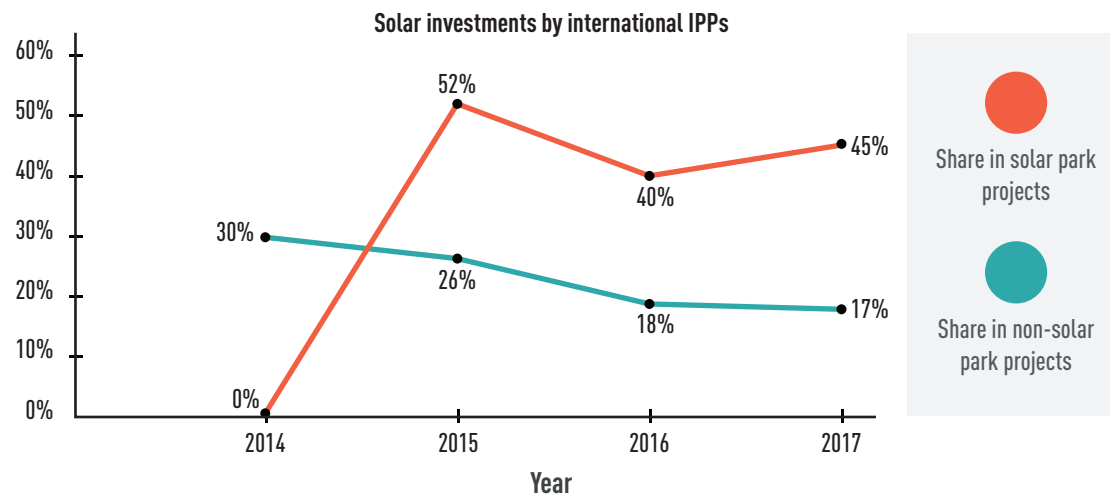
Solar parks offer project developers a ‘plug-and-play’ model, making land and evacuation infrastructure available in exchange for a usage fee. However, the convenience of solar park projects relative to non-solar park projects comes at a price premium for developers, and some industry participants have expressed concerns about the magnitude of upfront and recurring solar park charges.¹⁹ Given the premium associated with solar park charges and the competitive nature of bidding at solar parks, solar park projects have been dominated by international IPPs (defined as those incorporated in foreign jurisdictions), state-owned companies, and large private developers in India (Figures 5 and 7). The contribution of international IPPs to the total annual sanctioned capacity has grown significantly from 675 MW in 2014 to 1650 MW in 2017, but this increase has come about predominantly through projects situated in solar parks (Figure 6).



The contribution of international IPPs to the total annual sanctioned capacity has more than doubled, from 675 MW in 2014 to 1650 MW in 2017, but this increase has come about predominantly through projects situated in solar parks

¹⁹ Based on stakeholder interviews; Mercom, “Mercom Exclusive: Solar Park Costs on the Rise in India”, available at <https://mercomindia.com/mercom-exclusive-solar-park-costs-rise-india/>; accessed 28 May 2018.

Figure 6 - International IPPs prefer investing in solar park projects

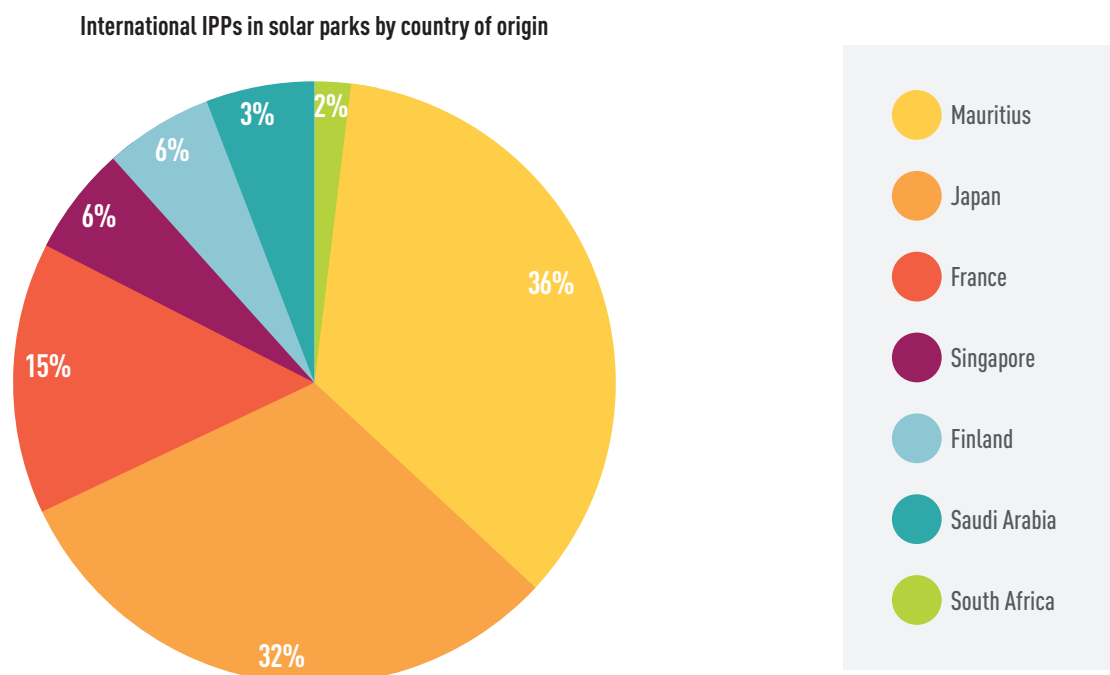


Note: The share of projects refers to the share in terms of the nameplate capacity of the projects awarded.

Source: CEEW and IEA analysis

Solar parks have attracted a number of international developers (Figure 7). However, they may not yet have reached a level of maturity that is facilitating diversified investment from mainstream sources. To illustrate, around 35% of sanctioned projects in solar parks are from IPPs registered in Mauritius - the largest country of origin among international IPPs investing in solar parks - where companies benefit from preferential taxation. This also includes firms with predominantly Indian management, but incorporated in Mauritius, which can have the effect of lowering the cost of finance for projects developed by such firms.

Figure 7 - Solar parks have attracted IPPs from a range of countries, but may not yet have reached a level of maturity that is facilitating diversified investment from mainstream sources

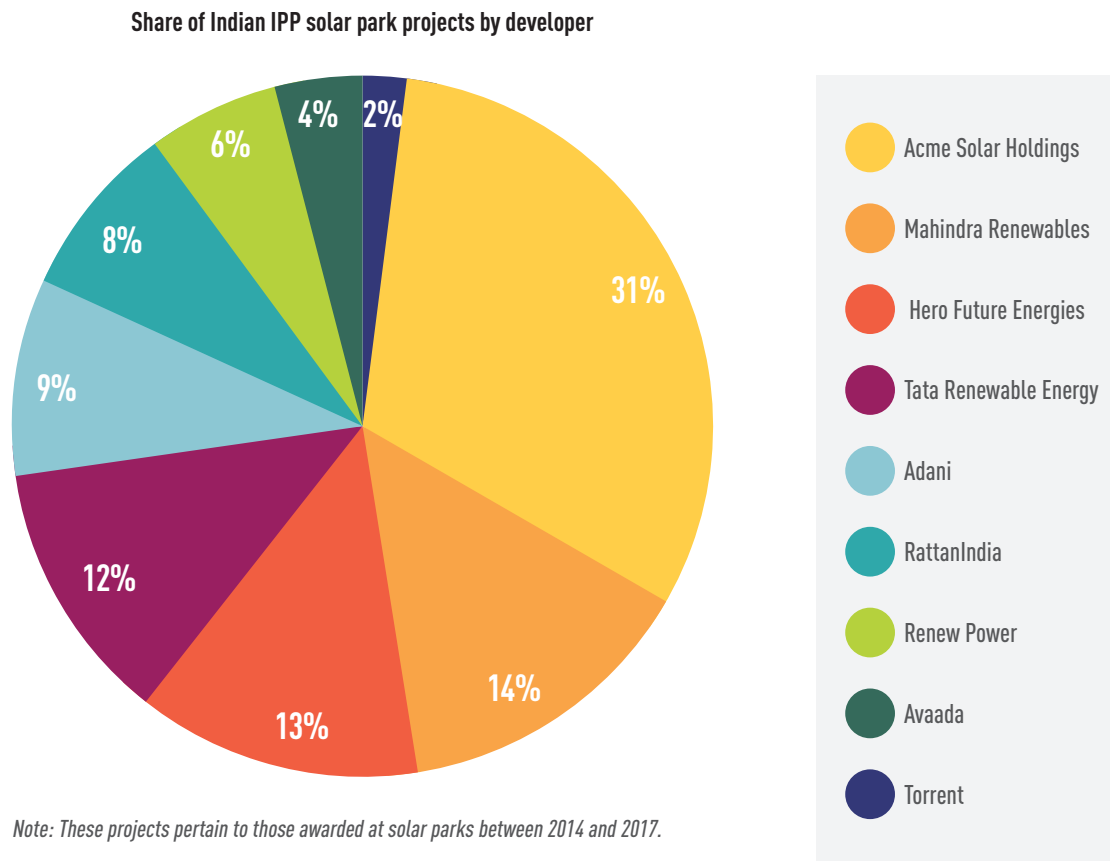


Note: These projects pertain to those awarded at solar parks between 2014 and 2017.

Source: CEEW and IEA analysis

More than a third of all solar park projects have been awarded to Indian IPPs. However, the space has been dominated by a handful of players. Large IPPs - which are able to raise capital at preferential rates by combining the power of their balance sheet, corporate fundraising abilities, and their ability to structure bankable solar park projects - have used solar parks to improve their competitive positions. Overall, solar parks have facilitated significant advances in market development and price discovery for India's solar PV sector.

Figure 8 - Large Indian IPPs too have invested in solar parks



Project Size

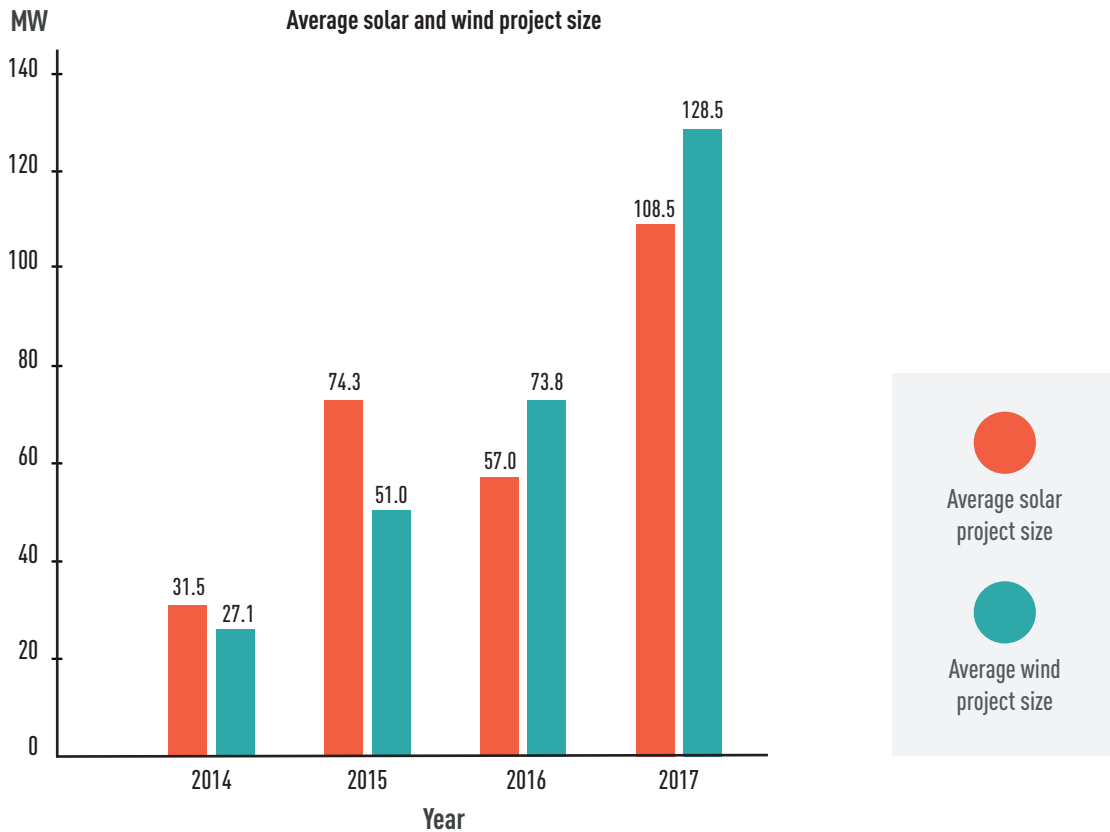


Big targets come with bigger project sizes

Ambitious targets and supportive policies have enabled bigger renewable project sizes.

The relatively small average project size of sanctioned renewable energy capacities in the recent past is a symptom of the humble beginnings of India's renewable energy sector. The average project size for both sanctioned solar and wind projects has increased manifold in the period 2014-2017 (Figure 9).

Figure 9 - Average solar and wind sanctioned project sizes have increased



Source: CEEW and IEA analysis

Average project sizes during this period have increased nearly fourfold to 110 MW for solar PV and five fold to 130 MW for wind. The growth in project sizes has been driven by the tendering of larger lot sizes in competitive auctions and by an overall supportive policy environment for RE, which has created greater demand certainty and enhancements to project economics through fiscal and financial incentives for developers. This trend towards great project scale is consistent with that observed in renewable auctions globally.²⁰ In the current climate in India, developers indicate they are bullishly bidding for capacity to grow their portfolios and enjoy the economies of scale from larger projects.

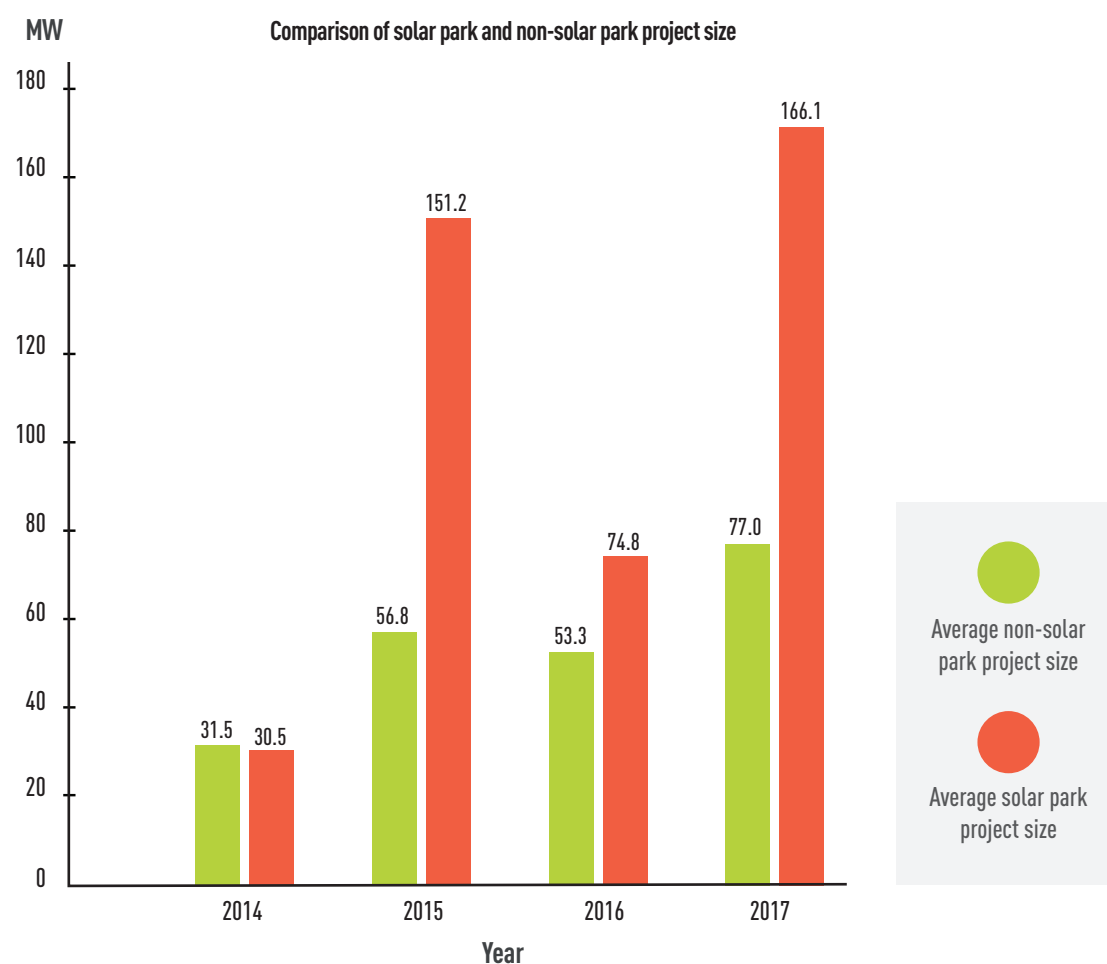


The growth in project sizes has been driven by the tendering of larger lot sizes in competitive auctions and by an overall supportive policy environment for RE, which has created greater demand certainty and enhancements to project economics through fiscal and financial incentives for developers

²⁰ IEA (2018), World Energy Investment, OECD/IEA, Paris

For solar projects, the tendering of projects in solar parks has been instrumental in raising average project sizes. This is illustrated by the comparison between solar park and non-solar park project sizes (Figure 10).

Figure 10 - Solar park projects are characterised by larger average project sizes



Source: CEEW and IEA analysis

Going forward, the challenges in organising contiguous land for setting up projects could constrain increases in average project size for both solar and wind. Land acquisition and right-of-way issues have historically been considerable challenges for developers in the Indian context.^{21,22} In addition to the government's Solar Park Scheme, the co-location of wind and solar projects, as envisioned in the recently issued policy on wind-solar hybrid projects,²³ represents another possible way to manage land acquisition risk and make more efficient use of available resources. Additional such measures may help to ensure that land acquisition risks do not slow the pace of capacity addition needed to realise RE targets in a timely manner.

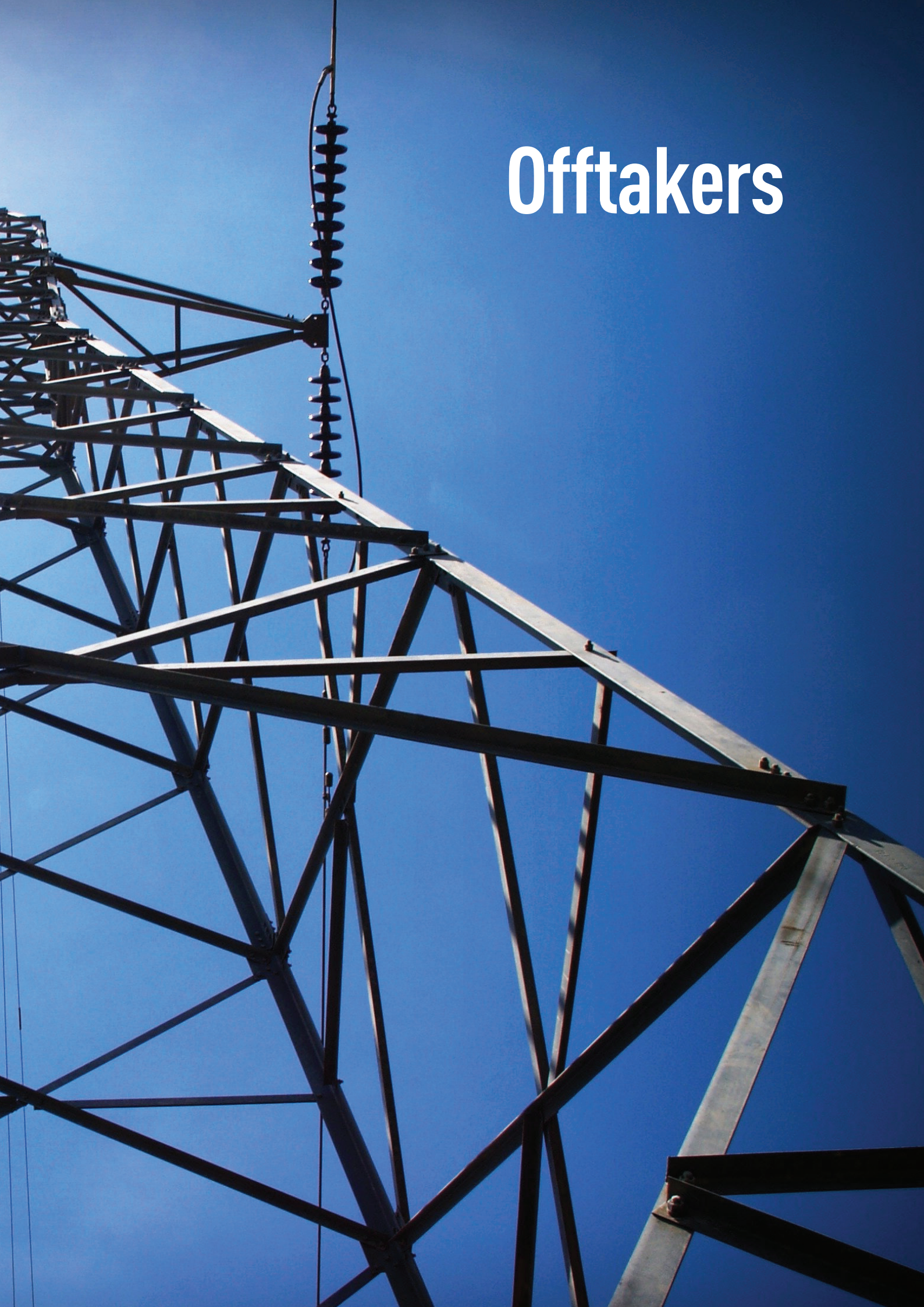
²¹ Kanika Chawla, *Money Talks? Risks and Responses in India's Solar Sector* (CEEW, 2016).

²² Based on stakeholder interviews.

²³ Press Information Bureau, "MNRE Issues National Wind-Solar Hybrid Policy", available at <http://pib.nic.in/newsite/PrintRelease.aspx?relid=179270>; accessed 30 May 2018.



Offtakers



Payment security is critical to harnessing renewables to meet India's targets

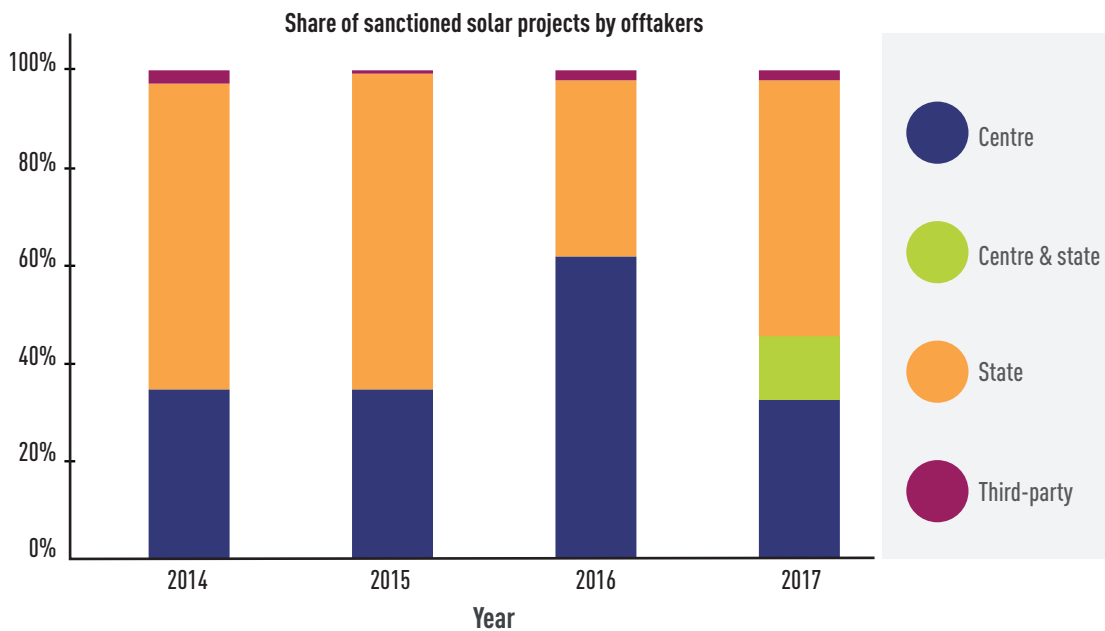
The creditworthiness of offtakers, which affects the timeliness and reliability of payments for power purchase, is having a strong impact on renewable investment decisions.

The financial health of India's utilities who are responsible for the purchase and sale of power has a direct impact on the viability of the power sector as a whole, and the renewables sector in particular. Delay in payments or potential default by offtakers is a major risk faced by RE investors.^{24,25} Recognising the important role of the offtaker in the financial sustainability of the renewable energy sector, the government's UDAY programme for DISCOM debt restructuring and reform will be central to the growth of the renewables sector. The improved financial condition of utilities under UDAY is helping to provide renewable energy projects with more reliable counterparties. However, the continuation of payment delays to generators and financial losses by the DISCOMs pose a major impediment for further investment and activity in the RE sector. The creditworthiness of the offtaker is therefore an important consideration in RE project deployment, which becomes clear through the market trends outlined in figures 11-13.



The financial health of India's utilities, which are responsible for the purchase and sale of power, has a direct impact on the viability of the power sector as a whole, and the renewables sector in particular

Figure 11 - Share of sanctioned solar projects with central government offtakers has risen



Note: Centre & State offtaker in 2017 refers to the Rewa ultra mega project, which has a combination of state and central entities as offtakers.

Source: CEEW and IEA analysis

²⁴ Kanika Chawla, *Money Talks? Risks and Responses in India's Solar Sector* (CEEW, 2016).

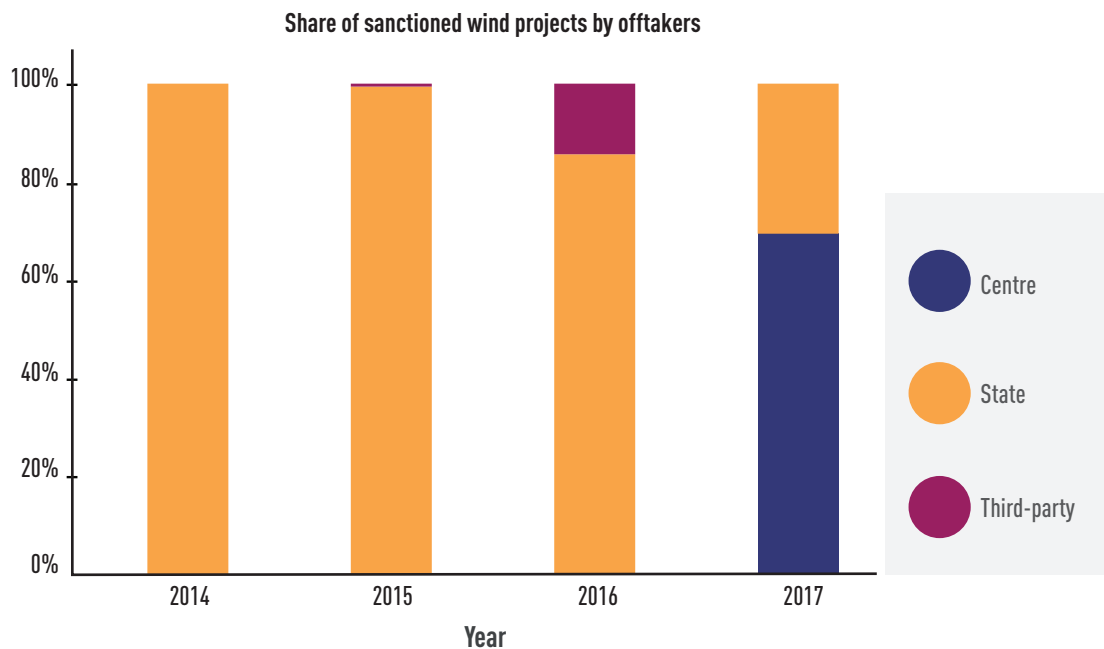
²⁵ Based on stakeholder interviews.

Both for solar and wind projects that have a central government offtaker, as indicated in figures 11 and 12, the counterparty is the Solar Energy Corporation of India (SECI). In February 2017, SECI was included as a beneficiary in a tripartite agreement between the Government of India, state governments and the Reserve Bank of India (RBI). The tripartite agreement serves as a payment security mechanism, significantly reducing the risk on receivables and enhancing the credit rating of the utility. The payment security mechanism, linked to a bankable PPA of a financially sound counterparty, makes projects very attractive for financiers. As a result, central government bids are oversubscribed, clearly reflecting the preference of IPPs for central government bids.



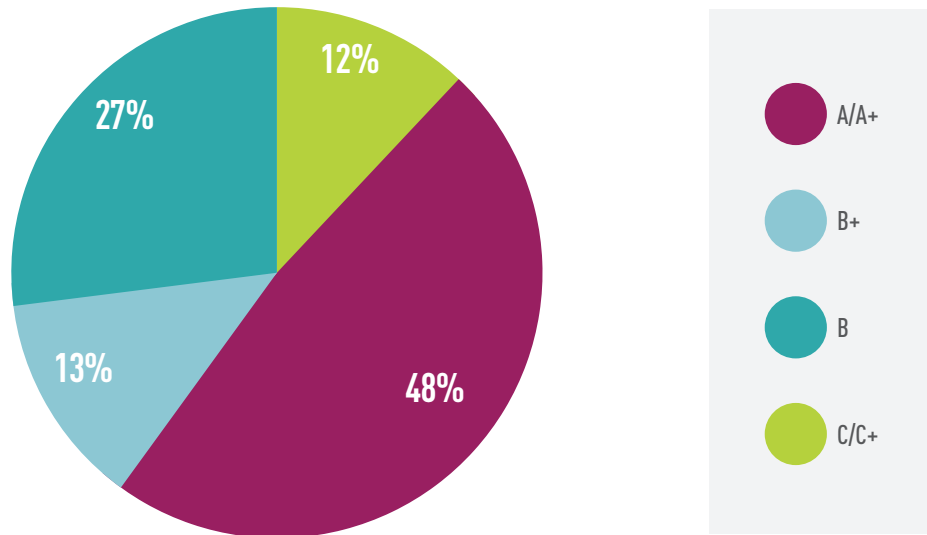
The tripartite agreement serves as a payment security mechanism, significantly reducing the risk on receivables and enhancing the credit rating of the utility

Figure 12 - Centre offtakers dominated the wind projects sanctioned in 2017



Source: CEEW and IEA analysis

Similarly, in the wind sector, the major proportion of central offtaker based capacity in 2017 represents the reverse auctioned wind capacity awarded by SECI. The transition to reverse auction based bids for wind was orchestrated through SECI, in order to build developer confidence in the tendering process. Had the reverse auction rounds been carried out by the state DISCOMs, developers indicate that the bid prices may not have declined as sharply as they did in the SECI bids, due to higher counterparty risk. IPPs would have needed to build in financial buffers for payment delays, and other risks to receivables, if financially over leveraged DISCOMs were the counterparty. Given the adverse financial condition of state DISCOMs in a number of states, DISCOMs characterised by superior financial and operating metrics account for the largest shares of state government entities as off-takers (Figure 13).

Figure 13 - Creditworthy state DISCOMs account for the majority of projects with state offtakers**Utility grade of the DISCOM for solar PV and wind projects where the offtaker is the state government**

Note: This chart corresponds to projects with state offtakers awarded between 2014 and 2017. Capacity corresponding to Madhya Pradesh's offtake from the Rewa ultra mega project has been allocated to the state for the purpose of analysis. The utility grade for each state has been estimated by averaging the grade for each state DISCOM as per the Ministry of Power's Fifth Annual Integrated Rating for State DISCOMs, 2017. These utility grades measure the operational and financial capabilities of state DISCOMs. In terms of financial and operational capability, the various ratings indicate the grade awarded to each DISCOM as per the following scale: A/A+: high to very high capability, B+: moderate capability, B: below average, C/C+: low to very low.

Source: CEEW and IEA analysis

The proportion of central versus state offtakers in a particular year is subject to variations due to actual tendering activity. For example, in the case of wind, central offtakers entered the market in 2017, with the commencement of competitive auctions for wind projects by SECI and accounted for an overwhelming majority of the projects that were awarded in that year. Similarly, in the case of solar, a lower share of central offtakers in 2014 and 2015 reflects lower tendering activity by central government entities in those years. Moreover, a single 1,500 MW solar tender in Tamil Nadu increased the share of projects with state offtakers in 2017.

Projects with central government entities (SECI and NTPC) as offtakers, which further sign power sale agreements (PSA) with state DISCOMs, are characterised by lower offtaker risk and are an attractive proposition for developers. The tendering of capacity by central offtakers, which in turn have PSAs with state DISCOMs, subject to the tripartite arrangement (between SECI/NTPC, States, and the Reserve Bank of India) has thus far functioned as an effective mechanism to increase the share of renewables in the electricity mix of states. This can be especially beneficial to states characterised by poor creditworthiness to realise their Renewable Energy Purchase Obligations and other state level renewable energy targets. While structural reforms would improve the creditworthiness of state DISCOMs with poor credit ratings, the tripartite agreement²⁶ can function as a transitional guarantee against default by state DISCOMs, thereby encouraging the sale of renewables to these utilities.

²⁶ Solar Energy Corporation of India (SECI) is a beneficiary in a three party agreement between the Government of India, state governments and the Reserve Bank of India (RBI). The tripartite agreement serves as a payment security mechanism for central government undertakings whereby, in the event of a payment default by any state government undertakings including DISCOMs, they can withhold funds from the centre's financial assistance to the states. National Thermal Power Corporation (NTPC) has been a beneficiary of this agreement since 2002.

Annexure

Methodology and Assumptions

The 2014–2017 period for analysis was selected to incorporate the sharp upward revision in India’s RE capacity addition target (to 175 GW by 2022) that was announced during the presentation of the 2015–16 union budget in the early part of 2015.²⁷ The announcement of the 175 GW target was a watershed moment in the development of India’s RE sector. It not only signalled a significantly heightened commitment to the transition to clean energy but is also accompanied by a surge in market activity in the RE sector. A strong commitment to realising this target has been the driver of several policy measures aimed at supporting rapid and streamlined deployment of capacity. Thus, the close alignment between the period of analysis and the timeline of the announcement was considered as an important factor in this trends report. The selected time frame also offers the opportunity for a comparison of projects awarded right before and those awarded right after the announcement of the revised targets, allowing an assessment of the impact of the political signalling on the sectoral trends.

To identify and gain meaningful insights into the clean energy investment trends, developing a comprehensive project-level data set for the RE sector for the period under consideration was critical. Given the complex nature of investment decisions, the collected project-level data are multidimensional, capturing various aspects of the projects under consideration. The parameters of the dataset have been categorised under the following broad heads:

1. **Basic project information:** Details of project sponsors, type of RE technology, nameplate capacity, project location, project status;
2. **Business model and contracting process:** Details of the offtaker, tariff information, incentives applicable to the project, project events and timelines;
3. **Financing information:** Details of capital structure and terms of financing, total project investment, details of refinancing (if applicable);
4. **Adjudication:** Details of any legal disputes surrounding the project.

In addition to analysing project-level data, open-ended structured interviews were conducted with a range of stakeholders in the Indian renewable energy ecosystem. These interviews were aimed at gaining a holistic perspective on the effectiveness of various policy measures in addressing risks, in order to contextualise and facilitate the interpretation of the trends emerging from the analysis of the project database. The stakeholders interviewed included developers, financiers, senior government officials, and representatives of RE sector-specific government agencies.

Data sources

The project database used for this analysis was collated from a variety of publicly available sources of data as well as through the discretionary use of some subscription-based databases. Publicly available sources of data for the project comprised data pertaining to RE projects reported by SECI and state-level RE nodal agencies, the Ministry of Finance’s database on infrastructure projects, regulatory filings of developers with the Ministry of Corporate Affairs and with stock exchanges, websites of developers, and media reports.

²⁷India Budget, “Key Features of Budget 2015–16”, available at <https://www.indiabudget.gov.in/budget2015-2016/ub2015-16/bh/bh1.pdf>; accessed 27 May 2018.

Data challenges

There is an overall lack of transparency pertaining to project-level information for RE projects. Nodal RE agencies at the state and central levels do report basic information on the list of tendered or commissioned RE projects along with the nameplate capacity and project location. However, there is wide variation in the comprehensiveness of the coverage across states, with most states compiling, recording, and providing partial or outdated information. Some states report additional information on offtakers, tariff details, and the dates of project events (such as dates pertaining to project commissioning and the signing of power purchase agreements [PPAs]), but data on these parameters are often limited. Given the lack of regular reporting in the sector, it is difficult to develop a comprehensive and exhaustive database in terms of project coverage for solar and wind for all the years under consideration. For example, in 2017, as against the figure of 6 GW for solar projects awarded under auctions, the project database captures 5.5 GW (nearly 90% coverage). In the case of wind power, the database captures all of the wind projects awarded in competitive auctions in 2017, although the comprehensiveness of non-auction projects is hard to ascertain.

Assumptions

The data constraints identified necessitated the use of certain assumptions for the purposes of our analysis. These include:

1. The analysis of all trends in this report is based on the date of sanctioning or award of the project, using this as a proxy for the date of the investment decision.
2. Wherever the dates of award of projects for competitively auctioned projects or the dates of sanctioning for projects under the feed-in-tariff (FiT) regime were unavailable, these have been estimated based on the respective dates of project commissioning. Based on a survey of PPAs pertaining to central and state solar tenders, a time frame of 15 months has been estimated between the date of award and the date of commissioning for solar projects. Although in some cases, a few state PPAs implied a longer time period between date of project award and date of project commissioning (about 18 months), we have applied the 15-month assumption uniformly in cases where the date of award was not available. In the case of wind, based on estimates of project construction timelines and the time taken for the grant of administrative approvals, we have estimated 18 months as the time frame between the date of sanctioning and the date of commissioning. This time frame is also largely consistent with the guidelines issued by the Ministry of New and Renewable Energy (MNRE) for competitive bidding for the procurement of power for grid-connected projects.²⁸
3. Offtakers have been classified under the following three categories for the purposes of this analysis: central government entities (centre), state DISCOMs (state), and third-party offtakers.

²⁸ MNRE, "Guidelines for Tariff Based Competitive Bidding Process for Procurement of Power from Grid Connected Wind Power Projects", available at <https://mnre.gov.in/file-manager/UserFiles/guideline-wind.pdf>; accessed 8 June 2018.



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