GLOBAL WIND ENERGY COUNCIL (GWEC) INDIA

ACCELERATING ONSHORE WIND CAPACITY ADDITION IN INDIA TO ACHIEVE THE 2030 TARGET

GWEC
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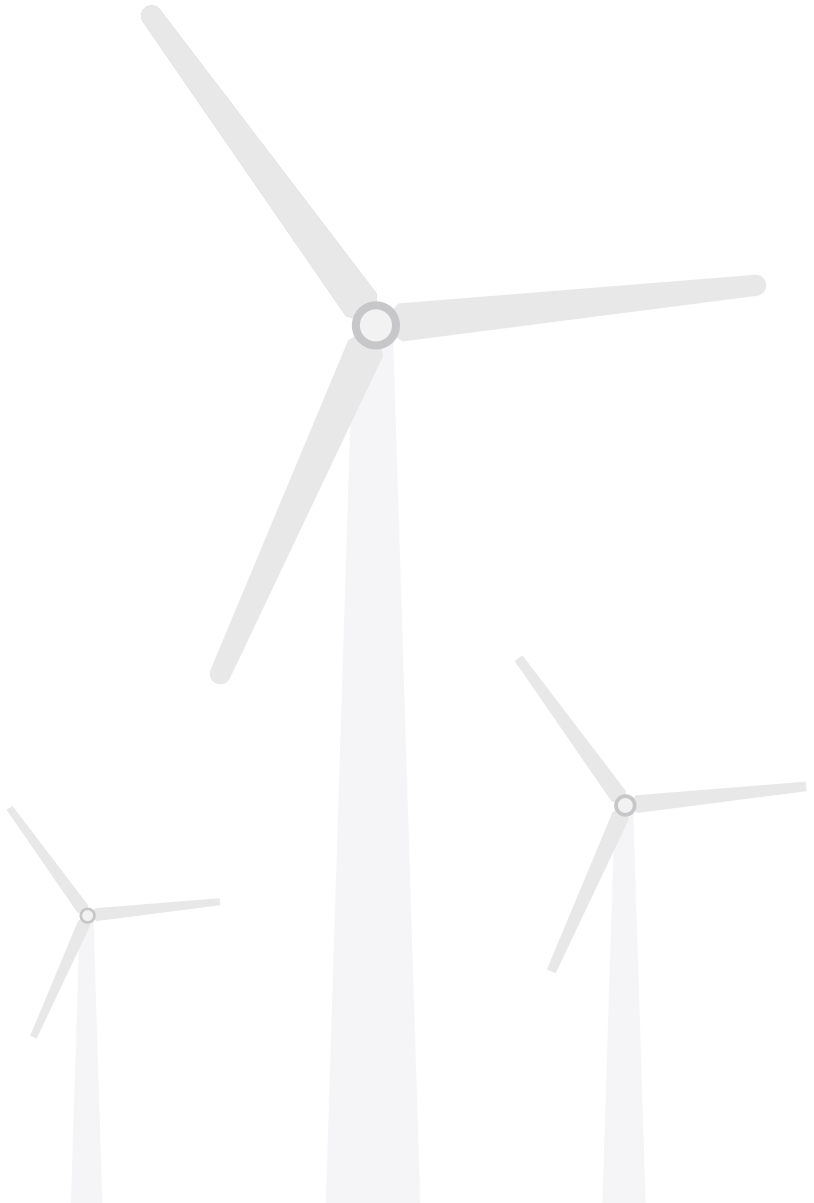

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Foreword

by Mr Ben Backwell

The efforts of India to carry out a thorough and wide ranging transition of its energy system will play a key role in helping the world to reach its climate goals and avert further dangerous global heating, while providing almost unlimited opportunities for investment and the creation of skilled jobs.

In 2015, the Paris agreement successfully achieved a historic consensus, committing the world to set limiting global warming to well below 2 degrees Celsius by 2100 and pursuing efforts to limit it to 1.5 degrees Celsius. At the COP26 meeting in Glasgow, further progress was made, with countries agreeing to phase down coal, work to eliminate inefficient fossil fuel subsidies, and work together to rapidly step up deployment of renewable energy. Commitments to meet net-zero targets now cover 80% of global GDP and 77% of global emissions.

However, we are far from being on-track to meet these ambitions. According to the recently published IPCC AR6 WG III report, global net GHG emissions were almost 12% higher than in 2010. And in 2019, around 34% of the total net GHG emissions came from the energy supply sector. Current national commitments up to 2030 would put the world on track for a 2.4 degree Celsius rise in average global temperatures, and a further upward revisions of targets will be needed rapidly in order to create a Paris-compliant policy pathway.[1]

At this juncture, India's bold ambitions for climate change mitigation through a push for rapid deployment of renewable energy sources such as wind and solar is of crucial importance. India contributed 6.8% of the global GHG emissions in 2018. Power generation accounts for 64% of its energy sector emissions which is 73% of country's total GHG emissions. The country has set a target of deploying 140 GW of wind energy by 2030 and has so far added nearly 41 GW of onshore wind energy capacity. I wish to commend the Indian Minister HE R K Singh Ji for introducing a series of policy and institutional mechanisms to fuel the larger energy transition agenda and to push progress in the wind sector even through the difficult conditions of the COVID pandemic.

This brings us to the issue of the slowdown in recent years of annual wind capacity additions. Since the financial year 2016-2017, India has only added 11.8 GW of wind energy capacity and annual capacity addition has remained less than 2.5 GW in the past few years compared to 5.4 GW in 2017. While there are a plethora of reasons for this slowdown, the

1 https://climateactiontracker.org/global/cat-thermometer/

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majority of hurdles are legacy issues- pending payments, land availability, permits and clearances, and infrastructure issues. If they remain unaddressed, these issues could continue to slow deployment lead to a further deterioration the financial health of the wind industry, putting the 2030 target at risk. India needs to tender an annual capacity of at least 8-9 GW wind projects in this decade to be able to meet its 2030 onshore wind energy capacity addition target – currently on an average 3.5 wind and 1.6 GW hybrid/RTC capacity is annually tendered.

The coal crisis that erupted in India in April 2022 underscores why India's emphasis on energy security is vital. The disruption in coal supply and availability, even if it is temporary, has once again brought to the fore the importance of diversification of fuel mix and a higher reliance on India's clean energy sources for meeting existing and emerging power demands. Wind energy is key to India's clean energy transition. As diversification of fuel in the electricity mix becomes growingly important to ensure energy security, wind energy will play a fundamental role in balancing the grid.

Indian states must harness the huge wind potential with which they are blessed, and overcome legacy challenges that have slowed the commissioning of utility-scale projects. This will require a greater understanding of the value that states can create for themselves by advancing the consumption of green power in terms of the socio-economic and environmental benefits of wind energy, and this is one of the central themes of this report. Realising these benefits, and curbing unpredictability and inertia from legacy issues will require government, industry and communities to work together closely, and GWEC and its local partners stand ready to play their part. The rewards of success, for India, its people and the climate cannot be overstated.

I would like to convey my heartiest congratulation to the entire GWEC India team, our partners and members for this important publication.

Foreword

by Mr Sumant Sinha

India has become a global leader in the worldwide energy transition with its impressive growth in renewable energy over the past decade and its ambitious climate goal to achieve 500 GW non-fossil fuel electricity capacity target by 2030, set by Hon'ble Prime Minister of India, Shri Narendra Modi, at CoP26 in Glasgow last year. The Prime Minister's climate target for India to become a net–zero economy by 2070 has set the tone for the country's next phase of growth in clean energy. It is essential that all stakeholders put their shoulders to the wheel and look at achieving these targets.

This task is challenging and befitting of a rising global power such as India, whose installed renewable energy capacity has increased nearly 400% in the past eight years and now stands at more than 160 GW, which is about 40% of the country's total installed power capacity. In meeting this challenge, India's wind energy sector will play a key role, as the country has fourth largest wind power capacity in the world with total installed capacity of 40.78 GW. The sector's development in India has the potential to offset an extra 229 million metric tons of CO2 over the lifetime of a wind farm (25 years), while also creating more than a million green jobs across the country.

However, the domestic wind industry has been facing challenges that intensified during the intense phase of the pandemic in 2020 and 2021. These issues were, however, eased with favourable government policies such as Energy Banking, Open Access, Feed in Tariff, Renewable Energy Obligation (RPOs) and Renewable Energy Certificates (RECs) and innovation in technologies, setting the stage for its enhanced contribution to India's clean energy journey in the coming years.

This GWEC report also points to the future and highlights scientifically robust models and studies that show that wind energy is an important element in India's future electricity mix and in its decarbonizing journey. With a target of 140 GW of wind installed capacity for 2030, one is looking at India better utilising its potential of over 302.25 GW at 100 m and 695.50 GW at 120 m onshore wind energy. Also, the Government to India's recent announcement that the country aims to achieve 37 GW of offshore wind energy capacity addition by 2030 will boost India's wind sector and contribute to the country's 500 GW RE target.

In India's wind growth story, one must appreciate the key role of the Centre, as well as of state governments, in enabling the development of the wind sector since the late 1980s, including several landmark financial and non-financial policy measures

Mr Sumant Sinha

Chairperson, GWEC India and Founder, Chairman and CEO, ReNew Power Private Limited

such as Accelerated Depreciation, tax benefits for wind equipment, and Generation-Based incentives. However, over the years, with the introduction of the reverse auction in 2016, clubbed with the elimination of fiscal support measures, market-based mechanisms have led to a complete transition in how the wind sector operated. Also, the size of wind energy projects has grown several fold with innovation becoming key to resilience and growth.

Here, I would like to commend the report for rightly focusing on the Indian reverse auction regime for deployment of wind capacity.

This regime led to innovation in wind tenders: wind-solar hybrid, round-the-clock (RTC), and blended . All these have hugely enhanced the continued relevance of wind energy and ultimately reduced our dependence on the fossil fuels. It is, however, also important to highlight that although the reverse auction mechanism for deployment of wind power has resulted in discovery of reduced tariffs because of competition vis-à-vis earlier mechanisms, the overall deployment of wind power has slowed down on account of legacy issues; concentration of wind projects in few geographies; and the lack of full coordination between Central and state agencies.

One main contributing factor of the slowdown is the artificially discovered lower tariff on account of unhealthy competition in the reverse auction mechanism. Given this, the Ministry of New and Renewable Energy (MNRE) has correctly announced it will do away with the reverse auction to curb unhealthy competition and provide more impetus to deployment of wind energy.

Going forward, there should be more innovative tenders, complemented with larger share of power from wind. Also, to expedite wind capacity deployment, the design of tenders should be state-specific with clearcut visibility into the quantum and timelines for bids; this can take place in the shape of an annual auction calendar at the beginning of the financial year.

In a broader context, the reading of this report will be very useful in helping readers understand what is required to further strengthen the Indian wind energy sector. The recommendations range from promoting bids that complement both wind and solar energy; resolving legacy issues into opportunities; and strengthening policy support and dialogue between the government and industry for formulating more effective auction designs.

Also, an adequate and timely deployment of wind power capacity is inevitable as consumers become more price-conscious and aware of the most pressing issue of the day: climate change. Further, educating customers about the practical and planet-friendly benefits of wind energy will support in its faster development.

In this context, this timely and insightful publication by GWEC India is excellent ready reckoner as the sector and all connected stakeholders contemplate the next phase of wind's journey across the fast-evolving Indian clean energy landscape. I would like to congratulate GWEC India wholeheartedly for its efforts in bringing this report out, as well as those of other contributors. This well-researched report will be useful to industry practitioners, policymakers, investors, lending institutions, international climate bodies, research bodies, NGOs, and academics.

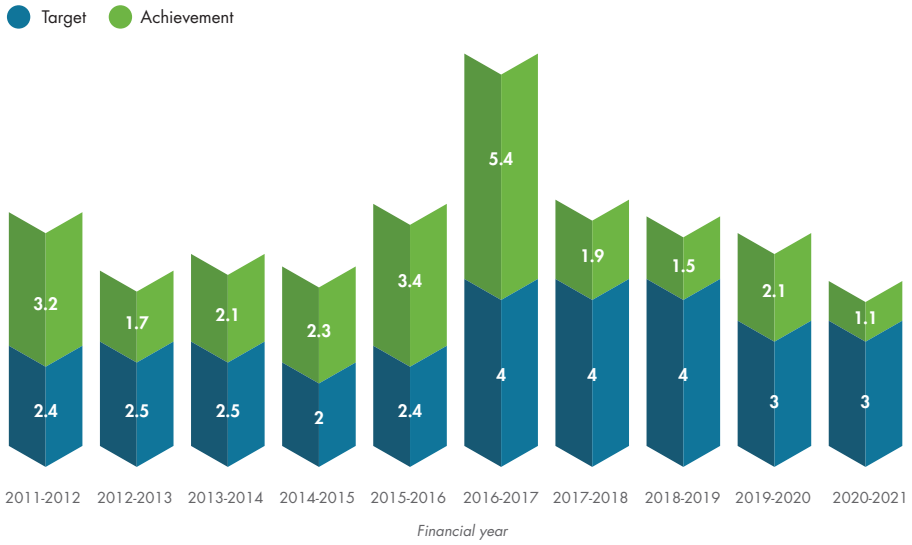
1. Introduction

Wind energy is increasingly recognised as a vital solution for addressing urgent global challenges, from energy security to climate change. The International Renewable Energy Agency's (IRENA) ''World Energy Transitions Outlook 2021'' and the International Energy Agency's (IEA) ''Net Zero by 2050'' roadmaps for a Paris Agreement-compliant global energy system by 2050 have projected the need for fast-paced growth in deployment of wind energy to limit global temperature rise to 1.5°C.[2] Within these strategic reports, wind scales up over the next three decades to become the predominant source of electricity generation worldwide by 2050, and together with solar, wind provides around two-thirds of global electricity.

India is at the forefront of climate action as one of the top countries for greenhouse gas (GHG) emissions and one which has announced its goal of achieving net-zero by 2070.[3] With over three decades of experience in harnessing wind energy technology for power generation, India has already achieved nearly 41 GW of installed onshore wind energy capacity, making it the fourth-largest market for installed wind capacity globally.

India has set a target of harnessing 140 GW (out of which 30 GW is offshore wind) installed wind energy capacity by 2030. The Central Electricity Authority (CEA) has estimated a 17.13% (140GW) share of wind energy in the likely installed capacity in 2029-2030 to ensure an optimal generation capacity mix (CEA 2020). However, recently annual wind capacity additions have declined, hindering India's implementation to

Figure 1 Annual wind power capacity additions versus targets, 2011-2021

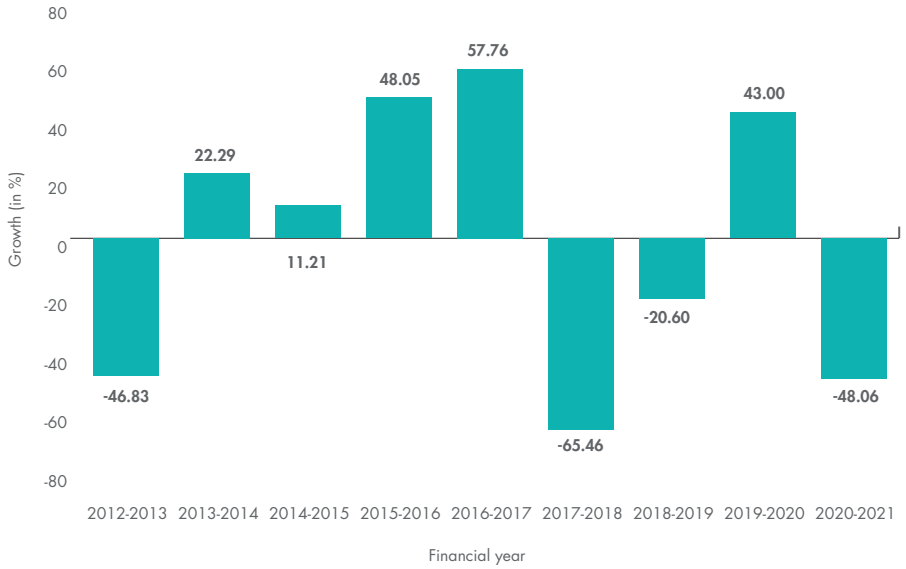


Source: (J, D and Majid 2019), (MNRE 2021) and CEA's Renewable Generation Reports for March 2021 and 2022

2 https://irena.org/publications/2021/Jun/World-Energy-Transitions-Outlook; https://www.iea.org/reports/net-zero-by-2050

3 https://pib.gov.in/PressReleasePage.aspx?PRID=1768712

Wind power capacity addition - Rate of YoY growth (in %)



Source: (J, D and Majid 2019) , (MNRE 2021) and CEA RE Generation Report for March 2021 and 2022

decarbonize the power sector, as well as other sectors such as heavy industry and transport. As shown in Figure 1 below, this decline of capacity additions began around 2017, after the Government of India (GoI) introduced a reverse auction regime for wind power procurement.

As the share of renewable energy in the grid increases, increasing wind power to meet growing power demand and to meet the demand for ancillary services (flexibility, responsiveness and balancing) is critical to ensure the reliability of the overall grid system (GWEC and MEC+ 2021). A recently published paper outlines that setting up 600 GW of renewable capacity, with a majority share from wind power, would reduce the frequency of operations of fossil-fuel based power plants and this could stabilize India's 2030 emissions below 2018 levels in a least-cost pathway (Deshmukh, Phadke and Callaway 2021). Other studies have estimated a 30.5% share of wind power in India's least-cost resource mix to meet the domestic electricity load in 2030 (Abhyankar, Deorah and Phadke 2021).

To meet India's net-zero and renewable energy targets, and safeguard energy security and self-sufficiency in the course of its clean energy transition, the GoI must revitalize the growth of wind power. This publication presents insights into India's current auctions regime, industry perspectives on the policy recommendations to restore wind growth and socioeconomic opportunities that lay ahead.

2. Background on wind power development and potential in India

To date, the growth of the Indian wind industry has been driven by a combination of factors: an evolving policy framework, emerging market dynamics and a growing appetite for green power generation and consumption.

As per the National Institute of Wind Energy (NIWE), India can generate 695 GW of wind power at 120 m above ground level (agl) height (NIWE 2019). Out of this potential, 340 GW is suitable for wasteland, 347 GW in cultivable land and the remaining is in forested areas. It is also estimated that there is 132 GW of wind power generation in high potential areas which hold capacity utilization factors (CUF) greater than 32%; about 57 GW is in areas with potential CUF greater than 35%. A list of high-CUF states and estimated wind power generation potential is provided in Table 1.

Table 1 Wind project capacity utilization factors (CUF) by state

State	Capacity Utilization Factor (CUF)					
	25-28% (MW)	28-30% (MW)	30- 32% (MW)	32- 35% (MW)	>35% (MW)	Total potential in MW
Andhra Pradesh	33,251	14,790	10,716	11,121	5,028	**74,906**
Gujarat	33,655	26,900	24,662	28,502	28,841	**142,560**
Karnataka	53,863	29,248	20,868	14,221	5,955	**124,155**
Maharashtra	47,324	20,597	14,131	12,526	3,635	**98,213**
Tamil Nadu	30,183	11,524	7,057	7,446	12,540	**68,750**
Kerala*	366	193	180	359	1,213	**2,311**
Madhya Pradesh*	12,103	2,398	779	124	0	**15,404**
Telangana*	17,989	5,057	1,369	379	43	**24,835**
Rajasthan*	98,714	27,394	1,621	27	0	**127,756**
Total potential in MW	**327,448**	**138,101**	**81,383**	**74,706**	**57,257**	**678,893**

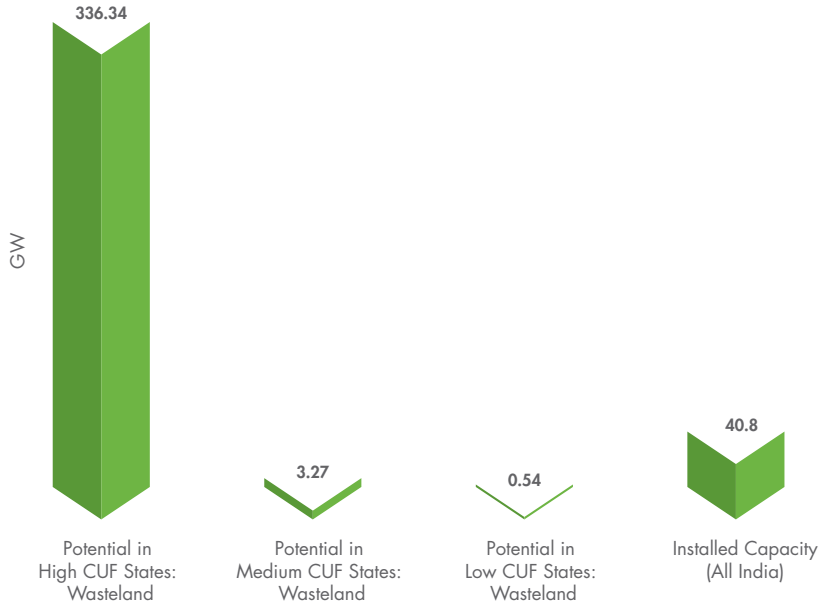
* Potential in scattered pockets

Source: NIWE, 2019

As per NIWE's estimates, the aggregated wind power generation potential in high-CUF states, considering wasteland alone, is 336.34 GW. **This means that the technical potential for onshore wind in wasteland sites in high-CUF states is more than eight times the country's existing installed wind power capacity and over eight times the onshore target for 2030 (see Figure 2).**

With an installed capacity of nearly 41 GW of wind energy and 49.3 GW of solar energy, India's Central Electricity Authority reported a generation of 58.13 thousand MU (wind) and 51.25 thousand MU (solar) between April and December 2021 (CEA 2022). As per the GoI's estimates, 2.2 MU of electricity is generated annually per MW of installed wind power, and 2 MU per MW of solar power (MNRE 2021).

Figure 2 Wind Energy Potential (Wasteland only) Versus Installed Capacity



Source: (NIWE 2019) and (CEA 2022)

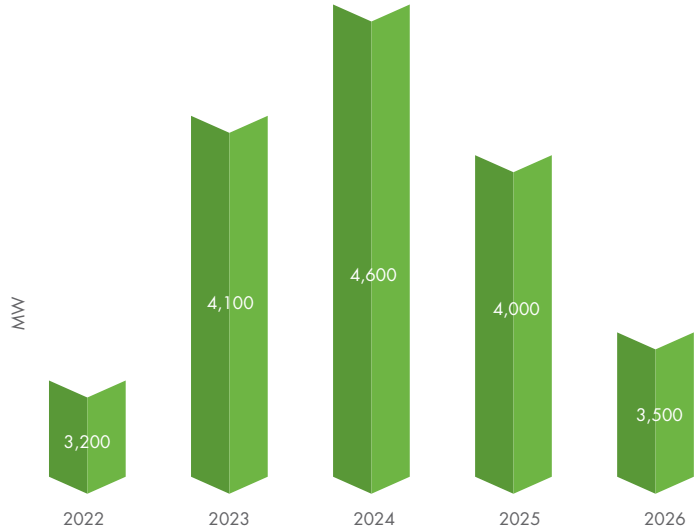
It is also notable that wind power is available when there is peak power demand in India, this is also the time when power costs are high and solar is mostly not available. Hence, it may be considered that one unit of wind power generated during the peak demand time cannot be equated with solar power generated during the non-peak hours. Techno-economic analysis of wind power projects in India is available in Appendix 1.

A major inflection point in the domestic wind industry was the introduction of the reverse auction mechanism for project allocation in 2016. Under this scheme, the Ministry of New and Renewable Energy (MNRE) intended to achieve better transparency and price discovery for the fulfilment of non-solar renewable purchase obligation (RPO) of states. This led to a major shift in the dynamics of the Indian wind industry. Unlike the pre-auction regime era, where Original Equipment Manufacturers (OEMs) undertook a major portion of project development operations such as land identification and securing clearances from various state departments, the auction regime prompted Wind Power Developers (WPDs) to undertake these key activities. WPDs also became responsible for the fulfilment of bid standards and requirements, as well as the technical feasibility of connectivity of the power generation asset to the state/central transmission utility.

The GoI and respective state governments have leveraged a range of policy and financial instruments to encourage wind industry investment, including generation-based incentives (GBI), feed-in tariffs (FiT) or preferential tariffs and accelerated depreciation (AD). While the GBI was operational until March 2017, AD was applicable for wind projects until 2017 and reduced to 40% as of 1 April 2017. Furthermore, to facilitate demand for green power, the government has used instruments such as the RPO and Renewable Energy Certificates (RECs).

Currently, there is no central financial assistance available for installing new onshore wind projects. Moreover, the reverse auction process has gradually become the only channel for price discovery for power purchase agreement (PPA) signing between the WPD and buyer using the market mechanism.

Figure 3 Forecast onshore wind installed capacity in India under business-as-usual scenario, 2022-2026



Source: GWEC Market Intelligence; GWEC India; Global Wind Report 2022

This is unlike the previous regime of FiT, wherein the generator would inject power into the grid at a price set by the state regulator. FiT for long term power contracts was fixed by the government. Gradually, a momentum for higher competition and competitive tariffs that are reflective of genetion costs began to gain popularity. This marked transition to a reverse auction mechanism.[4]

By 2017, India had added 32.27 GW of wind energy capacity through the FiT mechanism (MNRE 2021). As of December 2021, India has 40.8 GW installed wind power capacity; as of July 2021, 9.3 GW of onshore wind capacity is under construction.[5] According to GWEC India and GWEC Market Intelligence, around 19.4 GW of new wind power is forecast to be

4 FiT is still available for wind projects less than 25 MW

5 https://cea.nic.in/installed-capacity-report/?lang=en; https://cea.nic.in/wp-content/uploads/rpm/2021/11/Quaterly_Underconstruction_project_report_1.pdf

installed over the next five years from 2022 to 2026 (see Figure 3).

While these forecast volumes are an improvement from recent years, they are still insufficient for India to reach its wind power target of 110 GW (excluding 30 GW offshore wind) by 2030. Under this business-as-usual scenario by 2026, India will only have around 55% of the onshore wind capacity targeted by the end of this decade.

2.1. Socioeconomic benefits tied to wind power in India

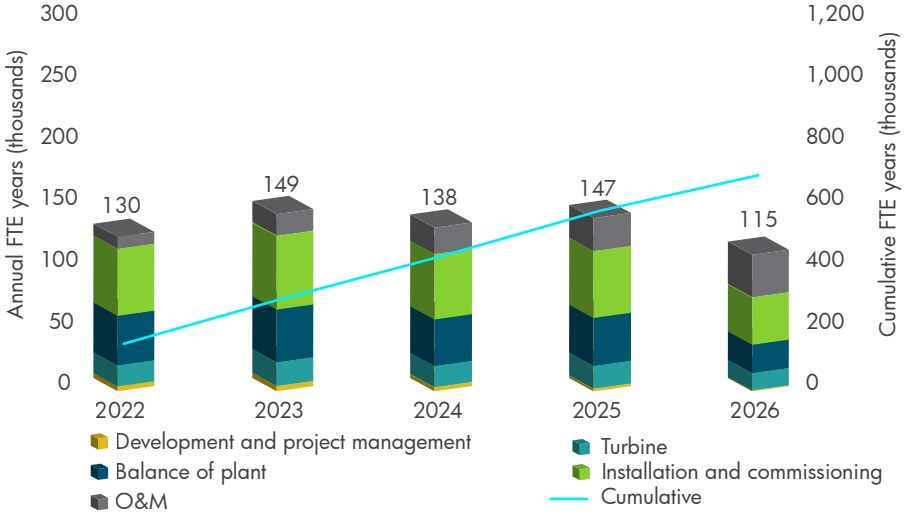
The Indian wind industry is home to at least 50,000 direct jobs, where nearly 10% of the worldwide factories producing wind turbine components (nacelles, blades, towers, generators, gearboxes and bearings) are based in India.[6] Analysis in early 2022 finds that an average of 33.7 FTE jobs (defined as a full-time job for one person for one calendar year) is generated per MW of wind energy installed in India, throughout the 25-year operating lifetime of a project (GWEC, 2022).

Under a business-as-usual scenario where 21.5 GW of onshore wind is forecast to be installed from 2022-2026 in India, a total of 1 million direct and indirect jobs will be generated over the 25-year lifetime of the wind projects (See Figure 4, which captures the job creation over the five years only).[7] These jobs are present across the project development, manufacturing, construction, installation and operations and maintenance (O&M) phase of a wind project, many of which would be generated in local communities and manufacturing centres in India. For instance, from 2026 onwards at least 36,000 direct and indirect FTE jobs would be generated for the O&M segment of the wind value chain, all of which would provide local employment opportunities in India.

Further having emerged as a manufacturing hub for domestic and international markets, the sector is complementing the efforts of the Indian government for the ***Aatmanirbhar Bharat*** (Self-reliant India) and Make In India initiatives. Over the years, with continuous technology innovation, investment in research and development (R&D) and a growing emphasis on indigenization, wind turbine capacities have grown by multiples—from kW-size turbines in the early 1990s to modern and highly efficient 3 MW-plus turbines now commercially available in India.[8]

In addition to job creation, the wind industry also brings in significant capital and economic value to India, at the national, state and local levels. Under the same business-as-usual scenario with 19.4 GW onshore wind installed from 2022-2026, around US$10 billion in direct and indirect gross value added (GVA) to the national economy over the 25-year lifetime of the wind farms (See Figure 5, which captures the GVA over the five-year period earlier estimated in GWEC 2022).

Figure 4 FTE job years created in the wind industry in a business-as-usual scenario in India, 2022-2026



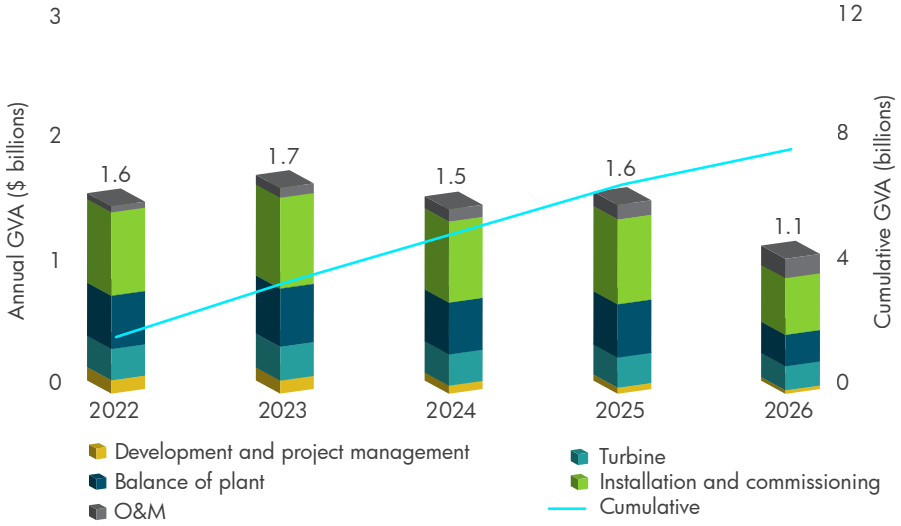
Source: (GWEC 2022)

6 IRENA and ILO (2021), Renewable Energy and Jobs – Annual Review 2021, International Renewable Energy Agency, International Labour Organization, Abu Dhabi, Geneva.

7 Capturing green recovery opportunities from wind power in developing economies, GWEC, 2022. The estimates in the chart are based on earlier projection of 21.5 GW capacity between 2022-2026 which is now revised as 19.4 GW.

8 https://pib.gov.in/PressReleasePage.aspx?PRID=1785808

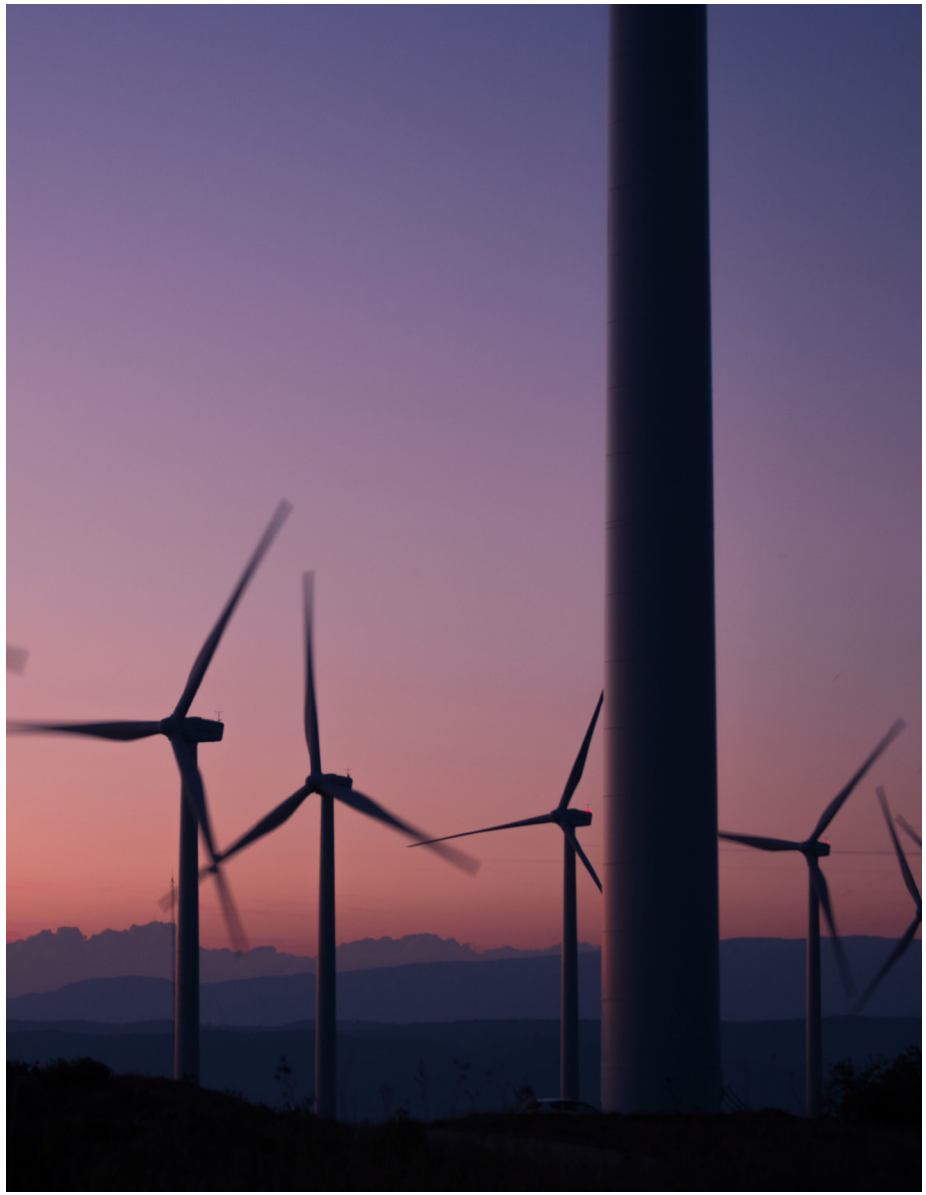
Figure 5 Gross value added (US$) by the wind industry in the business-as-usual scenario in India, 2022-2026



Source: (GWEC 2022)

The pipeline of onshore wind forecast to be installed in India over the next five years will also generate numerous social and environmental benefits, in addition to shoring up energy security. 21.5 GW of onshore wind will produce roughly 37,800 GWh of electricity from 2026, enabling 24 million homes to be powered with clean energy per year. This also translates to powering 10 million electric vehicles on an annual basis. The wind power generated will save roughly 525 million $MTCO_2e$ which would otherwise be generated by thermal plants – this is the same as taking 114 million cars off the road, presenting a huge upside in terms of air pollution and public health cost savings.

Finally, the volume of wind power generated from 2026 would allow for 71 million litres of water to be saved on an annual basis, which would otherwise be used for the generation of thermal power.



3. Insight into India's auctions regime for wind power

The Ministry of Power (MoP) issued guidelines for a tariff-based competitive auction process for procurement of power from grid-connected wind power projects in 2017.[9] Apart from enhancing transparency and introducing price competitiveness, this guideline aimed at standardizing the process of wind power procurement and defining the roles and responsibilities of key stakeholders.

India's e-reverse auction process for wind power procurement has the following design elements:

- **Tendering agencies**: There are three major wind power tendering organizations (a) Central agency: Solar Energy Corporation of India (SECI); (b) Designated state government institutions; and (c) National Thermal Power Corporation (NTPC). In recent years, state-level tenders have almost become dormant and it is primarily central tenders that are driving wind projects in the country. A list of all tenders is available in Appendix 2.
- **Tender type(s)**: Standalone wind project, wind and storage project, wind-solar hybrid project, blended wind power project, peak power and round-the-clock (RTC) supply of power.
- **Eligibility criteria**: In general, there are institutional, technology and financial eligibility terms mentioned in the tender "Request for Selection" document which have to be complied with or met by respective bidders. In addition, there are terms for payment/submission of (a) Document Processing Fee (non-refundable) (b) Document Fee (non-refundable) (c) Earnest Money Deposit (Refundable, if not qualified) (d) Performance Bank Guarantee (to be submitted after Letter of Award (LoA) is announced or before signing of PPA).
- **Submission of bids**: Both technical and financial bids are together submitted by respective bidders through a dedicated online portal. However, financial bids of only shortlisted bidders are evaluated after ascertaining that they meet prescribed eligibility conditions.
- **Selection of successful bidders**: As minimum bid criteria is often specified in the Request for Selection (RFS) document, more than one bidder may qualify for the award of the project. The successful bid is selected based on the lowest (L1) bid value received and capacity allocated. The process continues until subsequent higher bidders get their qualified capacity leading to the exhausting of full bid capacity.
- **Pricing rule:** Wind power tenders in India follow a pay-as-bid pricing rule, which means each winning bidder gets payment as per their corresponding bid. However, some bids mention matching L1 or having bids within 2% of the L1.
- **Penalty:** The RFS process includes terms for liquidated damages for delays in commissioning and in general leverages the Performance Bank Guarantee submitted by the bidder.

9 https://mnre.gov.in/img/documents/uploads/a3ebdeec0b6846b281db0708b746a7ef.pdf

3.1 Performance

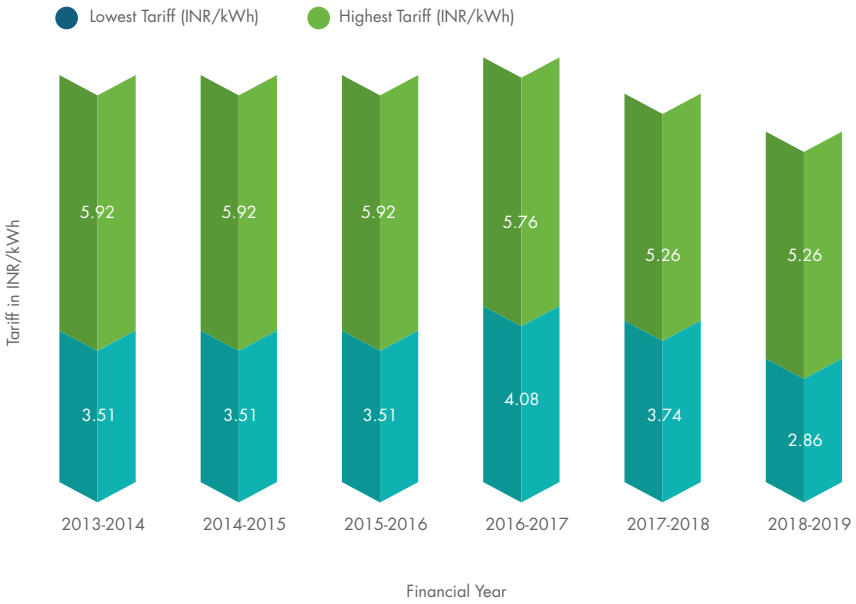
This publication evaluates the performance of India's wind energy auctions regime based on two parameters: cost efficiency and effectiveness.

A) Cost efficiency:

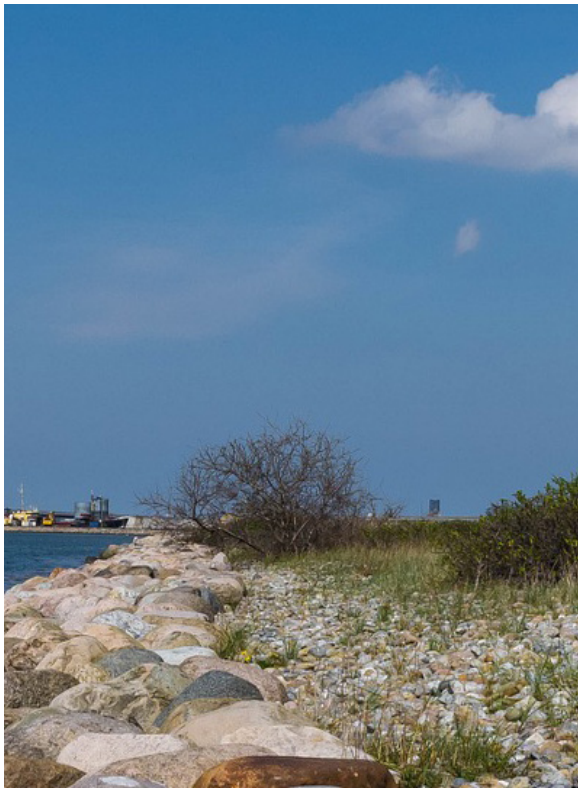
Cost efficiency refers to the cost of generation and support for renewable power (Río and Linares 2014). Globally, the reverse auction mechanism is a robust mechanism for triggering the deployment of wind power through market mechanisms and thereby reducing the subsidy burden of the government.[10] In terms of the impact of reverse auctions on the cost efficiency of wind power:

A.1) Tariffs during FiT and Auctions regime: Figures 6-8 highlight wind power tariffs during the FiT regime and reverse auction regimes in India. In 2017, when INR 3.46/kWh was the tariff discovered through the first-ever wind auction in India. This was lower than the lowest and highest FiT tariffs discovered during the previous as well as the same financial year across Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu. In subsequent auctions, wind power tariffs further decreased. Hence, it becomes evident that the transition from the FiT regime to the reverse auction regime has successfully brought down the wind power project tariffs. However, the comparison between tariffs discovered during the FiT regime and the earliest auction projects must not always be the framework for comparison. In the earliest reverse auctions projects, the WPDs were able to quote lower tariffs owing to factors such as the availability of the best sites in Gujarat and Tamil Nadu, availability of the most efficient and higher capacity turbines, provision for evacuation at CTU, and therefore zero curtailments, which were missing in case of projects commissioned during the FiT regime and prior to provisions for ISTS.

Figure 6: Minimum and Maximum FiT across Gujarat, Karnataka, Madhya Pradesh, Rajasthan and Tamil Nadu

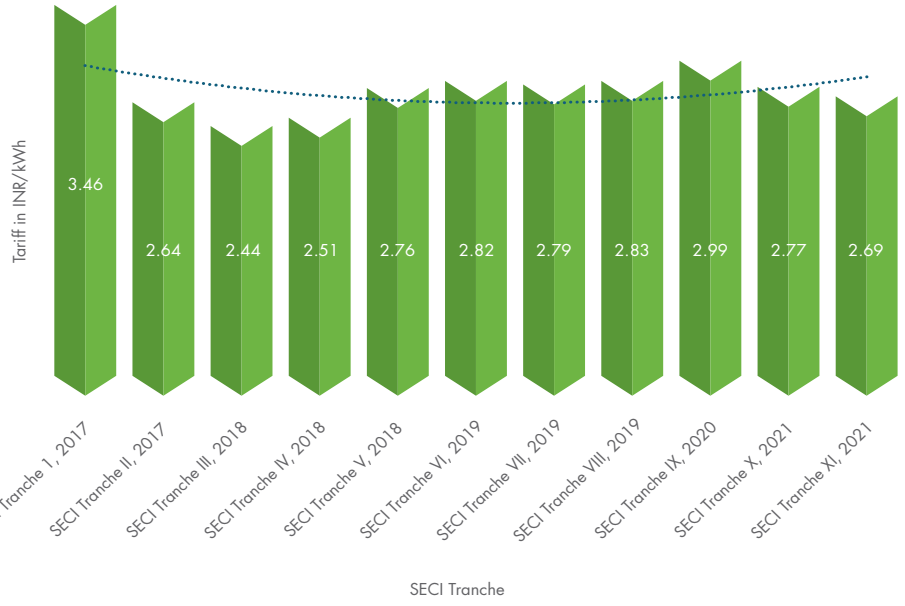


Source: Based on (Bose and Sarkar 2019)



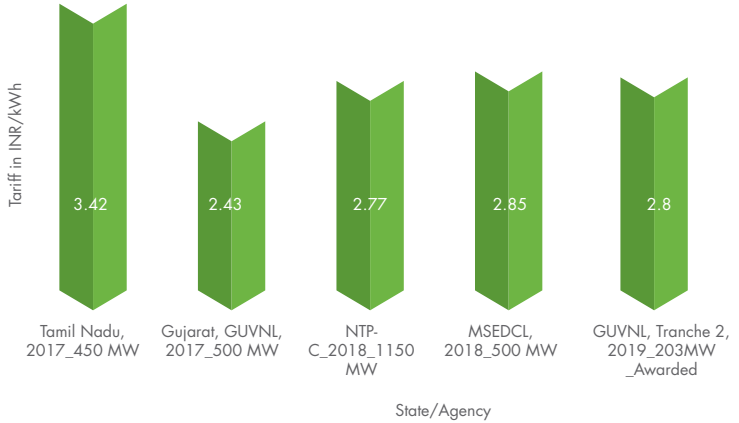
10 Procurement Options for New Renewable Electricity Supply, NREL, 2011; https://www.irena.org/publications/2019/Dec/Renewable-energy-auctions-Status-and-trends-beyond-price.

Figure 7: SECI Wind Auction Winning Tariff (INR/kWh)



Source: GWEC Market Intelligence- Global Wind Auction Database Q1 2022

Figure 8: Tariff Discovered in State/NTPC Wind Power Auctions (2017-2019)



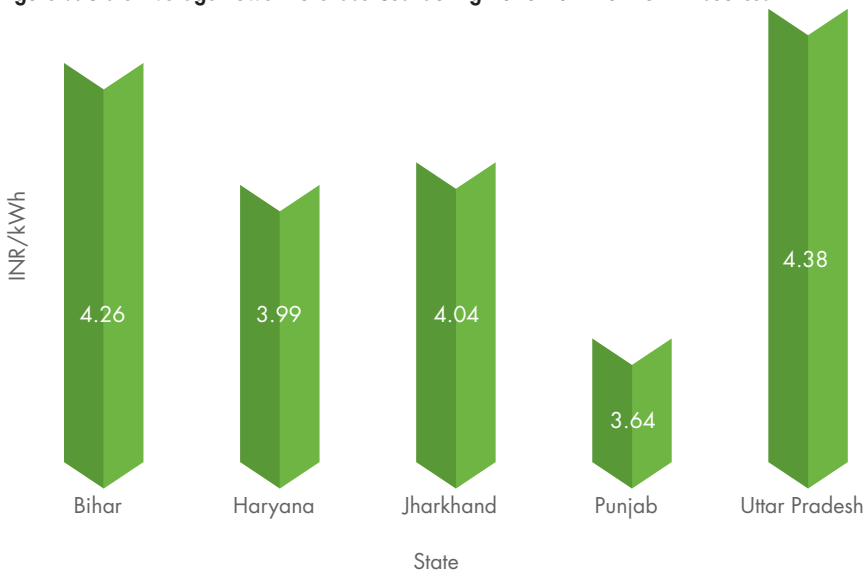
Source: GWEC Market Intelligence- Global Wind Auction Database Q1 2022

A.2) Tariff trends: The first auction conducted by SECI in 2017 led to the discovery of a tariff that was 9.42% lower from the then prevalent lowest FiT. Consequently, states began to recognize the potential of the auction regime. State tenders in Gujarat, Maharashtra and Tamil Nadu helped in expanding installed wind power capacity. This trend of decline in wind power tariff continued in SECI and state tenders (Figures 7 and 8)

A.2.1) Fall and rise of wind power tariffs: The SECI Tranche II auction led to a wind power tariff of less than INR 3/ kWh for the first time. Later, the SECI Tranche III auction almost brought wind tariffs at par with the then-prevalent solar tariffs. While initially, the wind tariff began to decline relative to the previous edition of the auction, this trend did not sustain for long. The initial decline in tariff was on account of the availability of more efficient technology (2X platform, higher rotor diameter and greater hub height), WPDs' access to ample equity finance, availability of high wind sites and existing capacities with OEMs.

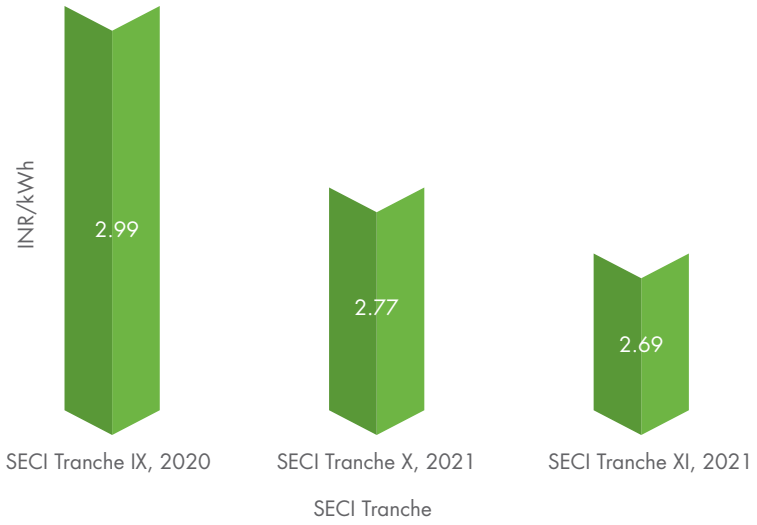
In due course, the entrenched state-level challenges around land availability, permits and clearances, transmission and power evacuation infrastructure availability and costs began to emerge. Gradually, the cost incurred for accommodating price escalation due to expected delays and other implementation hassles led to an increase in wind tariffs. While extremely low tariffs continue to be attractive for tendering agencies and to the offtakers, however, they are unsustainable unless suitable mitigation measures are undertaken to contain project execution challenges which may set any tariff discovered through competitive auction as unviable.

Figure 9: State Average Power Purchase Cost during 2020-2021 for non-RE sources



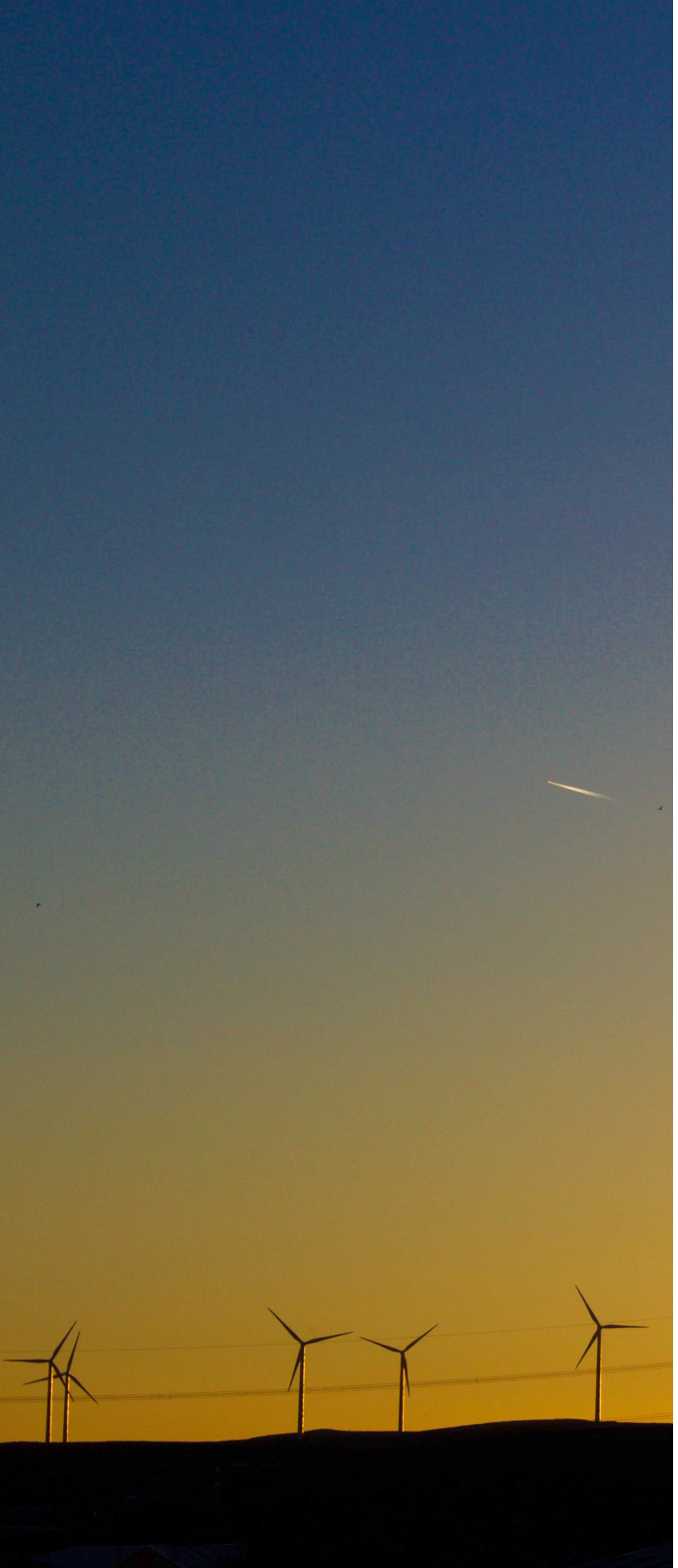
Source: GWEC India analysis based on (CERC 2021) and (CEA 2021)

Figure 10: Tariff discovered through wind power auction in 2020-2021



Source: GWEC Market Intelligence- Global Wind Auction Database Q1 2022 and based on (Bose and Sarkar 2019)

A.2.2) Wind power is cheaper than APPC in non-windy states: Only seven states (Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Karnataka) are considered to be the most promising states for wind power generation. Hence, most of the non-windy states have to purchase wind power from other states to meet their non-solar RPO. The Average Power Purchase Cost (APPC) for five non-windy states for the financial year 2020-2021 and the wind power tariff discovered through auction in that year has been highlighted in figure 9 and 10. The non-renewable energy (non-RE) APPC is relatively expensive as compared to the prevailing wind energy tariff. Yet, a majority of the non-windy states have failed to comply with their non-solar RPO targets in the past.



B) Effectiveness (capacity addition):

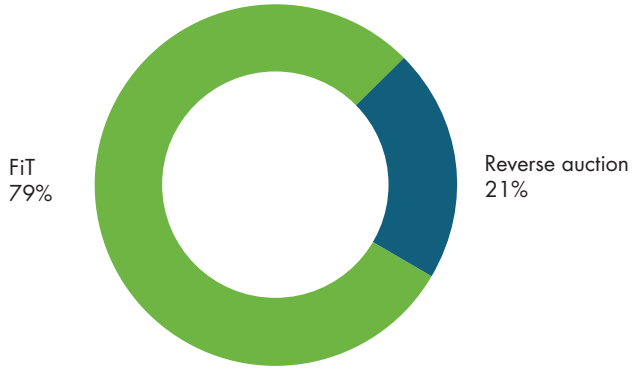
The effectiveness of a renewable energy auction regime is ascertained through an actual increase in installed capacity (Río and Linares 2014). It is evident from figure 11 that annual wind energy capacity addition targets have never been met post introduction of the e-reverse auction regime.

This section provides a deeper insight into the challenges that the wind sector is facing:

B.1) Project status: Out of the 20.72 GW capacity wind and hybrid/RTC/peak power tenders conducted/awarded by SECI, 7.92 GW is under construction[11]. Even SECI Tranche II and Tranche III projects that were awarded in the years 2017 and 2018 are reported to be in the ''under-construction'' stage.[12] A few of the earliest awarded projects have been surrendered/terminated due to the unviability of tariffs owing to challenges related to land acquisition, rise in price of commodities, and other operational delays among others. For the wind auctions administered by SECI, SECI Tranche V to XI, the entire awarded capacity is under construction as per the July 2021 report of the CEA. For SECI II (27%), SECI III (79%), SECI IV (79%), and SECI VI (79%) of the awarded capacity are under construction. Several projects under SECI I, SECI III, and SECI IV were cancelled/terminated/stuck. These projects are affected by one or more of the challenges mentioned below[13].

B.2) PPA signing: The challenge around the delay in PPA/Power Sale Agreement (PSA) signing is evident in the case of a majority of wind power projects that have been auctioned by SECI. A detailed list of the PPA/PSA status of wind and hybrid projects is provided in Appendix 3. It is noteworthy that DISCOMs continue to anticipate lower tariffs in forthcoming bids thereby

Figure 11: Wind capacity added pre and post e-reverse auctions regime



Source: GWEC's analysis

11 SECI Tranche V to XI, the entire awarded capacity is under construction as per the July 2021 report of the CEA. For SECI II (27%), SECI III (79%), SECI IV (79%), SECI VI (79%) of the awarded capacity is under construction. Several projects under SECI I, SECI III, and SECI IV were cancelled/terminated. Capacity added and under constructions capacities have been reported as per SECI's "Wind Monthly Progress Report for May 2022".

12 As of May 2022.

13 In January 2022, the Hon'ble APTEL reinstated the earlier canceled 50 MW PPA under Tranche I (https://aptel.gov.in/sites/default/files/Jud2022/A292of2021_11.01.22.pdf).

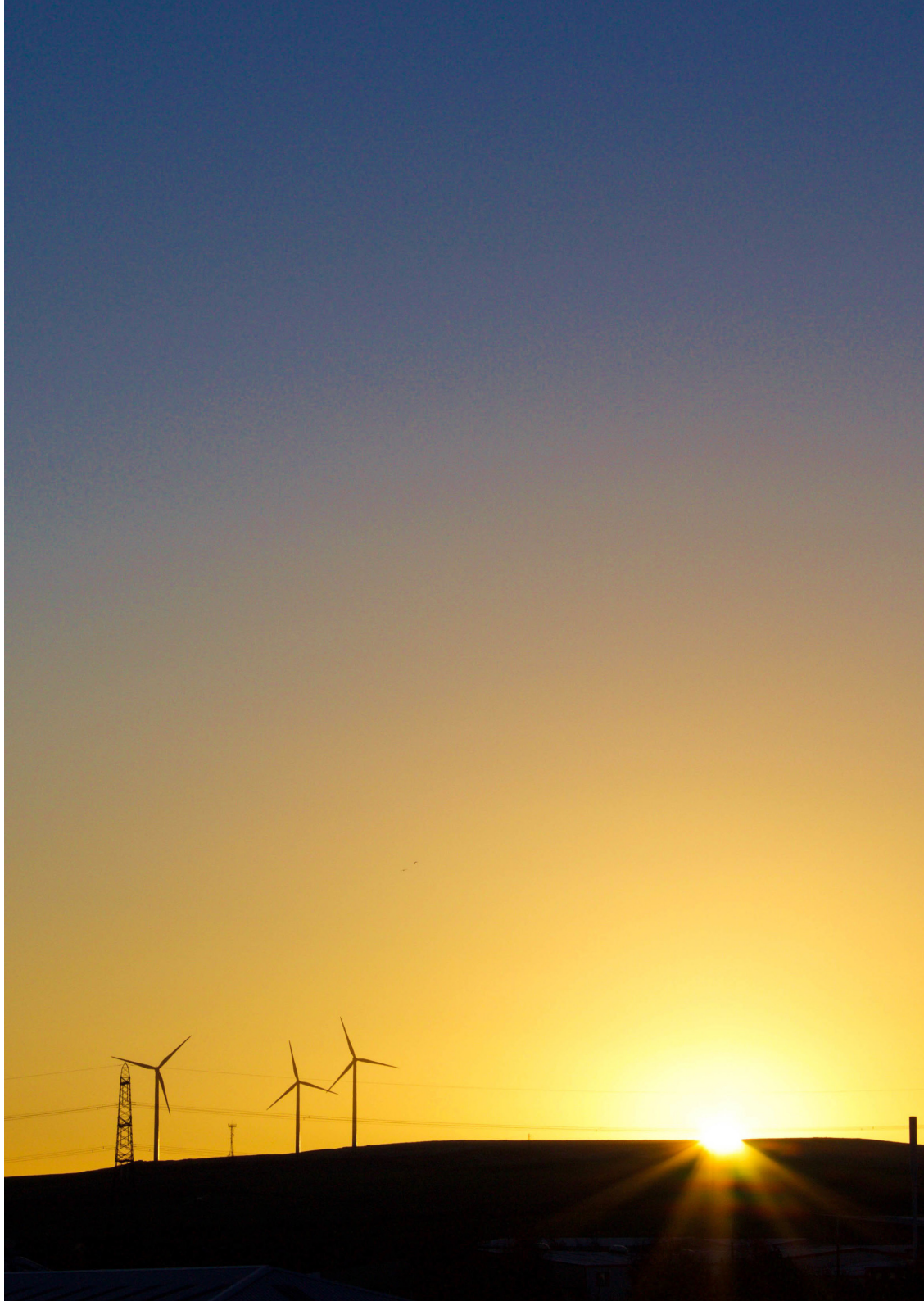
leading to accumulation in unsold capacities.

B.3) The growing concentration of projects in Gujarat and Tamil Nadu: A major share of projects lies in the states of Gujarat and Tamil Nadu, where higher CUFs are viable due to wind-rich sites. However, this has also led to an escalation in the cost of land, higher demand for transmission and power evacuation infrastructure and growing competition for the best-suited site for project deployment. In 2021, Gujarat added the majority 815.22 MW capacity while Tamil Nadu added 418.25 and Karnataka added 208.4 MW wind energy capacity[14]. In the case of earlier SECI bids, unavailability/ limited availability of transmission infrastructure in the states of Madhya Pradesh, Maharashtra, Andhra Pradesh, and Tamil Nadu immensely contributed to the preference for sites in Gujarat. Also, state governments in Gujarat and Tamil Nadu later introduced land policy changes which impacted several tendered and awarded utility-scale projects..

B.4) Major policy, finance and infrastructure-related impediments: Several perennial challenges have slowed the pace of utility-scale wind power project completion and in general, increased the project timelines and subsequently project costs. Some of the major impediments have been highlighted below:

i. **Land allocation**: As land is a state subject while most projects have been tendered by a central agency, a mismatch in land allocation priorities has caused delays in project development and completion. Land acquisition is a lengthy and bureaucratic process which can require up to 24 months in some states. In Karnataka and Tamil Nadu, there are ceilings on the size of land that can be allocated to an entity. In other states like Rajasthan, there is no streamlined dispute resolution process, resulting in extended delays to allocation. Also, due to the lack of land record

14 https://mercomindia.com/wind-capacity-additions-india-2021/

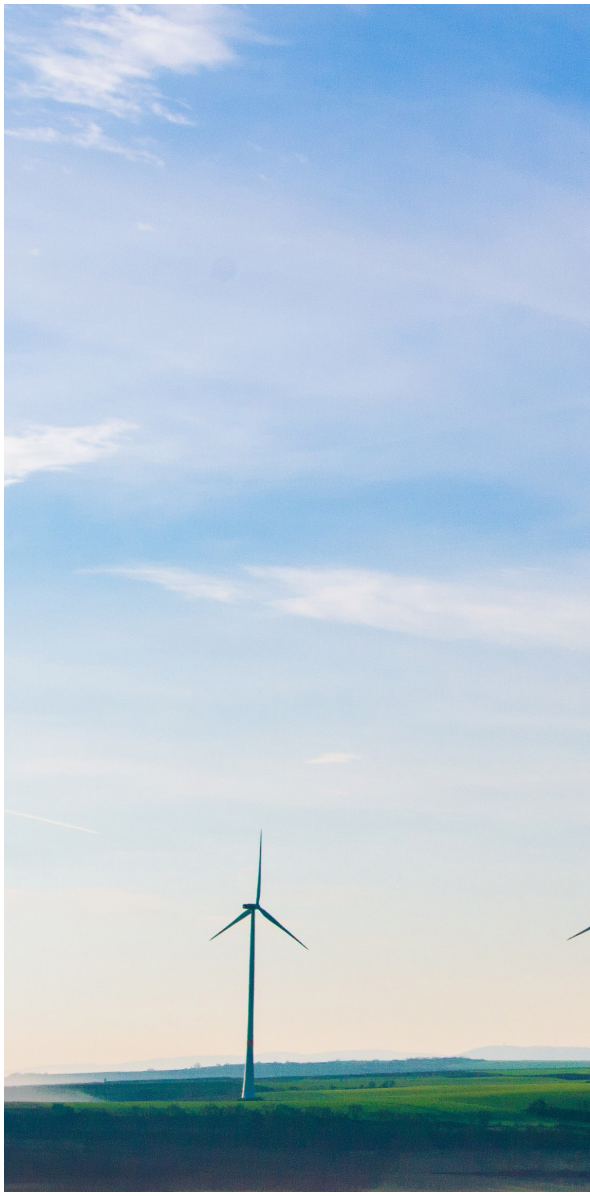


availability/digitization of records and due to issues regarding the conversion of agricultural land into non-agricultural land, land acquisition is challenging.[15]

In the case of Gujarat, the state government's reservation for allocation of land only to winners of tenders conducted by the state government impacted market sentiment, although the state government intended to safeguard opportunities for the state itself. This amendment in policy impacted WPDs which were exploring land tracts for upcoming wind tenders in the state. In late 2020, to address some of the issues around land availability, a large tract of land was designated for the establishment of a 30 GW wind-solar hybrid park in the Kutch region of Gujarat. However, even in this case, the evacuation infrastructure is so far in under approval stage and any delays in the commissioning of evacuation infrastructure might impact the financial health of power generators that have their power generation unit ready for operations. The issues around delays in clearances from the Ministry of Defence and the challenge around the management of the habitat of the Great Indian Bustard (GIB) cannot be ignored. A healthy resolution of these issues is a must.

ii. **Business sustainability**: Over the years, several Indian OEMs have been reported to be facing liquidity/bankruptcy issues[16]. With an annual domestic manufacturing capacity of 10-12 GW and a per annum commissioning of only 1-2.5 GW capacity (MNRE 2021). It becomes evident that the domestic market has not been able to sufficiently leverage the existing production capacities of wind manufacturing units in the country. This issue has become more acute during the COVID-19 pandemic, which has seen cost inflation for raw materials and commodities upstream in the WTG supply chain[17]. Moreover, the central government has eliminated or plans to eliminate/reduce concessions and increase taxes and duties which shall have an implication on the capital cost of wind turbines and other components.

Similarly, while reverse auction helps in the discovery of competitive tariffs, the issue around the timeline for adoption of the tariff has caused many concerns for WPDs and their investors. Delay in tariff adoption inadvertently affects project completion timelines and increases the burden of penalties and escalating project costs on the WPDs. Several instances of DISCOMs reneging on existing PPAs is very well known. Further, the WPDs



15 https://shaktifoundation.in/wp-content/uploads/2018/01/Study-Report-Addressing-Land-Issues-for-Utility-Scale-Renewable-Energy-Deployment-in-India.pdf; Kumar, A., Pal, D., Kar, S.K. et al. An overview of wind energy development and policy initiatives in India. Clean Techn Environ Policy (2022).

16 https://www.bloombergquint.com/business/why-indias-wind-turbine-makers-are-under-stress

17 https://www.ft.com/content/29832c31-b3be-43cf-8dab-6970daa57ebb?sharetype=blocked

also continue to face issues around pending payments due to the poor financial health of power distribution companies (DISCOMs). This is a huge burden on WPDs who are accountable to lenders, contractors and employees. Any deterioration in financial circumstances of a WPD negatively impacts their credit rating and hence their ability to participate in future bids. As a risk mitigation intervention, lenders and investors are increasingly seeking a lower debt to equity ratio for investments/ lending and demanding security against risks around PPA renegotiations and project delays (Sood, Bhansali and Rao, 2019). Apart from these, the issue around the preservation of the habitat of the Great Indian Bustard (GIB) has also disrupted progress in certain areas. While this is a concern that must be prioritized, there must also be a consensus on the financial implications of the conversion of overhead cables with underground cables. This might not be feasible in all areas as well as the need for this change could be mitigated in some pockets by the deployment of bird diverters. Most importantly, this must be covered under the ''Change in Law Rules'' as sufficient financial (beyond mere tax relief) and time extension relief must be provided to project developers who would otherwise have several financial and other project-level challenges.

Therefore, both OEMs and WPDs are impacted due to the slow pace of domestic deployment, project implementation challenges and payment hassles leading to reduced margins along the value chain. In these circumstances, checks on unsustainable tariffs quoted in bids and strengthening mechanisms to ensure the timely completion of projects of projects by addressing implementation hassles outside the control of WPDs becomes a crucial aspect.

iii. **PPA sanctity:** One of the foremost challenges faced by utility-scale renewable energy projects is PPA renegotiation; several wind projects have been affected by this challenge. Furthermore, the timeline for signing a PPA has not been adhered to in the case of several wind power projects. These instabilities continue to eclipse business sentiment and stagger the growth of India's renewable energy potential.

There continues to be a limited implementation of norms for linkage of tariff adoption timelines with the PPA's Scheduled Commercial Operation Date (SCOD). The lack of such an arrangement gives liberty to state-level agencies to delay tariff adoption or dishonour them while waiting for a lower tariff deal. Earlier, the unavailability of provisions for linking the Long Term Open Access (LToA) Agreement with PPA SCOD led to the levying of Point of Connection charges on WPDs, even if an extension for SCOD was obtained. While this has received support of the central government, the CERC is yet to bring this to actual practice. The WPDs have also incurred costs/losses due to the introduction of any new norms/amendments after awarding of the contract and/or due to termination of the contract. To mitigate this risk resulting from any change in laws/policies/duties, the government has introduced the ''Electricity (Timely Recovery of Costs due to Change in Law) Rules, 2021[18] which has come into force on 22 October 2021.

iv. **Infrastructure bottlenecks:** Grid curtailment has been one of the major issues in the past in several states. Between April 2017 to March 2019, Tata Power Renewable Energy Limited's Nimbagallu wind plant alone reported a generation loss of 32.66 MU and a revenue loss of INR 174.4 million[19]. While wind energy projects have now been awarded ''must-run'' status wherein curtailment is only allowed where grid security is to be maintained[20], state governments must introduce suitable robust forecasting systems for generation and demand as well as undertake necessary measures to ensure reliability and security of the grid. A suitable mechanism must be introduced by the respective regulatory commissions to review reasons attributed to reported grid curtailment instances. With some push for ISTS infrastructure creation, the WPDs are now able to tap sites in Maharashtra, Karnataka and Tamil Nadu.

For projects that are under construction stage, matching of transmission evacuation system with SCOD of wind power project alongside availability, accessibility and adequacy of the transmission network to address issues of congestion and curtailment is necessary. It is envisaged that the perennial issue of the unavailability of sufficient transmission and power evacuation infrastructure will be addressed through the prioritization of the Green Corridor-2 projects for renewable energy uptake.

3.2 Pace of installation and commissioning

The auctions process does not guarantee access to grid connectivity for power evacuation and land availability. As a result, several SECI projects are facing delays.

18 https://powermin.gov.in/sites/default/files/webform/notices/Clarification_on_Electricity_Timely_Recovery_of_Costs_due_to_Change_in_Law_Rules_2021.pdf

19 https://indiankanoon.org/doc/124067648/

20 https://pib.gov.in/PressReleasePage.aspx?PRID=1765903

There must be sharp positive growth in the current pace of auctions and project commissioning rate, otherwise, the 2030 wind installation target will be missed. The completion uncertainty and tepid growth rates also lead to an overheated domestic supply chain, where the existing manufacturing capacity is far exceeding installations. This is not a sustainable scenario and will force the retrenchment of the domestic value chain.

The average annual wind capacity tendered (excluding hybrid tenders) by SECI between 2017 and 2021 is 3.5 GW and 1.6 GW of average annual capacity was tendered between 2018 and 2021 by SECI as part of wind-solar hybrid/RTC tender. However, to be able to install 70 GW of onshore wind capacity by 2030, around 8-10 GW of annual tender capacity between 2022 and 2029 is required. If the legacy issues, which ongoing projects are facing, are addressed and suitable tariff adjustments are made, and suitable risk mitigation measures are put in place, timely achievement of India's 2030 onshore wind target is possible.

3.3 Non-solar RPO compliance

Section 86 (1) (e) of the Electricity Act 2003 mandated the State Electricity Regulatory Commission (SERC) to promote renewable energy by ensuring a percentage of renewable electricity in distribution licensees. To this end, on 14 June 2018, MoP notified the uniform RPO trajectory up to the year 2021-22 that seeks 21% RPO (10.5% non-solar and 10.5% solar) by 2021-22. Also, an RPO compliance cell was constituted on 22 May 2018 by the MNRE. Additionally, the government has provisioned the purchase of power from hybrid projects for the fulfilment of solar RPO and non-solar RPO in the proportion of rated capacity of solar and wind power in the hybrid plant respectively.

However, a majority of the non-windy states have consistently missed their non-solar RPO, which is primarily fulfilled through the purchase of wind power. During 2019-2020, out of 31 states and union territories, 61% could only meet less than half of their non-solar RPO target (Appendix 4). For the financial year 2019-2020, an additional 1.3 times the current wind power installed capacity was required to meet the target of the states and UTs[21]. The purchase of wind power enables DISCOMs to meet their wind RPO targets and it also ensures balancing of the grid. It also allows several C&I consumers to meet their voluntary commitments for net zero. Therefore, a continuous impetus on facilitating an enabling policy environment for the wind sector is important. The center's newly notified wind RPO is a welcome step in this direction.

Based on the considerations and challenges above, it is clear that re-evaluating the current mechanism for competitive bidding is imperative to ensure cost efficiency and effectiveness in performance is urgent to deliver the necessary capacity additions by 2030.

21 Assuming 1 MW of installed wind capacity generates 2.2 MU per year.

4. Industry perspectives on strengthening the wind power auction regime

In late 2021 and early 2022, GWEC India undertook a consultation with industry stakeholders on opportunities for strengthening the wind power auctions regime to support India's 2030 wind energy targets. Key industry perspectives from the consultation are discussed below:

A. Volume creation: The auctions regime has entrusted confidence in wind energy and wider renewable energy sectors. It has facilitated the creation of an annual volume of projects. However, there is a need for provisioning an annual auction calendar at the beginning of the financial year so that WPDs/ OEMs and their investors can adequately prepare their arrangements. Greater visibility of auction timelines and volumes, at least one year in advance, is recommended. Going forward, it is suggested that the state regulatory commissions (SERCs) invite a 5-10 year power procurement plan on a rolling basis from the DISCOMs. Such a provision has been considered in the draft Indian Electricity Grid Code (IEGC) Regulations 2022 and must be brought in force. The power procurement plan should lay out the year wise renewable energy requirement and procurement plan to meet the projected demand. After this plan is approved by the SERC, DISCOMs must sign PSAs with SECI and other tendering agencies for their required quantum with prices to be discovered under the auctions mechanism. This is likely to give firm demand for RE which can be then bid out as per a bidding schedule.

B. Participation of auction agencies: To date, most wind and hybrid auctions have been conducted by SECI. State-level tenders have almost become dormant. Hence, it will be useful to explore opportunities for having more proactive participation of institutions that are administering tenders as well as also facilitating the acquisition of land, which is a state subject.

C. Diversity of site classes and auction categories: In the past, SECI has convened sub-station specific bids.[22] It is suggested that bids specific to the class of site should be considered. It might also be useful to segregate specific sites for a particular wind auction category (RTC, peak power, standalone and hybrid). Also, to tap low-medium potential sites in states such as Karnataka, Andhra Pradesh, Madhya Pradesh, and Maharashtra, state-specific tenders must be rolled out. The state of Karnataka has already mapped taluk-wise wind power generation potential and this practice could be replicated by other states too. The central and state governments must also evaluate what capacity WTGs would be optimal for repowering projects and for upcoming green projects in the country.

D. Tariff robustness: In events of delay in PPA signing, holding discovered tariffs viable for a longer period in present times of huge market volatalities is difficult. Poject costs continue to rise when there are delays in project initiation that are beyond the control of WPD. It might be useful to explore linking the tariff

22 https://mercomindia.com/ayana-fortum-winners-seci-solar-auction/

discovered through a reverse auction commodity price index to mitigate any volatility arising from an increase in the price of commodities beyond a threshold. This shall strengthen the business case for wind projects. Furthermore, any restrictions on provisions for change of state after project award and signing of the LToA contract must be reconsidered/eased on a case-to-case basis.An alternate approach may be the setting of a base tariff for which annual volumes may be signed. The base tariff may be calculated as the weighted average APPC of states that consume 70% of power in India. Here, APPC shall exclude peak power tariffs and such peak power shall comprise 10% of most expensive power by bucket filling approach for each state.

E. Ensuring bidder credibility: Currently, a bid winner can back out at the time of signing a PPA/ PSA when a bank guarantee must be submitted. Hence, it might be useful to measures to control such instances unless there is a sufficiently justifiable reason provided. The bidding agencies may also introduce stringent criteria to ensure the seriousness of the bidder and such criteria might be identified in consultation with industry stakeholders.

F. Legacy challenges: Addressing legacy challenges related to pending payments by DISCOMs, land acquisition and infrastructure availability is pivotal. In the case of challenges around the availability of transmission infrastructure, leveraging the state's under-utilized transmission infrastructure might prove to be a win-win proposition if states are incentivized. On the land availability issue, it is noteworthy that consistency in Land Policy gives long-term visibility to WPDs to build project pipelines hence consistency in land policy is inevitable. Also, reduction, rationalization, and removal of certain costs, cess, and fees associated with land allocations with a focus on ''Ease of Doing Business'' might be very helpful. The NITI Aayog may consider developing an ''ease of utility-scale renewable capacity index'' to facilitate the identification of best pratices and initiate dialoge with relatively low performing states. For projects that are

stuck for a very long time due to challenges that are beyond the control of WPDs and where some volumes have been commissioned and the project has become unviable, there must be provisions for honourable exit for counterparties after payment of certain penalties. Honourable exit by way of such a provision is likely to provide much needed respite (financial, intellectual) to IPPs who can then focus on new capacity additions.

G. Incentivizing states for wind power procurement: States might explore opportunities for facilitating FiTs for small sized projects (less than 25 MW projects) and certain GST benefits to WPDs to attract higher participation. The centre may also explore avenues to incentivize non-windy states for meeting center's newly introduced wind RPOs (states are yet to announce their wind RPOs). Also, the government must explore how carbon markets and Renewable Energy Certificates (RECs) could be leveraged to incentivize states that are able to contract annual capacities beyond their targets.

H. Accommodating climate variability: In the past, due to climate variability and curtailment[23] issues, the ability of WPDs to draw benefits from the GBI scheme has been restricted. It is proposed that wind players be allowed to claim GBI beyond the existing 10 year period for an additional period of 5 years without any additional financial burden to the exchequer. Further, to mitigate the impacts of climate variability, which affects wind generation profiles, it might be useful to define a standard wind year and then assign certain benefits/compensation for a good wind/poor wind year to ensure sustainability in the long term and mitigate emerging climate risks for the business.

Advance innovative bids and alternate modes for wind power procurement: Innovative bids, such as 100% renewable energy RTC bids, might enhance the overall demand for wind energy. Also, in the case of hybrid projects, modification of Hybrid guidelines such that alternate technology is 50% of contracted capacity might further ensure higher deployment of wind. Also, the wind power generation and procurement process must not remain confined to the reverse auctions process alone. There must be flexibility, greater acceptance and support (support for open access) available for less than 25 MW projects that are likely to feed the needs of commercial and industrial (C&I) consumers. As there is a growing number of C&I consumers who are voluntarily committing to net-zero targets, this market segment is a promising area for WPDs. However, open access continues to witness hiccups which must be eased to boost green power consumption and for greening the manufacturing sector in the country. The government may also explore the possibility of including brownfield projects (vintage of less than 36 months) to participate in bids. Recently notified ''Green Open Access Rules 2022'' and wind RPO trajectories are likely to boost demand for clean power across states if compliance is made mandatory.

23 The central government has accorded "Must Run" status to renewable energy generation.

5. International experiences in auction design

In the course of industry consultation, several case studies were identified which may be instructive for improvements to India's reverse auction regime. This section highlights some of the international experiences and lessons learned in onshore wind auction design around the world:

A. Germany – incentivizing repowering of older wind projects: Germany has the world's third-largest installed onshore wind energy capacity, totalling 64 GW by the end of 2021. The country adopted auctions as the channel for wind power capacity expansion in 2017. Repowering of commissioned wind turbines (particularly turbines installed in the 1990s and early 2000s) has gained attention as constraints in land availability in wind-rich sites became more explicit. Additionally, technological

advancement (availability of higher capacity and more efficient turbines) since the first generation of installed turbines offers greater project efficiencies, considering the O&M costs for older units. The need for repowering has also emerged due to the lapse of the stipulated time for receiving a federal FiT, which makes several units relatively less financially attractive to operate and maintain.[24] The country's Renewable Energy Sources Act (Das Erneuerbare-Energien-Gesetz or EEG) was amended in 2012 to include a ''repowering bonus'' which created a financial incentive for advancing the repowering of aging turbines.[25]

B. Brazil – policy and price certainty in auctions: Brazil has more than a decade of experience with wind energy auctions after the first wind auction was conducted in 2009. Before the reverse auction regime, the country relied on a FiT. In recent years, private PPAs have increased due to very competitive prices in the bilateral market, while government auctions have slowed. Nonetheless, Brazil is one of the top wind markets worldwide, with policy certainty and a visible pipeline for procurement. Government authorities provide comprehensive plans which included auction schedules and technology allocations through a 10 year power system expansion plan (currently 2019-2029).[26]

At the auction stage, developers are mandated to submit proof of land use rights and preliminary environmental permits. This has reduced project risks. Awarded WPDs receive long-term energy contracts which are indexed to the consumer price index. Awarded projects also receive a Firm Energy Certificate (FEC)[27] for each 100 MW.[28] Furthermore, projects leverage the provisions for addressing deviations above/ below the agreed levels of production by allowing accumulation and carrying overproduction to make up for underperformance. This has helped in mitigating climate variability in production.

Brazil was among the top five markets in 2020 for new onshore wind installations, which totalled 17.75 GW. These projects have made wind the second-largest source of electricity generation in the country, after hydropower, and have supplemented Brazil's reserve margin.[29]

C. Denmark – clear auction guidelines and visibility: As one of the pioneers of wind energy, Denmark adopted auctions for the proliferation of onshore wind energy in 2016. The country has leveraged a feed-in-premium as an instrument whereby agents bid for a surplus over and above the wholesale market price which applies to the generating unit. This ensures that generators receive an appealing and competitive price for delivering electricity at locations and times when it is most valuable. Developers have had two years to reach grid connection from the time of concluding the price premium contract; the fixed price premiums have been granted for 20 years from the time of grid connection.[30] Lead times between the first announcement to the final bid have been as long as 26 months for some tenders, in the case of the 2019 technology-neutral tender for example. Denmark has also harnessed wind power through auctions to support ancillary services such as frequency response, voltage support, and system reserves.[31]

24 Repowering and continued operation | BWE e.V. (wind-energie.de)

25 30 Years of Policies for Wind Energy: Lessons from Germany (irena.org)

26 Electricity market design and renewable energy auctions: The case of Brazil - ScienceDirect

27 FECs are awarded for each 100 MW, and the total capacity contracted must be equal to the total FECs. The regulator issues FECs to each power generator.

28 https://www.energypartnership.com.br/fileadmin/user_upload/brazil/media_elements/Paper_Combined_Auctions_-_Diagramado_-_V9.pdf

29 https://www.iea.org/data-and-statistics/charts/electricity-generation-mix-in-brazil-1-jan-19-oct-2019-and-2020

30 http://aures2project.eu/wp-content/uploads/2019/12/AURES_II_case_study_Denmark.pdf

31 Renewable energy auctions. Status and trends beyond price. IRENA 2019. Last accessed online on 10 January 2022 from https://www.irena.org/publications/2019/Dec/Renewable-energy-auctions-Status-and-trends-beyond-price

6. Summary of recommendations

Given the current challenges facing the growth of India's wind sector, the perspectives from the Indian wind industry, and the experience of global onshore wind auction design to date, GWEC India provides the following recommendations to strengthen the current auction regime:

A. Promote complementarity and avoid competition: Unlike a utility-scale solar PV power project, to which wind energy tariffs are usually compared, a utility-scale wind power project involves a much higher grade of engineering. While transmission infrastructure, power evacuation, and land acquisition-related challenges are faced by both solar PV and wind power projects, the complexity of technology deployment and customization required to meet site-specific requirements in the case of wind projects make the technologies distinct. However, under the current regime, solar and wind are often described as competing technologies and they are compared based on tariffs discovered in auctions. This undermines their complementary roles for balancing the grid and thwarts the opportunity for diversification of the electricity generation mix and fast pace decarbonization. Hence, state regulatory authorities must adopt technology-specific approaches and development pathways appropriate to each technology and fuel type. This includes harmonizing centre/state incentives beyond non-solar RPO compliance by DISCOMs to support the overall grid profile and resilience. As wind power is available during peak power demand and because wind RTC/peak power projects have the potential to provide reliable green power, there is a strong case for rapid scale-up of wind power capacity in India, given legacy challenges are addressed.

B. Translate legacy challenges into opportunities: Tariff competition has led to a surge in demand for land in the most promising windy states and the high-CUF locations within these states. Consequently, challenges around land acquisition and infrastructure have become more prominent. By leveraging medium-low wind potential sites that are otherwise left unutilized, a wider penetration of wind energy projects is possible. The center and states must notify an annual auction calendar at the beginning of the financial year while outlining volume and tentative timelines. Further, the existing position and future likelihood of the availability of transmission

and power evacuation networks to absorb awarded projects must also be part of the calendar. Meeting the annual outlined bid capacity volume and timelines must be a shared responsibility of central and state level tendering and power infrastructure development agencies. Issues around transmission and power evacuation infrastructure availability are likely to be addressed only if wind capacity addition timelines are synchronised with power sector infrastructure augmentation plans. Evacuation planning must be done in wind zones and should be made co-terminus with 2030 targets of India. It is also suggested that the simultaneous tracking and reporting of both renewable power generation projects, the status of existing power evacuation and transmission infrastructure capacity and upcoming power infrastructure projects in prospective wind sites must be emphasized and reported via a unified user-friendly dashboard. Additionally, robust advanced data modelling tools that foster the projection of project completion timelines must be linked to tracking portals to facilitate the timely identification of any deviations. To resolve land-related issues, digitisation of records and the designation of land patches for wind parks by state governments are likely to bring great relief to WPDs. The land policies issued by the wind-rich states for wind project development should not differentiate between auctions conducted by the state agency or the central agency. Auction winners should be given equal opportunities for the acquisition of land for project implementation. Further, the state in which the auction winner is proposing to develop the project may be given the first right to sign PSA. On the financial front, it has also been reported that the DISCOMs often do not adhere to the PPA clause about the "Late Payment Surcharge". Hence, strengthening payment guarantee mechanisms by ensuring the availability of sufficient payment guarantees and financial reserves so that tendering agency/SECI can make necessary payments will further boost the confidence of WPDs. The tendering agency/ SECI may later settle their books with the respective DISCOMs. On such occasions for settlement, WPDs whose pending payment case was registered first must be given priority.

C. Introduce attractive auction design elements: Innovative site, sub-station and service-based requirements (reliability, peak power, grid balancing needs, etc) in wind auctions may boost overall market dynamics. Several developing countries leverage indexing clauses linked to the dollar or national inflation index[32] with provision for regular review to ensure the new present value of the project remains unimpacted by unforeseen external risks posed by inflation and/or market volatilities. Building on international best practices, it may be useful to explore linking wind energy tariffs with commodity price indices[33] to mitigate any business and project risks. In the case of unforeseen events such as the Russia-Ukraine crisis, COVID-19 and other similar events which lead to a rapid and unpredictable surge in commodity prices, sufficient adjustments must be provisioned to affected projects. Further, in case of delays in project execution for reasons not attributable to lapses on the WPD's end, timeline extensions must be provided and any resulting changes in SCOD timelines must be linked to other contracts (such as LToA charges) that are part of the overall project commissioning and any resulting penalty in cases must be waived off/suitably adjusted. To ensure project viability even in wake of events of an abnormally high surge in the price of raw materials and equipment due to force majeure events, suitable tariff adjustments must be provisioned. To support such adjustments, the benchmark cost of raw material and equipment must be notified and regularly updated by the regulator/any agency appointed by the government. The centre and states may also pursue state-specific tenders to better harness

32 https://publications.iadb.org/publications/english/document/Guide-for-Designing-Contracts-for-Renewable-Energy-Procured-by-Auctions.pdf

33 Such practice and formula is prescribed in equipment bids (cable/ transformers etc.) that are invited by state utilities

the country's overall wind potential while supplementing this with sufficient thrust for the achievement of wind RPO by states. In light of persistent market volatilities and legacy challenges that have led to a slowdown in wind capacity addition, measures for ensuring sustainable tariffs must be pursued. The government may also explore the possibility of the roll-out of the normal bid process wherein any bid below a certain benchmark value is eliminated to avoid tariffs that are not realistic and unviable. This might boost the participation of WPDs.

D. Strengthening policy support for wind projects and wind manufacturing: Firstly, wind projects in medium-low potential sites are likely to have relatively low CUF as compared to projects in high potential sites. Hence, comparing such projects only based on tariffs might pose a threat to the overall viability of such projects. There must be state-level targets set to advance wind projects in medium-low wind potential sites. Also, the government and the industry stakeholders must strengthen their partnership for drawing benefits from wind parks. The possibility of commissioning existing tendered projects at designated wind park locations must be explored and suitable financial outlays for wind projects must be facilitated. Second, repowering of ageing and old turbines with higher capacity turbines must be prioritized by rolling out win-win financial and business models for all stakeholders involved. This would also require the introduction of suitable measures for addressing offtake and power evacuation related hassles that are likely to emerge when higher capacity turbines are deployed. In addition, suitable guidelines for skills development and safe disposal/reuse of material/ equipment must be provisioned. Third, the need to link PPA SCOD with other relevant extensions and tariff adoption schedules must be mandated to provide a healthier business environment for WPDs. The PSAs must be signed as per approved PPAs. Fourth, having a comprehensive state wind energy roadmap

that outlines timebound state targets; investment opportunities and likely social, economic and environmental benefits; incentives to support wind projects as well as the manufacturing sector; policy measures; and institutional measures (for tenders, permits, clearances, and monitoring of power and infrastructure expansion projects) will infuse robustness to state's preparedness for harnessing available wind power potential. Fifth, in the current regime, the elimination of existing incentives and higher taxes and duties are raising the burden of supply chain cost inflation for WPDs and OEMs. Although wind energy developers receive zero fiscal incentives from the central and state governments, the industry has witnessed a continuous improvement in efficiency and CUF. Therefore, incentivizing OEMs' efforts for continuous technology upgrades and efficiency improvement through rebates taxes and duties is pivotal to supporting local manufacturing which not only feeds domestic needs but also adds value in terms of higher trade surplus. These interventions are likely to ensure the long-term viability and competitiveness of the Indian wind sector. Sixth, to support domestic manufacturing of turbines and wind energy components, provisions for introducing production linked incentive (PLI) linked to commissioned capacity must be explored. In the case of components that have to be mandatorily imported, necessary concessions must be provisioned and/or sustained.

E. Leveraging the proactive role of institutions: There must be a greater consensus among the central and state-level agencies, including tendering agencies, on growth targets and enabling policy interventions. At present, the tendering agency is responsible for successful RFS, auctions and LoA. After this, the state agencies which procure power or those which allocate land/permits and clearances have a vital role to play. The cases of Andhra Pradesh, where PPAs were revoked, and Gujarat, where the introduction of a policy to favour state tenders led to the loss of business sentiment, serve to demonstrate how differences in priorities of the central and state governments can adversely impact the realization of India's wind energy targets. Hence, strengthening the leadership role of tendering agencies and their ability to negotiate/facilitate the redressal of state-level challenges and hassles related to transmission/evacuation issues. Alternatively, a high power ''Wind Task Force'' might be constituted to expedite the execution of projects. Another important aspect is fast pace resolution of litigation and disputes related to renewable energy projects. The centre has already constituted a dispute resolution mechanism leading to the resolution of over 25 cases[34]. The states must also replicate this best practice by introducing suitable policy and institutional measures. Curtailing financial constraints in the Indian renewable energy sector requires is inevitable and a range of needful recommendations have been suggested by the Standing Committee on Energy (2021-2022) in the 21st Report of the Seventeenth Lok Sabha. Further to those recommendations, it is suggested that low-cost financing (subvention of 3% for 30 GW capacity for 5 years) must be provisioned for fast-track wind power project development. Next, CERC has notified final REC Regulations, 2022 wherein the multiplier for wind/solar has been kept as 1. These provisions must be brought into force and relevant procudure must be notified by POSOCO.

F. Strengthen dialogue between industry and government: Increased dialogue, information-sharing, and knowledge exchange between the GoI at the national and state level, as well as the global and Indian wind industry, can support the formulation of a more effective auction design. Hence, strengthening the consultation processes which feed into the tendering schedule, criteria, and selection methodology will allow for greater transparency and participation, leading to more effective competition and performance of auctions.

34 https://mnre.gov.in/img/documents/uploads/file_f-1646300805213.pdf

7. The way forward

Auctions have led to a reduction in the financial burden on the government by eliminating the need for FiTs for large-scale wind projects. However, the expectation for a never-ending decline of tariffs is unreasonable, particularly in light of recent events. During the COVID-19 crisis (first and second waves in India) and due to tensions between Ukraine and Russia, prices for freight and essential commodities such as steel and cement have soared[35]. This has escalated project costs significantly and raised procurement, logistic, and commodity price risks. There is a high likelihood that the viability of several projects, that are in the pipeline, is affected.

The review of the Indian reverse auction mechanism for wind power confirms success in terms of performance (tariff reduction – achieved as compared to FiT regime) while it also indicates a drop in annual capacity addition. The objective of competitive bidding is not limited to lowering tariffs; rather it is to realize a tariff that is competitive and reflective of prevailing market dynamics while safeguarding business sustainability for long-term industrial growth. However, in the case of an e-reverse auction, the tariff quoted by a qualified bidder is visible to other bidders. At this stage, bidders often start quoting much lower tariffs against the quoted tariff in the financial bid just to secure a project. Consequently, often, a very low-levelized tariff is discovered as an output of the e-reverse auction., which is not reflective of the prevailing market dynamics and is merely an attempt to secure project volumes. The Indian wind industry has witnessed a massive slowdown since the rollout of the reverse auction regime – this is reflected in lower margins across the value chain due to a continued drop in annual capacity addition despite relatively competitive tariffs discovered through the reverse auction mechanism. If the project implementation challenges remain unaddressed, even with attractive tender volumes and any kind of financial incentive, annual capacity additions shall not rise substantially.

If legacy challenges mentioned in this publication remain unaddressed, the burden of duties continues to widen and the elimination of existing concessions is aggressively pursued by the government, future wind energy tariffs cannot be expected to be lower than a certain threshold. Project implementation challenges shall continue to bear implications on project costs.[36] Addressing financial, policy, infrastructure and institutional challenges of the wind sector through robust planning and prioritization shall help accelerate the pace of annual wind capacity addition in the country. Measures for addressing legacy challenges as well as leveraging opportunities for strengthening both auction design elements and power generation/infrastructure project monitoring systems are inevitable to restore growth to get on track for India's 2030 targets. To eliminate mere volume seeking tendencies of bidders, a transition from an e-reverse auction regime to a closed bid system is recommended.

As the share of variable renewable power generation in the Indian grid system continues to expand, it is of utmost importance to acknowledge the broader long-term objectives of the infusion of wind energy in the grid. It supports diversification of the electricity mix which is necessary to ensure a reliable, secure, and quality grid system. Wind power is the cost-effective solution to meet this need. Hence, a comprehensive roadmap that is reflective of potential, targets, and, financial/non-financial commitments by central/state governments developed by engaging with key stakeholders (tendering agencies, regulatory authorities, power transmission, and evacuation agencies, and relevant state and central authorities responsible for permits/clearances/land allocation, industry representatives, and financial institutions) to support further proliferation of wind energy in the country.

35 https://www.moneycontrol.com/news/business/economy/builders-to-be-worst-hit-by-commodity-price-increases-steel-aluminium-makers-to-reap-export-bonanza-8210821.html and https://economictimes.indiatimes.com/industry/indl-goods/svs/steel/indias-top-steelmakers-hike-prices-by-rs-3000-rs-3500-a-tonne-due-to-rising-cost-inflation/articleshow/87472139.cms?from=mdr

36 Currently, India is unable to utilize a major share of its 10 to 12 GW annual wind manufacturing capacity.

About GWEC

GWEC is a member-based organization that represents the entire wind energy sector. The members of GWEC represent over 1,500 companies, organizations and institutions in more than 80 countries, including manufacturers, developers, component suppliers, research institutes, national wind and renewables associations, electricity providers, finance and insurance companies.

See https://gwec.net/.

About GWEC India

GWEC India was established in 2020 to renew momentum around wind power development and support India in achieving its ambitious renewable energy targets. Based in Chennai, the industry association represents the entire value chain of wind power in India, addressing regulatory bottlenecks, and facilitating dialogue and cooperation between government and industry stakeholders.

See: https://gwec.net/global-wind-energy-council/taskforces-committees/india/.

Appendices

Appendix 1

Techno-economic data and socio-environmental benefits of wind project

Per MW Cost and Socio-Environmental Benefits		Comment/Reference
Total Capacity (MW)	249.00	Author's compilation based on data for a 249 MW SECI Tranche I wind project in Tamil Nadu having 2.1 MW WTGs and commissioned in 2018 Source: CDM: Wind Power Project in Tamil Nadu by Green Infra Renewable Energy Limited (SECI-1) (unfccc.int)
Life of plant (Year)	25	
Plant Load Factor (PLF) in %	34.5	
Annual Generation (kWh)/MW	3033.12	
O&M Expense (INR Mn)/MW	0.80	
Total Cost (INR Mn)/MW	72.29	
Environmental Benefits		
Total Annual Emission reductions per MW [(tCO2e/ year) per MW]	2856.90	Based on data for a 249 MW SECI Tranche I wind project in Tamil Nadu having 2.1 MW WTGs and commissioned in 2018 Source: CDM: Wind Power Project in Tamil Nadu by Green Infra Renewable Energy Limited (SECI-1) (unfccc.int)
Operational water withdrawal intensity per MW (m3/MWh)	0	Source: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENAIndiapowerwater2018pdf.pdf
Land Requirement per WTG of 2 MW capacity (in acre)	2-3	Source: https://www.eib.org/attachments/registers/72204570.pdf Higher capacity turbines require lesser land
Social Benefits		
No of direct and indirect FTE jobs created per MW	33.7	Based on a calculation of the direct and indirect FTE (one full-time job for one calendar year) generated in India under a business-as-usual scenario from 2022-2026 in the development, manufacturing, construction, installation and O&M phase, over the 25-year lifetime of a wind project. See: Capturing green recovery opportunities from wind power in developing economies, GWEC, 2022.

Appendix 2

Status of SECI Wind and Hybrid Tenders, as of May 2022

Sl No.	Scheme: SECI		Total Capacity Tendered (MW)	Total Capacity Awarded (MW)	Under Construction Capacity (MW)	Winning Bid (in INR/kWh)
1	**SECI Tranche I, 2017**		1000	1049.9	0	3.46
2	**SECI Tranche II, 2017**		1000	1000	269.9	2.64
3	**SECI Tranche III, 2018**		2000	2000	1049.8	2.44
4	**SECI Tranche IV, 2018**		2000	2000	1586	2.51
5	**SECI Tranche V, 2018**		1200	1190	1190	2.76
6	**SECI Tranche VI, 2019**		1200	1200	950	2.82
7	**SECI Tranche VII, 2019**		1200	480	480	2.79
8	**SECI Tranche VIII, 2019**		1800	440	440.8	2.83
9	**SECI Tranche IX, 2020**	2500 MW ISTS-Connected Blended Wind Power Projects in India under Tariff-based Competitive Auction (TrancheIX)	2500	970	970	2.99
10	**SECI Tranche X, 2021**	1200 MW ISTS-connected Wind Power Projects (Tranche-X)	1200	1200	1200	2.77
11	**SECI Tranche XI, 2021**	1200 MW ISTS-connected Wind Power Projects (Tranche-XI)	1200	1200	1200	2.69
12	**SECI Tranche XII, 2021**	1200 MW ISTS-connected Wind Power Projects (Tranche-XII)	1200	Not Auctioned		
13	**SECI Tranche XIII, 2022**	1200 MW ISTS-connected Wind Power Projects Tranche XIII	1200	Not Auctioned		
Total			**18700**	**12729.9**	**9336.5**	

Source: (CEA 2021) and GWEC Market Intelligence- Global Wind Auction Database Q1 2022

Hybrid and Peak power/RTC Projects: SECI Tenders

Sl No	Scheme	Auction Scheme Type	Total Capacity Tendered (in MW)	Total Capacity Awarded (in MW)	Under Construction Capacity (MW)	Winning Bid (in INR/kWh)
1	**SECI Tranche 1, 2018**	SECI 1200 MW ISTS- Connected Wind-Solar Hybrid Project Tranche 1	1200	840	840	2.67- 2.69
2	**SECI Tranche 2, 2019**	SECI 1200 MW ISTS- Connected Wind-Solar Hybrid Project Tranche 2	1200	600	600	2.69
3	**SECI Tranche 7, 2019**	SECI 1200 MW ISTS- Connected With assured peak power supply in India ISTS-VII	1200	1200	1200	Peak tariff (6.12), off Peak Tariff (2.88)
4	**RTC 1, 2019**	SECI 400 MW ISTS connected Round the clock RE Power (RTC-1)	400	400	400	2.9
5	**SECI Tranche 3, 2020**	SECI 1200 MW ISTS- Connected Wind-Solar Hybrid Project Tranche 3	1200	1110	1110	2.41
6	**SECI Tranche 4, 2021**	SECI 1200 MW ISTS-Connected Wind-Solar Hybrid Power Projects (Tranche-IV)	1200	Awarded	1200	2.34- 2.35
7	**SECI Tranche 5, 2021**	SECI Hybrid Power Developers for Setting up of 1200 MW ISTS-connected Wind-Solar Hybrid Power Projects (Tranche-V)	1200	Awarded	1200	2.5
8	**RTC 2, 2021**	SECI 5000 MW RTC Power from ISTS-connected RE Power Projects, complemented with Coal based Thermal Power in India (RTC-II)	5000	Likely to be retendered		

Source: (CEA 2021) and GWEC Market Intelligence- Global Wind Auction Database Q1 2022

As per, 27th Report: Evaluation of wind energy in India. Seventeenth Lok Sabha. Standing Committee on Energy (2021-2022) :

- Out of the 20 GW that was bid (SECI I to SECI XI wind tender) , 78% capacity was awarded, 6% cancelled and 34% of the net capacity has been commissioned.
- Out of the 4250 MW wind solar hybrid bids that have been awarded as part of SECI tranche (I to IV) and MSEDCL bids, around 5% capacity has been commissioned as on 28 February 2022.
- MSEDCL, which is a state agency, also awarded 500 MW hybrid bid where winning tariff was INR 2.62/kWh

State/NTPC tenders

Sl No	State/Agency	Capacity in MW	INR/kWh	Capacity Awarded
1	**Tamil Nadu, 2017_450 MW**	450	3.42	450
2	**Gujarat, GUVNL, 2017_500 MW**	500	2.43	500
3	**NTPC, 2018_1200 MW**	1200	2.76	850
4	**MSEDCL, 2018_500 MW**	500	2.85	500
5	**GUVNL, Tranche 2, 2019_203MW_Awarded**	1000	2.8	203

Source: Based on (Bose and Sarkar 2019) and GWEC Market Intelligence- Global Wind Auction Database Q1 2022

Appendix 3

Status of PPA/PSA signing for wind and hybrid projects

Wind projects

As per the Quarterly Report on under construction Renewable Energy Projects published by the CEA in July 2021, PPA and PSA were reported as not signed for projects from Tranche IX onwards. PSA were reported as not signed for a majority of the Tranche VII and VIII projects.

Hybrid projects

As per the Quarterly Report on under construction Renewable Energy Projects published by the CEA in July 2021, PPA was reported as not signed for projects from Tranche III onwards and PSA was reported as not signed for any of the projects.

Appendix 4

Status of Non-solar RPO during 2019-2020

State	Non-Solar Obligation (MU)	Non-Solar Consumption (MU)	Compliance met (%)
Chandigarh	86.6	0	0.0
Lakshadweep	4.7	0	0.0
Manipur	66.2	1.5	2.3
Telangana	6677.8	513.6	7.7
Bihar	3053.6	266.3	8.7
Andaman and Nicobar	33.1	5.7	17.2
Haryana*	5144.4	902.1	17.5
Daman and Diu	263.8	49.5	18.8
Tripura	133.3	25.3	19.0
Goa*	445.9	103.1	23.1
Chhattisgarh	3053	720.7	23.6
Odisha	2348.8	683.9	29.1
Kerala	1953.2	677.7	34.7
Assam*	802.1	284.9	35.5
Uttar Pradesh*	11569.5	4470	38.6
Delhi*	3079.6	1209.2	39.3
Puducherry	291.7	122.8	42.1
West Bengal	4923.3	2128.5	43.2
Punjab*	4688.6	2151.1	45.9
Jharkhand	814	453.4	55.7
Meghalaya	98.5	68.6	69.6
Madhya Pradesh	7026.6	4988.5	71.0
Maharashtra	15210.5	11791.7	77.5
Rajasthan**	7906.8	6500.2	82.2
Dadar and Nagar Havelli	669.1	561.7	83.9

State	Non-Solar Obligation (MU)	Non-Solar Consumption (MU)	Compliance met (%)
Mizoram	50.1	49.6	99.0
Andhra Pradesh	6369.7	7486	117.5
Gujarat**	11531.7	14134.7	122.6
Tamil Nadu**	10620.8	13559.5	127.7
Nagaland	57.9	75.9	131.1
Karnataka	6102.6	14103.2	231.1

* Significant proportion of import of Solar and Wind from ISTS projects, so ISTS import data shared by POSOCO has been included in the consumption
** Significant proportion of solar/wind energy is exported to other States, data for export for Tamil Nadu ** 2019-20 is not available, the above table overestimates the compliance for these states

Source: http://www.indiaenvironmentportal.org.in/files/file/Action%20Plan%20for%20achievement%20of%20renewable%20energy.pdf

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