# Indian Wind Power

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## In this issue...



IWTMA
INDIAN WIND TURBINE MANUFACTURERS ASSOCIATION

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- Installation, Commissioning and Operation & Maintenance of Wind Turbines
- Grid Integration of Renewable Energy System
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- Seminar / Workshops on Wind and Solar Energy


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IWTMA
INDIAN WIND TURBINE MANUFACTURERS ASSOCIATION

# Indian Wind Power

*A Bi-monthly Magazine of Indian Wind Turbine Manufacturers Association*

Volume: 6 Issue: 3 August - September 2020



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# *From the Desk of the Chairman – IWTMA*

Greetings from IWTMA!

It is critical for the Wind Energy sector to gear up and move forward with agility and speed if we are to achieve the target of 60 GW of wind power installations by 2022. To discuss various impediments in the way of development of wind power in India, Indian Wind Turbine Manufacturers Association organized a high profile webinar on 28th October 2020. I would personally like to thank all the leaders from the industry and thought leaders from our stakeholder groups for participating in the event and making it a huge success.

Stalwarts of the industry and all its stakeholders deliberated on strategies and technological advancement needed to make India a Global Manufacturing Hub and also to discuss on Energy Transition, Sustainability and Climate Change. There was considerable discussion on ways to achieve the set targets, enhancing "Make in India' through the MSME sector and creating rural employment for skilled labor. Issues of "Demand Creation and Grid Management were also in focus during the webinar and the findings of the event have been sent to the Ministry for consideration. Over 400 participants from all over the word joined the webinar from the fields of wind power, turbine technology, grid, transmission, regulatory, developers, operations and maintenance, etc. The proceedings are also covered as an article later in this issue.

Irrespective of the discovery of tariff through competitive bidding, reliability in generation when at peak requirement is key. The Association in its representation to the Government has particularly pointed out combination of wind solar hybrid with hydro as storage to bring about the concept of 'Round the Clock' Power with a minimum of 50% PLF. However, realization of this target is possible only when the entire country and all the states cooperate in Renewable Portfolio Obligation (RPO) compliance and introduction of differential tariff for uniform development in all windy states in the country which is now restricted to mainly Gujarat and to some extent Tamil Nadu. Land and connectivity are most critical for wind energy development. Projects are delayed on account of difficulties in land clearance/allotment and connectivity to the state or majorly the CTU grid. Ministry of New and Renewable Energy has floated a Concept Note on development of Wind Park/Wind Solar Hybrid Parks which addresses the crucial issue of land and connectivity. One is aware that power is a concurrent subject and positive outcome is possible only when there is a total cooperation of the wind states to promote wind energy and to meet their own RPO, making this unique source available to the rest of the country.

Recently, our Hon'ble Prime Minister spoke at the convocation of Pandit Deendayal Upadhyay Petroleum Institute emphasizing the importance of Renewable Energy and gas generation reiterating that India is confident of achieving the targets of 175 GW by 2022 and 450 GW by 2030. Government of India's commitment was further strengthened by bringing in world leaders and stakeholders at the RE-Invest in November 2020.

The outlook for the financial year 2020-21 for wind energy has also been impacted by COVID 19 which has played havoc with lives and economies across the world. It is heartening that the International Energy Agency (IEA) forecasts that despite the impact of COVID-19 on the renewable sector, India would be the largest contributor to the renewable upswing in 2021, and the country's annual additions are expected to double in 2021 compared to 2020. Many auctioned projects are expected to become operational in 2021, which will lead to growth next year.

As we near the end of a crisis-ridden, challenging and unprecedented year it gives me great hope that the New Year will bring normalcy, peace and prosperity to the world. I would like to end with wishing all our readers a "Merry Christmas and a Happy New Year 2021".

Please stay safe and be healthy.

With regards,

**Tulsi Tanti**

Chairman

# IWTMA Webinar
# Wind is the Answer for Energy Transition
## 28th October 2020

The Indian power sector is undergoing a significant change that has redefined the industry outlook. Sustained economic growth continues to drive electricity demand in India. The Government of India's focus on attaining 'Power for all' has accelerated capacity addition in the country. By 2022, wind energy is estimated to contribute 60 GW, followed by solar power at 100 GW, and biomass and hydropower at 15 GW. The target for renewable energy has been increased to 175 GW by 2022 by the government of India. The key element of the Wind Power Industry remains its sustainability; this however is determined by long-term policies, goals and incentives defined by the government. A capital intensive industry also requires large international lending platform and a vibrant business climate with ease of doing business for long sustainability.

Indian Wind Turbine Manufacturers Association organized a very high profile webinar on 28th October 2020 from 1400 to 1730 hours to deliberate on strategies and technological advancement to make India a Global Manufacturing Hub and also to discuss on Energy Transition, Sustainability and Climate Change, achieving the set target, enhancing "Make in India" through MSME sector, creating rural employment for skilled labour and issues on Demand Creation, Grid Management, etc.

The webinar was joined by over 400 participants from all over the world in the field of wind power, OEMs, wind turbine technology, grid, transmission, regulatory, finance, developers, operations and maintenance, etc. A short report on the discussions held in the webinar is given below.

### 1. Inaugural Session


### Welcome Note

Mr. Tulsi Tanti, Chairman Suzlon Group and Chairman IWTMA welcomed His Excellency Mr. Freddy Svane, Ambassador to Royal Danish Embassy, Dr. Ajay Mathur, Director General, TERI and all the panelists and delegates to the webinar.

Mr. Tanti briefed about the wind industry in India adding that the India has moved from conventional to renewable energy sources in last 5 to 10 years and now more than 80% of the manufacturing in the country is under "Make in India" sector and has created more than 2 million jobs in the remote areas of the country. Renewable energy can reduce the import of oil content with the introduction of electric vehicles. Mr. Tanti outlined offshore which can be to the tune of 150 GW. India with latest technology and R&D Development available within the country championing 'Atmanirbhar Bharat' can become a major exporter to different geographies of the world. Climate change is being taken seriously and renewables can make a change. Wind Solar Hybrid is the answer and soon the country's power demand will be met by 50% from renewables.

### Presidential Address

The Presidential Address was delivered by His Excellency Mr. Freddy Svane, Ambassador to Royal Danish Embassy in India, New Delhi.


H. E. Mr. Svane expressed that the India is a part of global team be it energy or economy. He used a little departure from "Make in India" to "Make India". He added that the Denmark is very strong and early player globally in wind power and Denmark and India has joined hands many years ago to develop common trajectory. Many Danish companies have started production, research and development in India in the wind sector. Saying about the climate changes and climate risk, he expressed that India should become green super power. India and Denmark have finalised a partnership to develop the

new forms of cooperation and one of the specific sector he mentioned as energy and wind.

The Ambassador briefed that in the next COP, when Climate Change negotiations take place, one thing is to come up is Green Climate Funding of 100 bn US$ a year. Mr. Svane raised the point as to how this fund is created, generated and executed. He advocated that all the nations should work on sustainable energy as the whole world has agreed for achievement off sustainable and developmental goals with the United Nations (Paris Accord). India and Denmark will work on Wind Energy, Finance, Climate Change and work on both onshore and offshore.


## Keynote address

The Keynote address was given by Dr. Ajay Mathur, Director General, The Energy and Resources Institute (TERI).

Dr. Mathur positioned that wind is in transition and is at the cusp. It is a known fact that Renewable Energy is the cheapest form of power when the wind is blowing and the sun is shining, and wind can actually be generated between 6.00 to 11.00 p.m. meeting peak demand. The question is on reliability of power to generate when required and perhaps the answer lies in wind park and hydro to meet 24 x 7 power (wind hydro storage). While terming bidding 'wrong' there is a crisis in bidding of low tariff and under-subscription. Land and connectivity issues add to the woes. Thermal power has a two-part tariff while wind enjoys a 'must run' status. It is unfair that thermal plants comparing their variable cost to the full cost of RE and it is difficult to say if wind can come under two part tariff which will lose the 'must run' status.

The answer perhaps lies in unified terminology of all sources of power and a unified tariff taking care of grid management and grid security. Wind power with storage seems to be the closest answer. Dr Mathur concluded that time will tell the importance and role of wind energy especially in the context of climate change and India is a signatory to Paris Accord.

He stressed for ramping up and ramping down of fossil energy to help wind and Solar, reduce tariff to the consumers when demand is reduced and look at moving away from reverse bidding and consider under two-part tariff for wind and solar– determination and criteria.

Thereafter Mr. Shantanu Jaiswal, Analyst, Bloomberg NEF presented the Bloomberg Energy Outlook 2020 signifying the increased role of 'Wind'.

## 2. CEO's Round Table Discussions

Round table discussions were moderated by Mr. Shantanu Jaiswal, Analyst, Bloomberg NEF consisting of the following CEO's from key industry OEM's, IPP's and Financial Institutions.

- Mr. Tulsi Tanti, Chairman Suzlon Group and Chairman IWTMA
- Mr. Rajenthiran Pannirselvam, VP & Head of Services, Siemens Gamesa Renewable Power Pvt. Ltd.
- Mr. Balram Mehta, Chief Operating Officer, ReNew Power
- Mr. Pankaj Sindwani, Chief Business Officer, Tata Cleantech
- Mr. Vipul Tuli, Head-India, Energy, Sembcorp Green Infra Limited


The discussion started with the topic "What is ailing wind industry today". The reasons which came out of discussions are that the pricing is very low and unviable; hence banks are not keen to fund the projects. In 8 windy states the PLF and pricing is different. Developers are missing from the value chain in the projects to do the work of land acquisition, wind resource assessment, road construction, sub-station construction, etc.

On the question of lending for wind energy, the concerns came out that there are relatively higher numbers of variables in under construction projects and in operations in wind as compared to other resources. As the installations are happening in two states only, there will be congestion in transmission, land availability, ROW, etc. The projects bid at the so low tariff will be viable only

when they produce high PLF. Curtailment is a new variable on operations side. It was opined that on time execution and non-postponement of bids will only ensure flow of foreign capital. Banks have to develop the financing models to support the OEMs.

As the risk and rewards are not matching in development risk and volume risk besides the operating and resource Risk, under-subscription of bids is there. To cover these risks, operating and resources risks, low cost fixed interest rate of loans are needed.

Thereafter, the discussions started on the long-term and sustainable solution for growth and development solution including grid access problems. It was brought to the light that the investment in development of the site and the role of developer for bigger projects are needed.

IPPs are anyhow managing with the various measurements, approval, etc. Execution and evacuation risk is also there.

On breaking down the responsibilities, it was the view that the change to FIT from competitive bidding has completely changed the business mix of the country and if volume is down, margin pressure is continuing. OEMs should restrict to manufacturing and for supply and operations and maintenance developers has to come out.

On the question of business model, it was deliberated that the differential pricing has to come in different windy state for the bidders. SECI has to calculate and sell to the utility at average rate.

Utility has to go by the average purchasing model and bundling by the SECI. This power price will remain below APPC rate.

It was further put up that there should be no stand-alone wind or solar and the maximum bidding should be for the hybrid or the RTC factoring PLF of 50%. Every state has to follow RPO. Penalty should be there for non-fulfilment. Developers are to be promoted by OEMs and IPPs. We have to give the space to them and account the cost. That is the highest risk in the value chain. Proper pricing is to be given to the developer.

To avoid concentration of installations in few states, inter-state trading to be made more viable.

National RPO mandate is needed with proper penalties. Insurance and wind hedging is needed.

Cost of capital is always proportional to risk and there is need for both side of the capital–debt and equity. Tariff level should be sustainable.

On the point of the future of wind industry, it was opined that now turnkey solutions are not being offered in wind and IPPs have to go for their own development, EPC, O&M, etc. Industry has to think about zero waste wind turbines. Indian Renewable market is one of the most competitive markets in the world in terms of optimization and Public Sector companies, Railways, Oil companies have to come forward to invest in Renewables.

## 3. Session on "Demand Creation, Grid Management, 'Make in India' and Rural Employment"

This session was moderated by Mr. D. V. Giri, Secretary General, IWTMA. The panelists were as follows:

- Mr. B.P. Yadav, Joint Secretary-Wind, Ministry of New and Renewable Energy, Govt. of India
- Dr. Ajit Kumar, Director–Commercial and Operations, PTC India Limited
- Mr. M.R. Srinivasa Murthy, IAS, Former Chairman, KERC
- Mr. Amit Kansal, CEO and Managing Director, Senvion Wind technology
- Mr. S.K. Soonee, Advisor, POSOCO
- Mr. Neerav Nanavati, CEO and Country Manager, India, Engie


Mr. B.P. Yadav


Dr. Ajit Kumar


Mr. M.R. Srinivasa Murthy


Mr. Amit Kansal


Mr. S.K. Soonee


Mr. Neerav Nanavati


Mr. D.V. Giri
Moderator

The discussion on this topic started with getting the ideas as to how to create demand.

There were many suggestions like connecting the electricity to the last mile, creating demand for heating and cooling requirements in domestic and industrial sector, replacement of thermal generation with the renewable generation, etc. and bring energy efficiency. Decommission the old thermal power plants after their useful life was also suggested. But the obstacles are that Discoms have long-term PPAs with thermal power as the cost of generation in some of the old plants is very low and government has to incentivize the Discom to hive off the thermal power plants. Electric mobility is another area to create the demand. All the 3 basic

components – land, labour and taxes together can increase the industrial demand. For long-term demand creation, industry has to pick up 10% growth per year to achieve targets of the government.

On the question of the Grid Challenges it was told that the grid is available at every nook and corner of India and will reach wherever it is left.

On the point of non utilisation of manufacturing capacity of OEMs of 10000 MW, it was deliberated that under "Make in India" large amount of investment is coming in different manufacturing sectors. Government has started a lot of work on mining and metal industry. The introduction of electric vehicles will not only create new demand but it will change the peak also to 24 hours.

It was the opinion of all panelists that the low tariff bids in wind is a major hurdle in development of wind power and delay of the payments by Discoms. Other problems are PPAs signing, curtailment, RPO enforcement. Despite 'Must Run' status, wind power is facing curtailment. Central Government rules are not fully enforceable at State DISCOMs level. Power Trading Corporation can play a major role to help buyer-seller requirement and ease in payment as per their business model.

CERC has facilitated 'Green Term Ahead Market (GTAM)' and has placed it on the energy exchange.

A multi-model procurement model was also suggested as the retail investors are not able to bid in central or state bids due to their bigger volume. The investors can sell power directly to off-takers by-passing the DISCOMs. MNRE did ask for small bids but that did not take off. Large IPPs are looking for long-term sustainable PPAs. Enough investors are keen to invest in open access projects.

On the matter that GST Council has mandated the GST at 70/30, goods at 5% services at 18% and industry is not happy with it; the suggestions came that the Finance Ministry, Government of India can be approached to persuade that what type of fiscal regime need to follow to promote wind industry.

In the wind there is 80% localisation, supported by 4000 MSME vendors, best of technology, high PLF, turbine on footprint basis and zero water industry. It is not getting right deal it should get.

Wind industry has about 7 billion dollars of investment and support of MNRE is needed and renewable energy has great future. Instead of putting all the burden of promoting, balancing, subsidising, cross-subsiding RE on the stage on which the resource is there, and consumers of Discoms, a centralised policy is to be evolved to absorb any extra cost in promoting RE, clearly showing that this is the cost country can happily bear because the share of RE is not very high. It should be planned and absorb in an equitable manner, otherwise leave it to those state. We have to persuade the Central Government to prepare the policy, which is good for all the states, entire country and all the consumers.

India is in the Grid Code IEC 2020, specifically crafted to accommodate the renewables. Real Time market has been started. For transmission there is a planning regulation use of STU for CTU ensuring for enough transmission, balancing, etc. has already been introduced at the national level to keep the system flexible.

Real good policy on Repowering is needed. Export policy needed to export go up to 2 billion US$. Getting the sources of cheap money, lower interest and logistics are needed for the development of wind power.

## 4. Concluding Remarks

The concluding remarks were given by Mr. Indu Shekhar Chaturvedi, IAS, Secretary, Ministry of New and Renewable Energy, Government of India.


Mr. Chaturvedi expressed that the Ministry is aware of the problems and issues and efforts will be taken to help the sector to live up to its potential. MNRE is already working on offshore wind. Creation of manufacturing zones for renewable energy is already on the agenda of the Ministry, and Ministry is discussing various matters with the stakeholders every month to resolve the issues. He assured to go through the deliberations at the webinar and see what steps can be taken to resolves the issues facing the industry.

The event ended with a vote of thanks to all dignitaries, panelists, sponsors, participants, and those who worked behind the screen to make the webinar a fair success.


IWTMA looks forward to all stakeholders to join at the flagship event "Windergy India 2021".

# The Indian Grid of Tomorrow - The Story of Energy Storage Blending with Renewables

**Debmalya Sen**
Senior Consultant – Emerging Technologies
Customized Energy Solutions - India

Innovation and Agility are two terms which are applicable to almost every aspect of activities in today's world. As it is often described, the world today is called 'VUCA', which stands for volatile, uncertain, complex and action oriented. Thus, it changes every day and as it is said, change is the new normal. In fact, in many ways the normal itself has been changing everyday more so in the present condition that the world is in today because of the pandemic. You may be wondering why I am saying these in an article which is to talk about storage applications in the RE sector, well, it is because the whole transition which the RE sector itself is facing today can be defined by the above phenomenon.

## The S-Curve Analogy

In management curriculum, we are all taught of a subject called Strategic Innovation, where we are taught about the famous life cycle curve (better known as S-Curve). I tried to use the S-Curve in this context to understand where the major generating fuel mixes stands today in that curve. As can be guessed, coal is in its late maturity or early decline phase, but what is interesting to note here is the position of renewables in the curve. If we take note of the last 2 years, there has been a drop in the growth trend of renewables as a whole, which has more affected the wind (being the more mature technology as compared to solar PV). This means, renewables are slowly moving towards its maturity phase. This also brings in front the point of inflection.

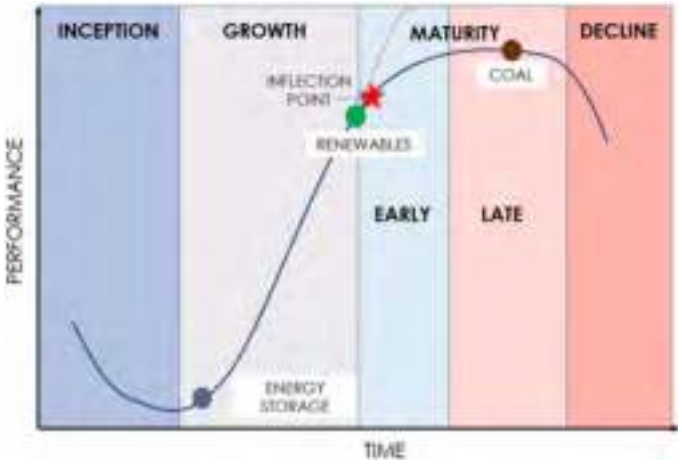


*Figure 1: S-Curve of Major Generating Fuel Sources*

Who will be the necessary catalyst which will be needed for renewables to extend its growth phase? But before discussing on the Who part, let us discuss a bit more on the Why part of the problem. The penetration of renewables in the grid has been a story which has been told multiple times, especially with the kind of growth renewables has had over the last 5 years, ably supported by Governments vision and policies.

Talking of Tamil Nadu alone, Tamil Nadu today has 23% of its generating capacity as renewables, almost equal to the PAN India installed capacity share of renewables (24%). But with more and more renewables in the grid, the concern of rising grid variability evolves and more so because to absorb all the renewables, the more stable power sources like gas and coal are being shut down, thus the grid inertia also reduces. So, what renewables needs to remove is the tag of "variable" or "unreliable" tag that it has on itself. This can be brought about by energy storage which can act as that much required buffer at grid to balance out the dynamics which a high renewable grid scenario always complains of. This issue has already been faced by countries with high share of renewables, the greatest example of the same being California. Thus, for renewables, the energy storage comes as that much needed inflection point/ catalyst which will help renewables to continue in the growth curve. Saying that, let us also see where energy storage as a technology fits in the S-Curve. Overall energy storage can be seen at the early stages of its growth curve and thus it also will need a booster which can pave way for it to find more applications. Renewables for energy storage is that booster which will help it to climb up the growth phase faster. So, it is quite a balanced game, where as much as renewables need energy storage to remain on the growth phase, the other part of the story is also true, i.e. energy storage as a technology also needs renewables to find more applications and deployment opportunities to help it climb up the growth curve.

## Challenges of a Renewables Heavy Grid

Speaking of challenges of a high RE Grid, we discussed the main issue of renewables being variable in the discussion above, one more challenge with high RE is evacuation of power. As on date, many states are already running its coal fleet on technical minimum, i.e. 55% as prescribed by CEA. Thus,

addition of more RE with not subsequent significant increase in load demand will mean that more and more RE will have to be curtailed, especially so during the high renewable seasons of the year. This is an issue which has been faced by many states also at present. Tamil Nadu itself has been facing on an average a yearly curtailment of 30% only for wind. The state has huge potential of wind (68.5 GW at 120 mtrs) and there is a significant scope of improvement of Solar too which today stands at 3.9 GW and as per the state solar policy, has set a target of 9 GW by 2023.

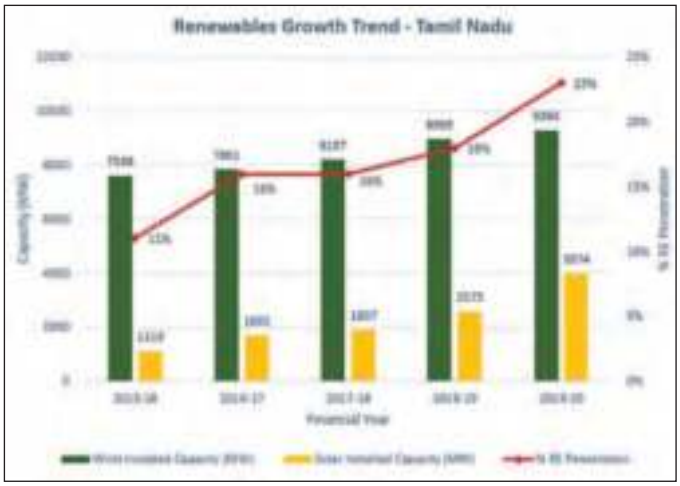


*Figure 2: Renewable Growth Trend – Tamil Nadu*

What this means is that though there will be huge installations going forward, we will not be able to utilize the resources to its full potential due to mismatch in demand and supply equations. This is more pronounced with solar as solar generates at its full potential during noon when the load demand is not high, whereas when the load demand actually increases in the evening, solar generation plummets thereby giving rise to a situation which demands very fast ramping. Coal units are not designed for fast switching and as such the coal units must be kept running even in such periods when solar is generating at its peak, thereby giving rise to challenges of grid management and curtailments. Also, what does not help here is the constraints of evacuation network available which itself is being overloaded with random expansion of renewables but not sufficient expansion of the T&D network. The issue here is evacuation lines connected to renewable sites are only partly utilized due to lower utilization factors of renewables (wind 30%, solar 20%). Thus, the issue comes up at the connected sub-station end which becomes overloaded during high RE resource months. One way of utilizing these transmission networks better is hybridization of wind and solar resources, but the same is more beneficial only for co-located sites which again is a challenge as getting such a site which has both resources good is rare. With Solar Energy Corporation of India (SECI) now coming out with the paper of high performing renewables, whereby there will be an annual requirement of higher PLF in the range of 60 to 80% based on various combinations, there is an indication that future wind or solar tenders will no longer be plain vanilla and will be combined with the entrance of energy storage in some form. All the above issues like RE curtailment, grid balancing, utilization of T&D network and the criteria of high performing renewables can be ably supported by energy storage and thus we see the growing demand and deployment of the same in the grid worldwide today.

## Energy Storage – the Solution

Over time the technological improvements that energy storage has seen along with the drop in battery cell prices, specifically for battery storage has made energy storage a tough competitor when compared with other technologies. As on date RE + battery storage is already more economical than new built coal or gas-peaker plants. Let us look at some recent examples. The new coal plant PPA which was signed by the Madhya Pradesh Government and Adani states of a tariff of INR 4.8/kWh with escalations for the next 25 years. Now, let's talk of the 1.2 GW SECI peak power tender which was won at an average cost of INR 4.3/kWh including storage of 6 hours and the more recent 400 MW RTC tender won by Renew at a base year tariff of INR 2.9/kWh and the LCOE of INR 3.6/kWh. These clearly show that RE with Storage is becoming a much more lucrative choice going forward.

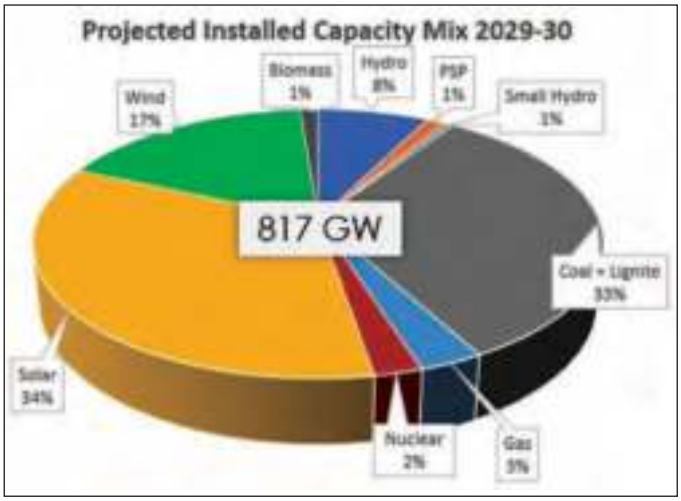


*Figure 3: Projected Installed Capacity Mix 2029-30 (CEA)*

The story becomes more compelling because, as per CEA, there is around 25 GW of coal plants which are scheduled for retirement from 2022 and 2030, but there is also around 34 GW which are planned to be built. Thus, the question which comes up here is that do we need to build more coal plants? Or do we have other options. The Optimal Generation Report as released by CEA earlier in the year projects to a total capacity


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With 23 years of leadership in the Indian wind market, Suzlon has been the largest contributor having built ~35% of India's wind installations. With over 12 GW of wind assets under service, Suzlon is the largest private player in the operations and maintenance services for energy assets.
With end-to-end business solutions Suzlon has led the green energy revolution to power India's social, economic and ecological development sustainably.
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of 817 GW of total installed capacity in 2030 from 370 GW as it is today. What is interesting to note here is that the percentage of coal in the grid which is 55% today drops to 33% whereas the percentage of renewables in the grid increases to 51%. In terms of generation too the percentage of RE increases from 10% as on date to 31% in 2029-30. The report further projects that in such a RE heavy grid if we want to keep RE as must run then the technical minimum of coal plants have to be further reduced from 55%. This though comes at a cost, it comes at a cost of lowering efficiency, increasing heat rate and $CO_2$ emission from the coal plants thereby increasing the per unit production cost. Studies forecast that keeping the tech min of coal constant there can be as high as 40% curtailment seen in renewables to balance load demand. But even then, due to variability of renewables we will still need to build coal plants. One way of optimizing this is to make renewables more dispatchable, which can only happen when we make renewables more reliable and extract higher utilization from it.

## Evolving Tenders

As discussed before, SECI recently has discussed about various innovative tenders with storage and proposes 3 categories of storage linked tenders in future, the same being:

1. Hybrid and peak power – to supply assured power during peak periods – 40% CUF
2. RTC RE – round the clock renewables – 80% CUF, and
3. Firm flexible RE for 12–16 Hours with ±10-20% flexibility – 60% CUF

As per SECI, deployment of energy storage at generation side will improve quality of power and PLF of plants and that such tenders with requirement of high PLF will help in better utilization of transmission network and help in reducing building of more transmission networks. This will also help in addressing high curtailment issues of RE, apart from helping in smoothing out high ramping requirement.

| Tendering authority | Location | RE (MW) | Battery Storage (MWh) | Duration (Hour) | Tender scope | Current status | Winner | Date of tender issuance |
|---|---|---|---|---|---|---|---|---|
| **NTPC** | Andaman & Nicobar Islands | 17 | 6.8 | 1 | EPC | Cancelled | BHEL | Mar-18 |
| **NTPC** | Andaman & Nicobar Islands | 8 | 3.2 | 1 | EPC | Cancelled | BHEL | Mar-18 |
| **NLC** | Andaman & Nicobar Islands | 20 | 8 | 0.5 | EPC | Commissioned | L&T | Apr-18 |
| **SECI** | Leh | 3 | 5 | 1 | EPC | Result announced | | Jul-18 |
| **SECI** | Kaza | 2 | 1 | 0.5 | EPC | Result announced | Sunsource | Aug-18 |
| **SECI** | Lakshadweep | 20 | 60 | 1 | EPC | Bids submitted | | Feb-19 |
| **SECI** | Leh | 3 | 3.2 | 1 | EPC | Results announced | Sunsource | Mar-19 |
| **SECI** | Leh and Kargil | 14 | 42 | 3 | BOO | RFS Issued | | Mar-19 |
| **REIL** | Andaman & Nicobar Islands | 1.7 | 1 | 1 | EPC | RFS Issued | | Apr-19 |
| **SECI** | Andhra Pradesh | 160 | 20 | 2 | EPC | Bids submitted | | Apr-19 |
| **SECI** | Leh | 2 | 2 | 1 | EPC | Cancelled | Sunsource | Jun-19 |
| **SECI** | PAN India (1200 MW) | 300 | 150 | 6 | BOO | Result announced | Renew | Sep-19 |
| **SECI** | Lakshadweep | 1.95 | 2.15 | 1 | EPC | Result announced | Sunsource | Sep-19 |
| **SECI** | PAN India (400 MW) Hybrid, RTC | 400 | Optional | - | BOO | Result announced | Renew | Oct-19 |
| **MPPMCL** | Madhya Pradesh | 500 | 1500 | 8 (3 Hr continuous) | EOI | EOI Presentation done | | Oct-19 |
| **SECI** | Andaman & Nicobar Islands | 4 | 2 | 0.5 | BOO | Delayed | | Jan-20 |
| **SECI** | Kargil | 14 | 42 | 3 | EPC | Delayed | | Feb-20 |
| **SECI** | PAN India (RE + Thermal) | 5000 | - | - | BOO | Pre Bid Meeting done | | Mar-20 |
| **SECI** | Chattisgarh | 100 | 150 | 3 | EPC | Site Visit Scheduled | | Sep-20 |

*Table 1: Tenders with Storage Requirements (2018-2020)*

Overall, this is a good move, and there has been an increased interest in such tenders in the Industry. Talking of which, let us discuss a bit more on the fate of tenders related to RE + Storage announced till date. A total of 18 tenders have been announced from 2018 to date, inked with mainly solar. The total battery storage requirement in the same is around 350 MWh and the duration allocated in maximum of such tenders ranges between 1 to 2 hours with exception of the recently won 1.2 GW peak tender which is of 6 hours duration.

Initially some of the tenders got cancelled even after being announced, some got delayed and some are still getting delayed today but on a good note, we saw the commissioning of NLC 20MW/8MWh Solar with Storage tender recently and also Sunsource winning the Lakshadweep, Leh and Kaza tender. The road though has not been smooth. There has been hurdles in the form of site clearances, right to work issues, etc. which has delayed many projects but slowly the sector is overcoming the initial hurdles and making ground.

## Energy Storage Market Potential

There is a hope that now with guidelines for RE + Thermal bidding and procurement being laid and CERC paving way for connectivity rules for RTC tenders, the road ahead will give rise to exponential growth in the RE + Storage sector. CEA projects that by 2030, the generation side need a requirement of 128 GWh of storage to be sustainable. India Energy Storage Alliance projects that the RE + Storage market will grow at an annual CAGR of 40% from 2019 to 2027. The total potential of storage associated with Stationary Storage from 2019 to 2027 can be approximately 328 GWh. This obviously will need proactive policy support and incentives. Recently, Government of India has declared battery storage as a Champion sector and now with "Atmanirbhar Bharat", the announcement of domestic manufacturing of batteries can come soon as per NITI Aayog.

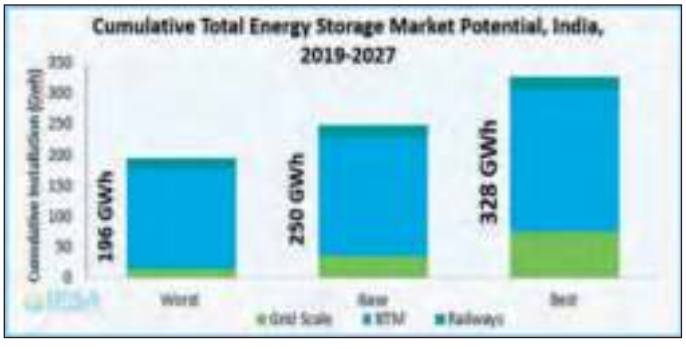


*Figure 4: Cumulative Total Energy Storage Market Potential*

## How can Energy Storage help India's Dream of 450 GW RE by 2030

The way forward for making high performing renewables a success is storage. Renewables alone without being oversized cannot generate a PLF of more than 35% annually under optimum sizing. Thus, if we are talking of attaining annual utilization of 60 to 80% it will mean that we need to oversize the renewables portfolio, but the question is therefore by how much? Oversizing a renewable portfolio will also mean signing of a third-party contract along-side with the contractual PPA with DISCOM to sell off the excess power being produced over and above the contractual capacity to evacuate under the PPA. A high oversized RE portfolio has its own challenges, starting from getting separate grid connection and evacuation clearances to getting suitable third-party contracts laid. Also, even with oversizing there will be still events in low resource months like April or October, where the required PLF will still not be reached and certain months like in June and July, where the PLF can actually shoot over 100% keeping the contracted load as reference. Another issue with oversizing is which resource to give major oversizing, wind or solar. Solar though is better as CAPEX/MW is lower but oversizing solar will not serve the purpose of getting round the clock power or higher utilization as solar resource is only limited to 6 hours a day. Thus, the major oversizing activity will need to be done through wind, but it should also be kept in mind that the CAPEX of wind is double than that of solar. So, how can storage help here? Storage can help in managing the oversizing to an optimal level and the storage portion can help in further smoothening the load curve. It can help in utilizing some of the excess energy getting produced to get charged and thereafter get discharged in such durations when the cumulative RE load is low e.g. during late night hours. The sizing of storage can play an important role as oversizing of storage will yield in low utilization and inadequate sizing will yield in occurrence of multiple charge-discharge cycles. Taking example of the RTC tender which Renew won,

| Fuel | Installed Capacity (MW) | Annual Generation @ 100% CUF (MWh) | Anticipated Annual Generation (MWh) | Annual CUF | Portfolio RE Annual PLF |
|---|---|---|---|---|---|
| Solar | 300 | 2628000 | 735840 | 28% | 30% |
| Wind | 100 | 876000 | 306600 | 35% | |
| Solar | 200 | 1752000 | 490560 | 28% | 32% |
| Wind | 200 | 1752000 | 613200 | 35% | |
| Solar | 100 | 876000 | 245280 | 28% | 33% |
| Wind | 300 | 2628000 | 919800 | 35% | |

*Table 2: Various combinations of Wind and Solar blending and Resultant PLF Trend*

the portfolio of RE in the project can be as high as 1300 MW against a contractual agreement of 400 MW, which further can be topped up with storage of 100MW/400 MWh.

A question here though remains. Is such a jump in utilization factor requirement necessary? Can we not take it in a more sustainable and step wise manner? Can we not make use of hybrids with storage and keep the utilization factor in such a range which will not demand for oversizing? Or if at all oversizing must be done, the same will be limited/optimized extent. Oversizing to a huge extent will affect the energy-ecosystem in many ways too. Like it may bring about dynamics in transmission network planning. No matter how much the RE portfolio is oversized, there will be lull periods (as explained before) which will remain and also such periods where the RE portfolio will be enough to attain 80% utilization and the storage associated with the project will not at all be utilized (monsoon period). This putting a higher capacity of storage will also not be beneficial.

## The question therefore is… What is the way around?

The SECI stakeholder's discussion brought out many such options and alternatives. Apart from the above challenges, one very important point discussed was- Why not focus on making forecasting and scheduling of renewables stricter? Why not set targets for renewable dispatches? Rather than making the RE curve flatter why not retain the bell curve nature of renewables and focus on making that curve smoother instead. This will also require storage to be included in the RE portfolio and thus renewables will get much needed tag of being reliable and responsible as a fuel source. This will also help in better utilization of the transmission network and save unnecessary new installations. Ideas like existing projects with and without PPA and transmission approval should be allowed for Hybrids, this will also help in better utilization of T&D network and help in better utilization of land and RE resource also came up. Renewables may not be thought of to serve the base load, that is already being served, the focus can move towards making renewables more reliable to serve the variable and peak load. Also, it will be more efficient if rather than going for high PLF tenders, we instead match tenders as per what DISCOM requires. This will also call for better demand forecasting.

Overall, yes, the way we are progressing to is right but with a little tweak here and there. This will make the move sustainable over the long run. Else, in other to fix a short-term issue, we may end up creating a long-term problem for ourselves. Thus, it is very essential that the steps we take today are long sighted and make sure that they are sustainable in the long run, especially in today's world where technological disruptions are taking place more sooner than ever before.

## Snippets on Wind Power

### ⇨ AP to Set Up 7 Storage Plants to Tackle Power Fluctuations

In a major development, the Andhra Pradesh state government has decided to set up Pumped Hydro Storage Power Projects (PSP) as part of its decision to promote new renewable energy power plants. The PSP mode is likely to balance fluctuations in total input power from the existing renewable energy plants depending on solar and wind power stations. PSP projects will act as large scale energy storage stations. The government has identified seven locations to set up PSP plants to the tune of nearly 6,300 MW.

*Source: TNN, October 21, 2020*

### ⇨ NIWE Initiates Project to Collect Wind Data in Ladakh

The National Institute of Wind Energy (NIWE) has initiated a project in Ladakh for collection of wind data in order to make the region carbon neutral, according to information provided by the Ministry of New and Renewable Energy (MNRE). It added that six wind masts have also been transported to the region after the completion of site visits. "Installation will be carried out after the receipt of no-objection certificates for land. Apart from Ladakh, it said that officials have also visited Leh to expedite identification of land for setting up of solar projects. It added that the Power Grid Corporation of India has been requested to prepare a project report for transmission infrastructure of 10 GW capacity for exporting power from Leh.

*Source: ET Energy World, October 16, 2020*

### ⇨ Vestas Launches New Low-Wind Turbine Variant for Indian Market

Denmark-based wind turbine firm, Vestas, has said it has launched a new variant of turbine optimised for low and ultra-low wind project conditions in India, locally manufactured and sourced in the country. The V155-3.3 MW turbine would increase the turbine swept area by 67 percent in comparison to V120-2.2 MW, and improve the annual energy production by more than three percent for a 300-MW wind park with 46 fewer turbines.

*Source: ET Energy World, October 06, 2020*

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# A Lorenz Curve Based Approach to Quantify Wind Power Variability

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## 1. Introduction

Lorenz curve can be an effective tool in measuring the inequality of power generation from wind plants. Similar to the method of quantifying the PV power variability using Lorenz curve[1], useful insights into the wind power variability can be gained. A Lorenz curve based method shows a simple representation of wind power variability useful for policy makers and other stakeholders. A Lorenz curve[2-4] based measurement of power variation is able to quantify the irregularity of the power generation. Though a Lorenz curve is traditionally used to measure the income inequality in economics, a similar measure can be used to quantify the power variation of utility scale wind power plant.

Here, we describe a method to construct the Lorenz curve of utility scale wind power output. An empirical method is considered to construct the Lorenz curve and calculate the respective Gini coefficient to measure the irregularity of wind power output. Since significant differences in simulated performance using hourly and minute-by-minute data exist for a wind power system, we consider shorter time intervals (2 min.) to enable a comprehensive analysis.

## 2. Lorenz Curve for Wind Power Variability

A Lorenz curve can be constructed to characterize the variability of wind power distribution similar to the PV power distribution as described in reference[8]. If $P_W(t)$ be the wind power generated at time $t$ $(0 \le t \le T)$ where $T$ is the time period under consideration, for a fixed power value $P$, $\pi(P)$, the proportion of unit that generates the wind power $P_W(t)$ is less than $P$, and can be represented using probability measure as

$$\pi(P) = Probability\{P_W(t) \le P\}. \quad (1)$$

Considering $P_{min}$ and $P_{max}$ as the minimum and maximum wind power at the time period $T$, $\pi(P_{min}) = 0$ and $\pi(P_{max}) = 1$ using reference[1]. If $\eta(P)$ represents the proportion of wind power generated by the unit $\pi(P)$, $\eta(P)$ can be defined as:

$$\eta(P) = \frac{1}{\mu_P}\int_{P_{min}}^{P} \hat{P}\left\{\frac{d}{dP}\pi(P)\right\}_{P=\hat{P}} d\hat{P} \quad (2)$$

Where $\mu_P$ represents the average power at the time period $T$ and $\hat{P}$ is a continuous variable required to perform the integration. In (2), $(d\pi(P)/dP)$ represents the probability density function, and $\eta(P_{max}) = 1$ and $\eta(P_{min}) = 0$. Due to feasibility of data acquisition, $P_W(t)$ can be considered as discrete time-events using fixed time intervals.

The Lorenz curve $\eta = \eta(\pi)$ in the time period $T$ can be used to quantify the variability of the wind power output and the Gini coefficient of the Lorenz curve can be a measure of variability. The Gini coefficient at the time period $T$ can be defined as the ratio of the area under the curve $\eta = \pi$ and the area between the curve $\eta = \eta(\pi)$ and $\eta = \pi$. The numerical value of the Gini coefficient ($g$) at the time period $T$ can be represented as (see Appendix for derivation):

$$g_T = 1 - 2\int_0^1 \eta(\pi)d\pi \quad (3)$$

The straight line $\eta = \pi$ represents the ideal condition of perfect equality, i.e. the variability of the wind power output is zero and $g$ tends to 0[8]. For high-variability of wind power output $g$ tends to 1.

## 3. Empirical Lorenz Curve for Wind Power Variability

For computational simplicity, the Lorenz curve $\eta = \eta(\pi)$ can be approximated empirically using the following model[1,5].

$$\eta(\pi) = (1-m)\pi + m\pi^n, \quad (4)$$

Here $m$ and $n$ are the model parameters such that $0 \le m \le 1$ and $n > 1$. Using two different values of $\eta$ at $\pi = \alpha, \beta$, where $0 < \alpha < \beta < 1$, the model parameters can be approximated as[5],

$$m \approx 1 - \frac{\eta(\alpha)}{\alpha} \quad (5)$$

$$n \approx \frac{\log[\{\eta(\beta)-(1-m)\beta\}m^{-1}]}{\log\beta} \quad (6)$$

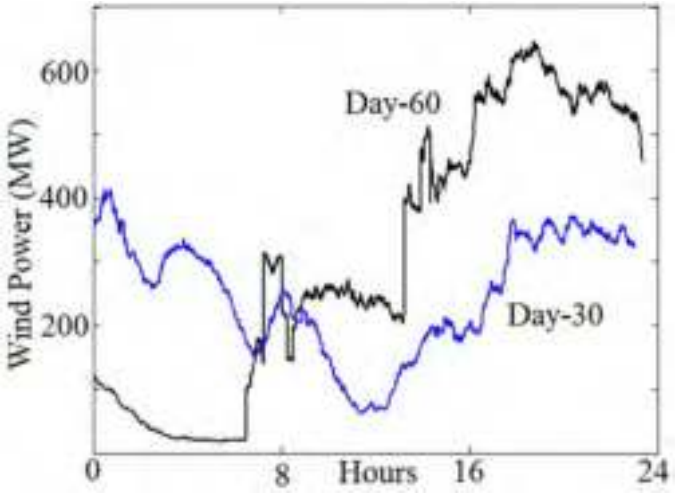
The choice of $\alpha$, $\beta$ depends on the availability of the data. If the percentage share of power output is less than 20% ($\eta(0.2)$) and more than 20% ($1 - \eta(0.8)$) are available, ($\alpha$ =0.2 and $\beta = 0.8$), the model parameters $m$ and $n$ can be represented as[1,5].

$$m \approx 1 - 5\eta(0.2) \quad (7)$$
$$n \approx -4.48\log[\{\eta(0.8) - 0.8(1-m)\}m^{-1}] \quad (8)$$

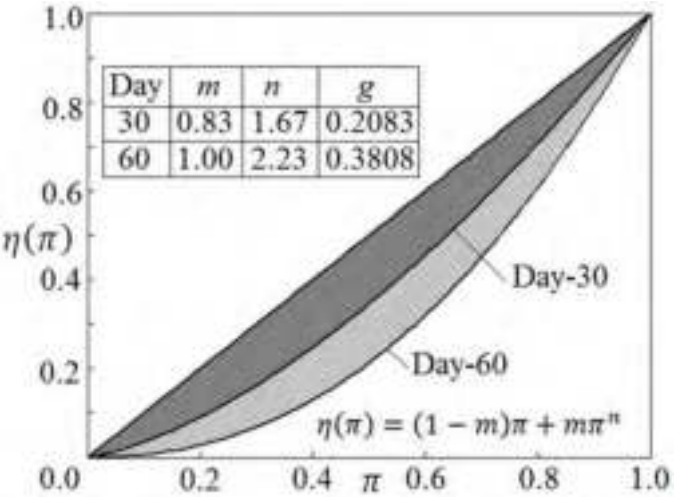
Using the model parameters values, using[3] and[4] the Gini co-efficient ($g_T$) of the wind power output for the time period $T$ can be represented as[1,5],

$$g = m\frac{n-1}{n+1} \quad (9)$$

Here we have considered wind power data for the state of Karnataka, India at 2 min intervals from July, 2010 to June, 2011. Here $W(t)$ is in MW and each 2 min interval is considered as one data-point of the wind power. Figure 1(a) shows the daily wind power output of two different days (Day-30 and Day-60) and their respective Lorenz curve is shown in Figure 1(b). These two representative days show the diurnal and seasonal variability of wind power. It is easy to visualize the variability of the wind power output in Figure 1(a) and this variability can be quantified using the Lorenz curve shown in Figure 1(b).




*(a)*




*(b)*

*Figure 1: (a) The wind power output of two days (Day-30 and Day-60) (b) The Lorenz curve of power variability of wind power plant for two different days (Day-30 and Day-60)*

For day-30, the value of the model parameters $m$ and $n$ are 0.83 and 1.67. Hence using[4], the Lorenz curve of the wind power output can be represented as $\eta = 0.17\,\pi + 0.83\,\pi^{1.67}$. Putting $\pi = 0.6$, we get $\eta \approx 0.46$. Hence we can state that wind power output was less than 46% of the maximum power output for 60% of the day-30. Similarly for day-60, $m$=1.00 and $n = 2.23$ which produce the Lorenz curve $\eta = \pi^{2.23}$. For $\pi = 0.6$, we get $\eta \approx 0.32$; hence we can state that for 60% of day-60, the wind power output was less than 32% of its maximum power output. The Gini coefficient of respective days can be calculated using[9] and shown in Figure 1(b). Without giving complicated distribution related to the variability of power, a statement such as "in 60% of operation time the wind power output is less than 46% (for day-30) and 32% (for day-60) of the maximum power" is simple quantification of power output variability which is helpful to system operators, policy makers and other stakeholders.

## 4. Discussions

The maximum power ($P_{max}$), minimum power ($P_{min}$), average power ($\mu_P$) and the standard deviation of ($\sigma_P$) of the wind power output of each month are shown in Figure 2. For simplicity in data visualization, we have considered the monthly average of wind power output and analyzed the monthly variability of wind power output. As shown in Table I, the $m$ and $n$ values for different months are calculated using[7] and[8]. Without considering all data points, the percentage share of power output less than 20% and more than 20% are considered to estimate the values. Using the $m$ and $n$ values the Lorenz curve[4] is used to estimate the values of $\eta(0.2)$ and $\eta(0.8)$ of each month. Here $\eta(0.8)$ of a month represents that the wind power output is less than $100\eta(0.8)$ % of maximum power output for 80% of plant operation time. Similarly, $\eta(0.5)$ of a month represents that the wind power output is less than $100\eta(0.5)$ % of maximum power output for 50% of plant operation time.

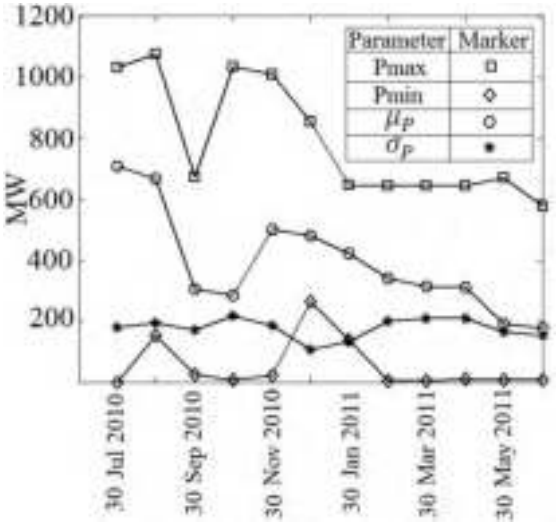



*Figure 2: The maximum power ($P_{max}$), minimum power ($P_{min}$), average ($\mu_P$) and the standard deviation ($\sigma_P$) of the wind power output of different months.*

*Table I: Values of model parameters m and n for different months and respective Gini coefficient value of wind power output for the state of Karnataka, India for the period from July, 2010 to June, 2011*

| Month | *m* | *n* | *g* | $\eta$ (0.2) | $\eta$ (0.8) |
|---|---|---|---|---|---|
| Jul,10 | 0.64 | 1.55 | 0.1380 | 0.3986 | 0.7409 |
| Aug,10 | 0.65 | 1.65 | 0.1594 | 0.3821 | 0.7298 |
| Sep,10 | 0.90 | 2.03 | 0.3059 | 0.2704 | 0.6522 |
| Oct,10 | 0.68 | 3.53 | 0.3798 | 0.2189 | 0.5653 |
| Nov,10 | 0.76 | 1.72 | 0.2012 | 0.3507 | 0.7098 |
| Dec,10 | 0.26 | 2.72 | 0.1202 | 0.4095 | 0.7337 |
| Jan,11 | 0.59 | 1.86 | 0.1774 | 0.3675 | 0.7176 |
| Feb,11 | 1.00 | 1.99 | 0.3311 | 0.2517 | 0.6414 |
| Mar,11 | 0.96 | 2.27 | 0.3728 | 0.2190 | 0.6105 |
| Apr,11 | 0.95 | 2.32 | 0.3777 | 0.2153 | 0.6061 |
| May,11 | 0.82 | 3.17 | 0.4267 | 0.1811 | 0.5482 |
| Jun,11 | 0.82 | 3.26 | 0.4350 | 0.1756 | 0.5402 |

Using Table I, we can state that in July 2010, the wind power output was less than 74% of maximum power output for 80% of plant operation time ($\eta(0.8) \approx 0.74$). Similarly, for 50% of plant operation time in July 2010, the power output was less than 40% of maximum power ($\eta(0.5) \approx 0.40$). Though the Lorenz curve based approach does not consider the meteorological information and other information related to stochastic variation of wind speed and direction, the quantification of power variability using distribution inequality shows a simple representation of power irregularity useful for techno-economic assessment.

As shown in Table I, when the value of $\eta(0.8)$ and $\eta(0.2)$ is low (high) the Gini co-efficient (***g***) is high (low). As shown in Table I, the Gini co-efficient value for different months lies between 0.12 (for month December 2010) and 0.435 (for month June, 2011) and gives a good measure to quantify the irregularity of the wind power output.

## 5. Conclusion

This article introduces the Lorenz curve based method to quantify the variability of wind power output. The Gini co-efficient based on Lorenz curve is traditionally used to measure the inequality of income distribution and in this paper it is shown that this co-efficient value can be a good measure to estimate the irregularity of the wind power output for techno-economic and policy perspective. The Lorenz curve and Gini co-efficient can be a measure of power fluctuation and can be used to model and optimize the irregularity of load and generation of utility scale grid connected wind power.

## Appendix

*Lorenz Curve and derivation of Eq. (2)*

The mathematical description of Lorenz curve and Gini coefficient is available at[1,7,8]. If ***f(x)*** be the income distribution where $X_{min} \leq x \leq X_{max}$, ***f(x)dx*** represents the number of persons having income in the set [***x***, ***x+dx***]. Considering $\pi(X)$ as the proportion of units that receive an income up to ***X***,

$$\pi(X) = \int_{X_{min}}^{X} f(x)dx \qquad (A.1)$$

If $\eta(X)$ is the proportion of the total income received by the same unit,

$$\eta(X) = \frac{\int_{X_{min}}^{X} xf(x)dx}{\int_{X_{min}}^{X_{max}} xf(x)dx} \qquad (A.2)$$

Here ***f(x)*** is a probability measure of the income distribution; hence the average value can be represented as,

$$X_{avg} = \int_{X_{min}}^{X_{max}} xf(x)dx \qquad (A.3)$$

Using (A.3),(A.2) transforms into

$$\eta(X) = \frac{1}{X_{avg}} \int_{X_{min}}^{X} xf(x)dx \qquad (A.4)$$

The curve $\eta = \eta(\pi)$ represents the Lorenz curve of the distribution (see Fig. A1). Differentiating (A.1) we get

$$\frac{d\pi(X)}{dX} = f(X) \qquad (A.5)$$

Replacing ***f(x)*** of (A.5) in (A.4),

$$\eta(X) = \frac{1}{X_{avg}} \int_{X_{min}}^{X} x \left\{\frac{d\pi(x)}{dx}\right\} dx \qquad (A.6)$$

*Gini coefficient and derivation of Eq. (3)*

The Gini coefficient is defined as the ratio of the area under the curve $\eta = \pi$ and the area between the curve $\eta = \eta(\pi)$ and $\eta = \pi$. Using Fig. A1, the Gini coefficient can be represented as

$$g = \frac{A}{A+B} \qquad (A.7)$$

Here A+B = area of the triangle = ½ (A.8)

And

$$A = \frac{1}{2} - B = \frac{1}{2} - \int_0^1 \eta(\pi)\mathrm{d}\pi \qquad (A.9)$$

Putting the value of A and B in (A.7)

$$g = 1 - 2\int_0^1 \eta(\pi)\mathrm{d}\pi \qquad (A.10)$$

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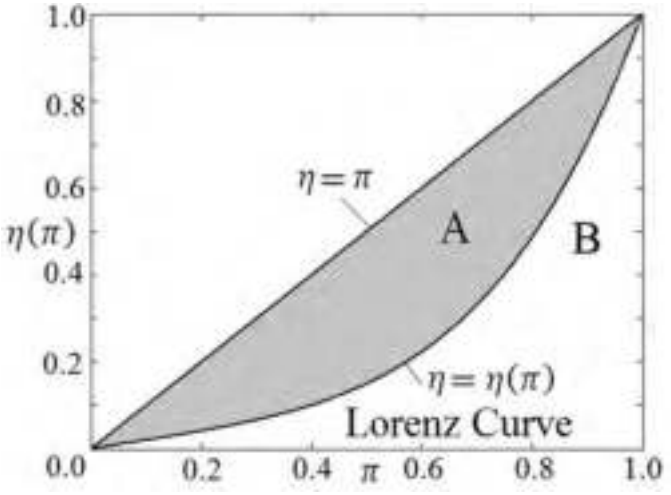


*Figure A1: Lorenz Curve*

## References


1. Abhik Kumar Das, "Quantifying photovoltaic power variability using Lorenz curve", Journal of Renewable and Sustainable Energy vol. 6(3), 2014
2. Gastwirth, J. L. and M. Glauberman, "On the Interpolation of the Lorenz Curve and Gini Index from Grouped Data". Econometrica vol. 44, pp. 479–483, 1976.
3. Kakwani and Podder, "Efficient Estimation of the Lorenz Curves and the Associated Inequality Measures from Grouped Data". Econometrica vol. 44, pp. 137–148, 1976.
4. Rasche, R. H. et al. "Functional Forms for Estimating the Lorenz Curve", Econometrica 48, pp. 1061–1062, 1980.
5. Abhik Kumar Das & Jai Asundi , "Using the Gini Index to Measure the Inequality in Infrastructure Services Provided within an UrbanRegion", , Int. J. of Critical Infrastructures, Vol.8, No.2/3, pp.178–186, 2012
6. Mathew, S., Philip, G.S.: Advances in Wind Energy Conversion Technology. Springer, New York (2011)
7. Dorfman, Robert (1979). "A Formula for the Gini Coefficient," Review of Economics and Statistics, 61, 146–149
8. Papoulis A., Pillai S. Unnikrishna. "Probability, Random Variables and Stochastic Processes", Mc Graw Hill, 2002


## Snippets on Wind Power

### PM Discusses Wind Energy Sector with Vestas CEO

Prime Minister Shri Narendra Modi has interacted with Mr. Henrik Anderson, President and CEO, Vestas on the issues related to the wind energy sector and highlighted India's efforts to harness renewable energy. "Had an insightful interaction with Mr. Henrik Andersen, President and CEO, @ Vestas. We discussed a series of issues relating to the wind energy sector. Highlighted some of India's efforts to harness renewable energy in order to build a cleaner future for the coming generations," PM Modi tweeted on 13th October 2020. "Great talk with Hon'ble PM @narendramodi on innovative ideas that can push the envelope in the #energytransition. Very insightful and we are very much looking forward to a continued collaboration and increased footprint in India", Anderson said in a tweet.

*Source: IANS, October 07, 2020*

### GE Renewable Energy to install 121 Turbine Sets for SB Energy in MP

GE Renewable Energy has said on 16th October 2020 that it will supply, install and commission 121 sets of its 2.7-132 onshore wind turbines, cumulating 327 MW to be installed at Pritam Nagar wind farm in Madhya Pradesh for SB Energy (SoftBank Group), which has bagged the bid in tranche-VI auction of wind projects by Solar Energy Corporation of India (SECI). The blades for the project have been manufactured at its plants in Vadodara and Bengaluru, and assembled at the company's multi-modal manufacturing facility in Pune.

*Source: PTI, October 16, 2020*

### Power Regulator Wants Government Not to Infringe Regulatory Jurisdiction

Power regulator Central Electricity Regulatory Commission (CERC) has advised the Union Ministry of Power against jurisdictional overreach in framing regulations for the power sector that infringes the substantive functions of the Central Commission. The regulator has issued an advisory over the draft rules proposed by the ministry, asking the government to work in harmony by honouring the respective jurisdiction carved out in the Electricity Act 2003. The CERC also said that several of the issues contained in the draft regulations fall under the purview of the states and the power ministry should first consult with the state governments before framing rules.

*Source: IANS, October 18, 2020*

# Digitalization of the Wind Farms

**Dr. Shambhu Ratan Awasthi,** Professor
Rabindranath Tagore University, Bhopal

The wind energy has experienced a significant growth over the past few decades i.e. from 6.1 GW of global cumulative installed wind power capacity in 1996 to 651 GW by 2019[1]. The wind energy plays an important role in the fight against climate change by minimizing the dependence on fossil fuel based energy. Wind resource has great potential and only a small part of that could be converted into other forms of usable energy.

There is an urgent need of very rapid growth in eco-friendly and renewable wind energy which is hampered due to high energy cost, low Tariff, expensive and cumbersome maintenance due to large turbine size, ever increasing hub height, low availability in case of forced or maintenance shutdown, etc. resulting in low capacity utilization. In this scenario, digitalization of wind farms can play a significant role by boosting annual energy yield at a lower cost due to increased uptime. The paper discusses digitalization process and issues related to wind farms.

## Introduction

The wind energy sector has transformed from a nascent state in its early days in the 70s to a giant industry. It is seen from Figure 1 that installed wind power capacity in Europe in wind grew from the 6th position in 2005 to the 2nd position in 2017. In a span of 12 years it has overtaken fuel oil, nuclear, hydro and coal. Now it is next only to the gas-based installed power capacity.

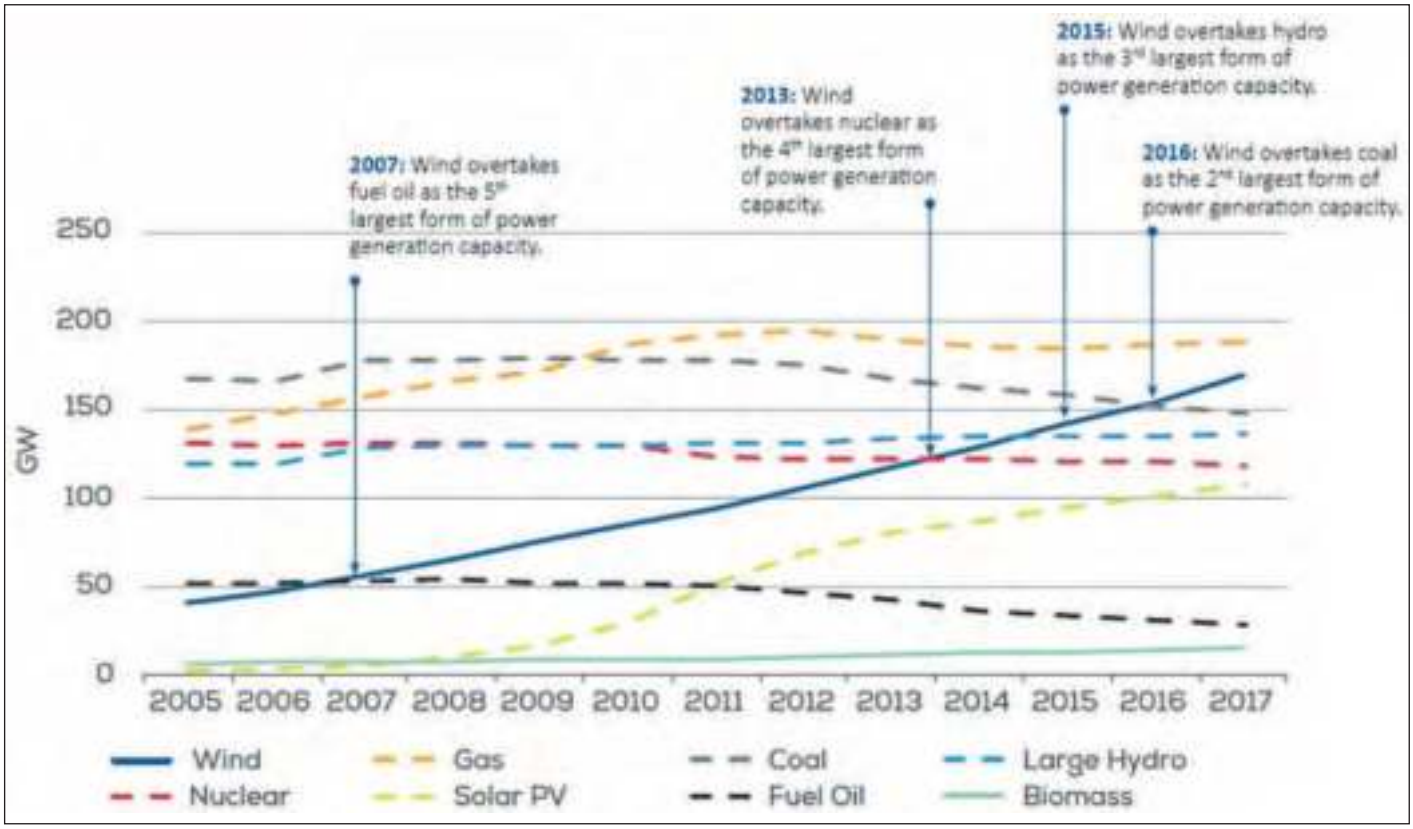


*Figure 1: Cumulative Power Capacity in the European Union 2005-2017[2]*

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The question arises whether the installed wind power capacity has reached its apex. Even with all this growth, very little of its full potential has been exploited. The cost of onshore wind energy in general and offshore in particular can be made more competitive by reducing the downtime during the maintenance to enhance availability and profitability.

The wind farms are mostly located in difficult places like mountainous regions or offshore to capture the favourable wind resource. It becomes difficult to deploy logistic support to these sites. The solution lies in the digitalization of the wind industry. The remote support services based on digital technology can play an important role in increasing the turbine uptime and availability.

## Digitization and Digitalization

Digitization is the conversion of data, documents and processes from analog to digital. For example scanning a photograph to create a digital file, converting MS Word file into PDF, converting physical sound into a digital file, etc.

Digitalization goes beyond digitization. Digitalization is the process of transforming into a digital business. It leverages digital technology to transform business' processes viz. evaluation, reengineering and reimagination.

Thus, a document is digitized whereas a power plant or a factory is digitalized i.e. a transformation by establishing trends and taking business decisions.

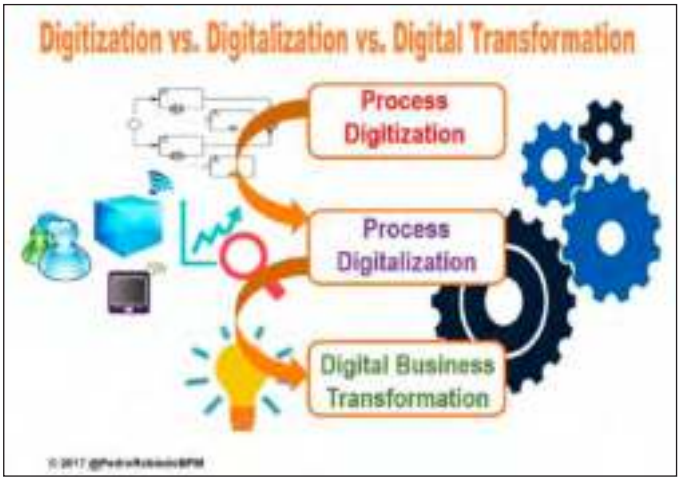


*Figure 2: Stages of Digital Transformation*[3]

## Advantages of Digitalization

In the context of a wind farm, digitalization leads to the following advantages.

I. Loss of generation due to the unplanned downtimes could be reduced by anticipating degradation and failures and taking proactive actions. It could be critical if the failure occurs during a period of rough weather when logistical support may not be available or accessible.

II. Predictions based on analysis of data pertaining to vital parameters, such as temperature, vibrations, etc. provide time to plan minor repairs before they become major problems leading to forced shutdowns.

III. Replacing a routine preventive maintenance by a condition monitoring strategy based maintenance to reduce costs, risks and to increase availability.

IV. The system becomes more observable and controllable which enhances its performance by maximizing the energy yield of entire wind farm instead of each wind turbine in isolation.

V. Similarly, wind power plants are able to support the grid by maintaining frequency and voltage as per the National Grid Code, as well as their ability to operate in stand-alone mode.

VI. Digital Twin models based on enhanced predictive analytics and machine learning techniques allow the operators to make financial gains by adding value to the wind energy and power trading through data-driven strategies.

VII. The productivity of skill based workforce improves by rescheduling resources around specific actions that need to be taken based on the priority set as per criticality.

VIII. The need of maintenance will be minimized which will reduce the health hazard to the employees and also improve their availability.

IX. Stock level of various spare parts requirements planned on the basis of failure rates, logistical constraints and associated costs will be logical and reduce the cost.

In the modern wind farms, most of the electronic circuits, processors work on digital signals and the cost involved in their digitalization should be affordable keeping in view the associated benefits. The process of digitalization has already started in Indian power sector including power grid. The Indian wind farm owners can take advantage of above benefits to the extent possible.

The capacity of the wind turbines is increasing which means that fewer turbines are needed to generate the same amount of energy. In such a scenario, the reliability and availability of wind turbines become significant because operation and maintenance (O&M) can be extensive and costly, particularly in offshore. Further, if the component fails during adverse weather conditions, the project site may not be accessible. Similarly, the non-availability of proper vessels at a specific time may result in long downtimes, thus reducing the power generation and consequential loss of revenues and profitability. The wind power has not yet become fully grid friendly at all the places.

Modern wind farms generate huge data through large number of sensors. However, this data is hardly used or analyzed until a failure takes place. The use of new sensing and condition monitoring techniques, the Internet of Things (IoT) and analysis of Big Data can contribute in enhancing the life and efficiency of the wind turbines and reduction in maintenance cost.

## Digitalization of Wind Farms

As the wind turbine technology evolves to become more sophisticated, the wind industry can learn to adapt their operations accordingly. For example, with the recent bandwidth up-gradation from 4G to 5G, offshore wind turbines are in a position to communicate much faster with asset owners at any place.


*Figure 3: Digitalization of Wind Farm[4] (Courtesy: GE)*

The cloud offers a safer space to store voluminous data, the wind industry can take advantage of this to allow turbines to store more analytics than ever before. More data base makes it possible to go for in-depth analysis but it becomes necessary to properly interpret to get further insight into the health of the turbine. Artificial Intelligence (AI) may be used to assist in interpretation of data.

The use of drone is also a possibility with the wind industry. The photographs can be taken remotely by a drone which can then be stitched by cloud computing before finally passing them over to an AI system to identify any problems (i.e. cracks in the blades, etc.) and formulate the maintenance plan in order to avert any mishap by timely actions.

## Initiatives to Digitalize Wind Farms

The Digital Wind Farm starts with the digital twin, a cloud-based model of a wind farm. With digital twin technology, engineers can mix and match up to 20 different turbine configurations to ensure that the best wind turbines are offered to suit the specific wind farm site. Once the wind turbine is installed, the digital twin model can start collecting and analyzing data, and providing solutions to make the turbine more efficient. Important players in wind turbine sector, such as General Electric (GE), Siemens, Vestas, Nordex, among others are investing to digitalize their core business.

General Electric (GE) was the first to realize the potential of internet and emerged as pioneer to lead the wind energy transformation into digital by developing digital twin software. In 2015, GE launched the world's first Digital Wind[5]. It is comprehensive hardware and software solution build on the Predix cloud-based platform, which allows wind farm operators to connect, monitor, predict and optimize wind turbine and wind farm performance.

The Digital Wind Farm consists of two key parts viz. a 2 MW wind turbine and wind power software that can monitor and optimize the turbine as it runs and generates energy. GE installed in 4,000 digital units which resulted in improvement in turbine efficiency up to 5% which translates to hike in profitability up to 20% and could help generate up to an estimated $50 billion of value for the wind industry[5].

Vestas, Denmark is digitalizing its business by acquiring Utopus Insights, a leading energy analytics and digital solutions company. It will have a greater predictability of the system allowing a better asset management and cost reductions.

Digital solutions have also arrived to the North Cape, in Norway at Arctic Wind, the Finnish wind farm operator. It has developed a digital wind farm to remotely keep track of the health of turbines to make it cost-effective. For instance, a virtual replica of Havøygavlen in Norway, the most northerly wind farm of the world, has been built to cope-up with the difficult and costly maintenance tasks under extreme weather conditions with temperatures of say -25°C along with the months of pitch darkness which makes the logistics a nightmare of transporting crews and other resources. The wear and tear on materials is much more under extreme weather conditions. Cracks in the structure of a turbine blade may result in catastrophic damages. That is why the identification and prediction of structural failure are critical aspects of wind farm operations. The structural monitoring requirements are met by cloud solution for digital inspections. With this tool, a digital representation of Arctic Wind's physical system is created. Real-time data from sensors continuously reflects and represents the physical reality, replacing the need for physical inspections with digital inspections of the turbines. The complex forces including cyclic loadings are considered to detect instantaneous impacts and long-term effects of cyclic loads. Thus, self-diagnosing, self-repairing and self-regulating features result in higher efficiency, improved safety, less downtime and lower costs.


*Figure 4: Wind Farm Digital Twin Project[6] (Courtesy: GE)*

ABB is bringing digital technology to wind turbines with ABB ability remote support services for wind farm operators. This increases turbine uptime, lowers operation and maintenance (O&M) costs and reduces the cost of energy. ABB is going ahead with the digital transformation of the electrical drivetrain comprising of generator, converter and transformer. The data is acquired from the converter's control system as well as sensors mounted on generator and transformer with sampling at millisecond intervals. The internet transmits data to a secure cloud platform for storing and processing in real time using algorithms and analytics. The combination of cloud computing and machine learning results in maintenance plan to attend the defective parts of the generating system with minimum downtime and adequate safety.

## Digitalization of Smart Grid

The 'grid' is a network of transmission lines, transformers and substations that deliver electricity to the customer from its source, say a wind farm. It must evolve further to become digital. As the level of wind power penetration into the utility networks increases, more restrictive grid codes are to be complied by modern wind power projects for power transmission in order to ensure stable and secure operation of a power system. Thus, wind power projects must be able not only to generate active power but also to provide fault ride-through capability, frequency support and voltage regulation similar to the conventional power plants equipped with the synchronous generators.

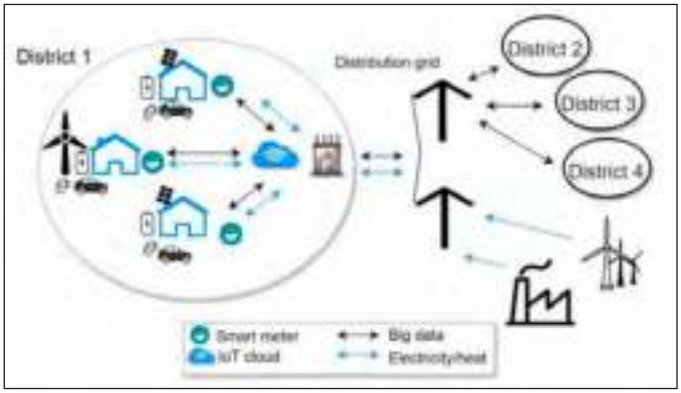


*Figure 5: Digitalization of Smart Grid[7]*

In essence, the smart grid is a digital technology that enables communication between the utility and customer. It consists of a series of computers, automated process and new technologies working together to create a responsive grid. For example, if there is an emergency such as a blackout, the smart grid technologies can detect this and isolate the fault.

The smart grid has the ability to predict demand and coordinate storage at multiple levels. It could be used to tell the turbines in a wind farm when to operate; dependent on what the demand for energy is, meaning energy usage becomes much more efficient and cost-effective.

## Job Opportunity

With the latest innovations and digital transformations, the analytics has become more accessible and comprehensive, and easier to interpret. It enables the wind farms, to leverage a more cost-effective operation that realises increased power output. But what does this mean for the engineers and technicians?

The cloud platform offers a safer space to store huge data. This opens-up more job opportunities for specialized engineers and skilled technicians to analyse and interpret the data. Artificial Intelligence (AI) may be used to assist in interpretation of data thus replace some manual workforce with a digitalised process.

The use of drone is also another possibility for remote photography of the wind farm which can be given proper shape by cloud computing for interpretation and identification of problems by AI. It helps to pin point the specific maintenance actions.

In view of above, the demand of engineers with technical skills in the areas of mechanical, electrical and control & instrumentation, blade and turbine technicians will increase to support digitalization. Obviously, the skills in the specific areas described above and a reasonable knowledge/experience in wind energy sector will be the prerequisites to qualify.

## Conclusion

The necessity and advantages of wind power digitalization can be understood by visualisation of the formation of wind farm. The wind farms are mostly located on hills/forests where deployment of logistics becomes more challenging during extreme weather condition. Further, the hub heights of 100 m or even more is quite common in modern wind turbines. One can just imagine the time to get details of fault of one wind turbine and similar data of other turbines and send the same to the head quarters. All this will be eliminated by digitalizing the wind farm which will also avoid human errors and provide accurate data. This is the prime reason to go for digitalization. Further, as mentioned earlier, since digitisation has already been done, the next step of digitalization is possible in a short time at an affordable cost.

Higher turbine uptime will become extremely important in future in higher turbine ratings, particularly in offshore wind turbines. It means that wind farms will use fewer turbines to generate the same energy. Reliability and availability of turbines are affected by forced shutdowns hampering the power generation which results in loss of revenue and profitability. Furthermore, the giant turbines are installed offshore, making maintenance extremely challenging and at prohibitive cost. Digitalization with the use of cloud computing, artificial intelligence and drone photography in conjunction with condition based monitoring facilitates dependable predictability which decreases maintenance cost and down time, pushes-up availability and energy yield.

However, the digitalized world also has some built-in risks. The threat of cyber-attacks or concerns on intellectual property rights, and data privacy are very sensitive and challenging. These days, Digital Twin, Big Data, Cloud Computing, IoT, AI, Robotics, etc. are trending topics in wind energy. The wind energy sector still has a long way to go to fully digitalize but with the small moves here and there, the journey has begun.

## References


1. Global Wind Report. 2019. Global Wind Energy Council, https://gwec.net/global-wind-report-2019/
2. Mikel De Prada. 2018. The Wind is blowing towards a Digital Future, incite, http://www.incite-itn.eu/blog/the-wind-is-blowing-towards-a-digital-future/
3. Pedro Robledo. 2017. Process Digitalization in Digital Transformation, https://medium.com/ @ pedrorobledobpm/process-digitalization-in-digital-transformation-8998477c97cc
4. Digital Twins – Rise of the Digital Twin in Industrial IoT and Industry 4.0, i-scoop, https://www.i-scoop.eu/internet-of-things-guide/industrial-internet-things-iiot-saving-costs-innovation/digital-twins/
5. GE Launches the Next Evolution of Wind Energy Making Renewables More Efficient, Economic: the Digital Wind Farm, https://www.ge.com/news/press-releases/ge-launches-next-evolution-wind- energy-making-renewables-more-efficient-economic.
6. Digital Solutions for Wind Farms, GE Renewable Energy, https://www.ge.com/renewableenergy/wind-energy/onshore-wind/digital-wind-farm
7. Statkraft Summer Project. 2017. Digitalization in the Energy Industry, https://statkraftsummerproject.wordpress.com/2017/08/07/digitalization-in-the-energy-industry/

# Round the Clock Tenders and its Significance in Renewable Energy Development

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## Context

India is a country which is moving rapidly towards a prospective future in various sectors be it power, oil and gas, automobile or pharma, etc. In the past five years, India has shown its huge potential growth in the power sector. The era where every state was facing peak deficit situation and poor network infrastructure is no more the case; rather, the situation is vice-versa. India's strong commitment to consistently adding green power in its total energy mix has motivated many investors across the globe to invest in green infrastructure projects.

While being specific with renewable energy (RE) sector per se, the previous years have been most crucial for every stakeholder in the entire power sector from policy makers to implementing agencies to RE developers and end beneficiaries such as distribution companies (DISCOMs). With just merely 20 GW solar addition under National Solar Mission by 2022, the targets were revised to 175 GW. This is a major step towards India's commitment under the Paris Agreement of creating additional 'carbon sink' of 2.5 to 3.0 Billion Tonnes of $CO_2$ by 2030. India has witnessed one of the aggressive wind and solar capacity addition bringing the present overall share ~19% of the entire energy mix u/s 63 of the Electricity Act, 2003, which was ~9% in 2014.

The RE sector comprises of various types of bidding guidelines with different themes such as ultra-mega solar park to large scale wind parks to wind-solar hybrid projects, where Solar Energy Corporation of India's (SECI's) role has been most crucial in not only conducting all such successful competitive bidding but also in witnessing the most competitive rates in both wind and solar Inter State Transmission System (ISTS) connected projects. Keeping an ambition of achieving the most aggressive target of 175 GW and achievement of actual physical capacity additions with all possible motivation to investors across the globe is not an easy task. This depends not only on successful bids but also depends on the awarded project execution and achieving the target Commercial Operation Date (CoD) as per the bidding guidelines and its offtake.

Even with all efforts and mandatory norms for the procurement of RE power under Renewable Purchase Obligation (RPO), the intermittent nature of both wind and solar and lower utilization factor have made it difficult for the buyers to get convinced about such sources as their preferred option and to build a generous share of RE in their energy portfolio. While on one side, RE targets and favorable policy provisions are aiming to achieve desired RE capacity addition, the question arises as to whether we are planning it right to increase the acceptance of variable RE to ensure maximum utilization and off-take.

## Why RTC?

It is evident that, due to the surplus power scenario, most of the conventional generator sources who are not even in the mid of completing their life are stranded due to higher variable cost. Most of the states avoid adding any new conventional capacities at least for the next 10 years. Thus, the situation becomes contradictory where the state utilities who want a steady source of round the clock (RTC) power are not comfortable in procuring intermittent power knowing the fact that, the share of RE will be more in near future and thus procuring green attributes for fulfilling their RPO target will not suffice.

SECI being an implementing agency on the ground along with the policymakers have closely monitored such market dynamics and consistently made improvements in their tenders and came up with the first-ever RE tender for 1,200 MW ISTS-connected RE projects with assured peak power supply in India followed by 400 MW RTC - I tender which is purely based on providing the Round the Clock (RTC) power through RE generating sources as well as storage as an option.

The participants in 1,200 MW Bid include Greenko, ReNew Power and HES Infra with a total tendered capacity of 1,620 MW. Post E-Reverse Auction, Greenko bagged 900 MW with pumped storage for INR 4.04/kilowatt-hour (kWh) and Renew Power bagged 300 MW with battery energy storage for INR 4.30/kWh. The outcome of the tender is shown in Table 1.

| Sr. No. | Participants | Tendered Capacity (MW) |
|---|---|---|
| 1 | Greenko Energies Private Limited | 900 |
| 2 | HES Infra Private Limited | 120 |
| 3 | ReNew Solar Power Private Limited | 600 |

*Table 1: Participants and their Tendered Capacity*

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- Reduce operating and maintenance costs
- Reduce lubricant consumption
- Minimize environmental impact
- Reduce energy losses
- Decrease warranty claims
- Reduce time to market
- Customize solutions

For these and more solutions, visit www.skf.com/wind
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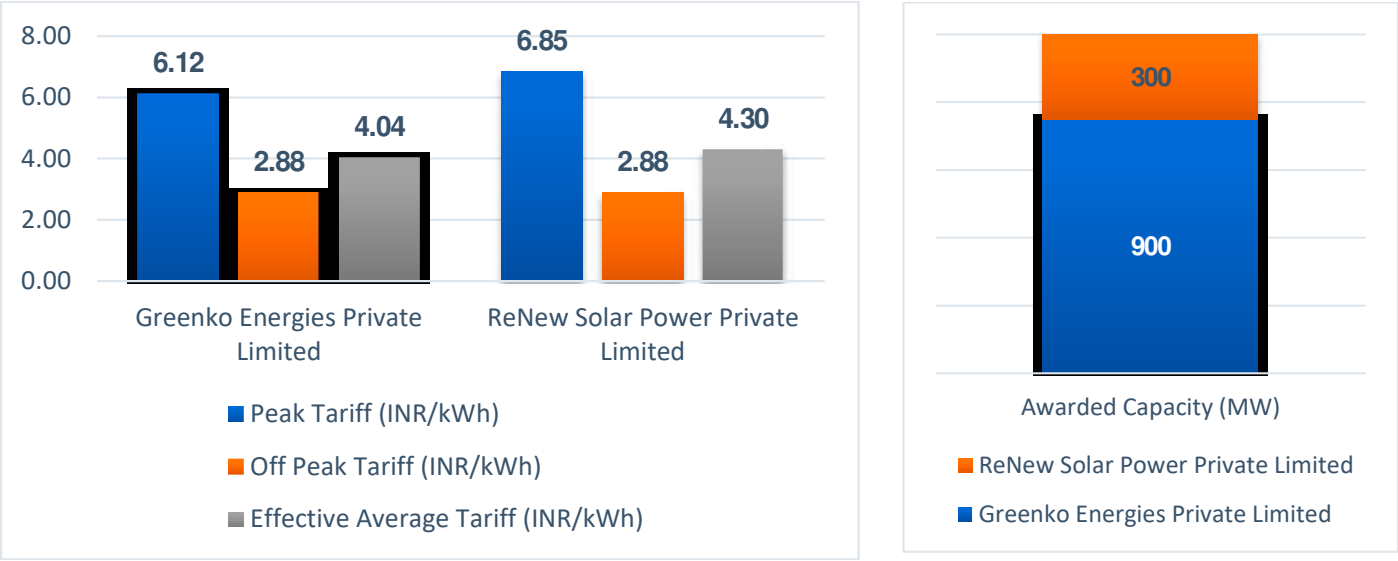


**Data Source: SECI-ISTS-RE-with-Peak-Power-1200-MW-ISTS-VII-Result-Web-Upload

*Figure 1: Result of E-Reverse Auction (Tariff and Capacity)*

The participants in 400 MW – RTC - I Bid include ReNew Power, Greenko, HES Infra and Ayana Renewable with a total tendered capacity of 950 MW. Post E-Reverse Auction ReNew Power bagged 400 MW with a tariff of INR 2.90/kWh. The tariff will increase by 3% per year for the first 15 years of the 25-year power supply. The outcome is shown in Tables 2 and 3.

| Sr. No. | Participants | Tendered Capacity (MW) |
|---|---|---|
| 1 | ReNew Solar Power Private Limited | 400 |
| 2 | Greenko Energies Private Limited | 400 |
| 3 | HES Infra Private Limited | 100 |
| 4 | Ayana Renewable Power Private Limited | 50 |

*Table 2: Participants and their Tendered Capacity*

| Bidder's Name | Awarded Quantity (MW) | Tariff (INR/kWh) |
|---|---|---|
| ReNew Solar Power Private Limited | 400 | 2.90 |

**Data Source: SECI-400 MW-RTC-I-Result-Web-Upload

*Table 3: Result of E-Reverse Auction*

The recently floated 5,000 MW RTC–II tender of bundled RE power with thermal generating sources have been unique and practical bid while changing the mindsets of the procurers that RE can also be utilized as RTC power. The entire transition of evolving this idea was based on the stakeholder's response in the previous two RTC bids by SECI and yet it is still at an experimental stage. The key features of the latest 5,000 MW tender include:

- To have energy terms on annual basis.
- To have 51% RE.
- Bidder should guarantee the availability of 85% of the power to be on annual basis.
- Off-peak period and peak period is similar to thermal power. However, they should be defined by the concerned Regional Load Despatch Centre (RLDC) where the end procurer is located.

The evolution of the RTC concept over three bids is illustrated in Table 4.

| Parameters | 1,200 MW Bid | 400 MW Bid | 5,000 MW Bid |
|---|---|---|---|
| **Tariff Structure** | Fixed Tariff | Escalating Tariff | Fixed & Escalating Component of Tariff |
| **Location Specified** | Co-Located | No Location Constraint | within RLDC Location Connected With Multiple CTUs |
| **Technology Mix** | RE + Storage Mandatory | RE Component + Storage (Optional) | RE + Thermal Component + Storage (Optional) |
| **Power Supply Profile** | **85%** of Peak Power Availability on a Monthly Basis | **80%** Annual Availability and 70% Monthly Availability | **80%** Annual Availability<br><br>Min. of 51% of Energy From RE Sources |

***Data Source: SECI Bids (Peak, RTC-I, RTC-II)

*Table 4: Key Specifications*

In the first bid, the developer shall supply energy during the peak hours with RE using storage. In the second bid, the developer shall use 100% RE supported by energy storage RTC system. The developer will have an option to build a hybrid plant with wind and hydropower or can have an energy storage system (could be battery-based or pump or any other available technology). In the latest bid, to address the challenges of intermittency and low capacity utilization, high cost based thermal power is allowed to bundle with cheaper RE to provide RTC to the DISCOMs.

This tender has opened up avenues for utilizing stranded thermal power plants which are in existence but stranded due to various reasons such as higher fuel cost, pending litigations before the authorities, higher variable cost due to additional installations such as Flue Gas Desulphurization (FGD) for the compliance of environmental norms, etc. While these bids are recognizing thermal power plants, it is also important to consider the gas-based generators who have faster ramping up/down rates as far as conventional based generators are concerned. Gas-based generators can play a better role in increasing the flexibility to the grid.

The increasing interest in the concept of bundling of RE generation with such steady generators for providing RTC services is mainly due to the dual benefit of a relatively cheaper power portfolio with reasonable firmness and assurance for DISCOMs. Besides, procurement under RTC route enable minimal curtailment of the power of the RE developers and also provides a sigh of relief to those generators who have tied up for long-term with DISCOMs, however, does not come under the Merit Order Despatch.

## Way Forward

It is evident from the present market scenario that, there shall be an increase in RE share in power portfolio. However, ensuring optimum utilization of RE generation is the key. RTC is one of the methods to address the intermittency of wind and solar-based generation. It is also a known fact that the steady conventional generators and their share in the energy mix will be required to serve the nation's baseload requirement. Thus, operating hand-in-hand with these steady generators under RTC procurement route will only accelerate the deployment of RE.

Dependence on the Green attributes would slowly get phased out and dependence on the actual RE power shall be the common practice. The time has come where there is a strong need to move from the experimental bidding to full-fledged bidding. Going forward, the RTC power concept should not just be limited to long-term Power Purchase Agreements (PPA's) but also should be brought in providing support in the ancillary service and reactive power market. To harness India's huge RE potential while reducing its carbon footprints is a long journey with many challenges. Promotion of concepts like that of RTC power based on bundled power sources shall play a significant and distinct role in India in achieving the RE capacity addition target.

# Regulatory Update on Wind Power

## Rajasthan Electricity Regulatory Commission RE Tariff Regulations 2020

Rajasthan Electricity Regulatory Commission has issued its RERC RE Tariff Regulations, 2020 on 2nd November 2020. The summary of the Regulations related to Wind energy are as follows.

1. Competitive Bidding for Wind Energy. Project specific tariff for below 25 MW projects.
2. Must Run Status for wind energy.
3. Determined the CUF as 21% for Jodhpur, Jaisalmer and Barmer and 20% for other districts.
4. Competitive bidding for Repowering projects too. For repowering-
   a. Minimum 10 years of operation.
   b. Existing PPA- last three year's generation prior to re-powering would continue to be procured on the terms of PPA in-force and remaining additional generation may be purchased by Discom a tariff discovered through competitive bidding.
5. For Wind Energy metering at Grid substations of licensees
   a. Losses of 1% for metering up to 33 kV.
   b. Losses of 2.5% for metering at 132 kV and above.
6. kVArh Charges- 15 paise per kVArh from April 1, 2020 with escalation of 0.50 paisa/KVArh.
7. Energy drawn shall be set off against energy sold on quarterly basis.
   a. Excess drawal will be carried forward on monthly basis and settled on quarterly basis at tariff applicable to a Large Industrial consumer.
   b. Where sale to Distribution Licensee is not being effected or where sale to distribution licensee is under REC mechanism, such drawal from the grid shall be billed at tariff for tariff HT -5 (temporary supply applicable to HT Industrial consumer).
8. For captive use both within the State or outside the State
   a. An exemption of 75% in Intra-State transmission charges and wheeling charges for the Renewable Energy with Storage projects commissioned before 31.03.2023 – Exemption is for first seven years.
   b. An exemption of 100% in Intra State transmission charges and wheeling charges for Solar Power Project for supplying power to Electric Vehicle charging stations either under Captive route or through open access-exemption shall be applicable for first ten years.
9. No Cross-Subsidy Surcharge and Additional Surcharge for Captive.
   a. Applicable on Supply of power to third party consumers.
10. Maximum permissible capacity of eligible individual new RE captive power plant installed behind the meter shall be limited to 100% of the Contract Demand.
11. The maximum permissible energy to be consumed and banked from RE captive generating plant is limited to the energy corresponding to the minimum CUF plus 5%.
12. Yearly Banking allowed only for captive users and not for Third party for new and existing customers.
    a. Enhanced the maximum ceiling of the banked energy to 25%.
    b. For existing users monthly banking facility is available.
    c. Banking Charges 10%.
13. Monthly Banking for Existing Renewable Energy based Captive Generating Stations
    a. Injected energy is more than the energy drawn - excess energy of each time block shall be cumulated till the end of the month and shall be set off against the cumulative drawal of Discom's energy in the same month except drawal during peak hours.
    b. Unutilized banked energy at the end of the month shall lapse.
    c. Banking charges @ 10% of banked energy.

Compiled by **Rishsbh Dhyani,** Kshema Power

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## Snippets on Wind Power

### Huge Renewable Energy" Deployment Plans for Next Decade: PM Modi

Speaking at the RE-Invest 2020 conference organised by Ministry of New and Renewable Energy Prime Minister Mr. Narendra Modi invited global investors to join India's renewable energy journey. The virtual conference was joined by the Prime Minister of Israel and Netherlands and Ministers from around the world. Mr. Modi said that there are huge renewable energy deployment plans for the next decade that are likely to generate business prospects of the order of around 1.5 lakh crore rupees or $20 billion per year. Renewable energy capacity will rise to 220 GW by 2022 from the current 136 GW, he added. Now, investments and scale are bringing costs down and we are expanding our generation capacity and network to ensure every citizen of India has access to electricity to unlock his full potential, he said.

Inviting the investors, developers and businesses to join India's renewable energy journey, Mr. Modi referred about various programmes and prospects like "One Sun, One World One Grid", India progressively becoming a preferred destination for investment in renewables, making India a global manufacturing hub in the renewable energy sector, very liberal foreign investment policy for renewables, focusing on innovative bids for supplying 24 by 7 power from renewables, Solar-wind hybrid projects, comprehensive National Hydrogen Energy Mission, ensuring "Ease of doing business", establishment of dedicated Project Development Cells and FDI cells in all Ministries to facilitate investors, etc.

### NTPC to Stop New Land Acquisition for Coal Based Projects

India's largest coal-fired power generator, NTPC Ltd, aims to transform itself into the country's biggest renewable energy producer and refrain from acquiring land for new thermal power projects. To optimize cost, bring synergy in operations, and to add renewables with a focused approach, company has taken the decision for the formation of a separate subsidiary company for carrying out renewable energy business. By 2022, it plans to set up 10 GW and by 2032 it plans to add 32 GW of renewable generation capacity to its portfolio through organic and inorganic routes.

*Source: Mercom India, Sep 25, 2020*

### IREDA Sanctions Loans worth Rs. 12,696 Crore in 2019-20

The Indian Renewable Energy Development Agency Ltd (IREDA) has sanctioned loans worth Rs. 12,696 Crores and has disbursed Rs. 8,785 Crores, supporting capacity addition of 5,673 MW during 2019-20.

*Source: PTI, November 12, 2020*

### Ministry of Power Signs Pact with Three State-Run Utilities for Augmenting Generation

The Government of India's Ministry of Power has signed a Memorandum of Understanding (MoU) with three state-run major power utilities: SJVN, NTPC, and Power Grid Corporation of India Ltd (PGCIL) to increase power generation and transmission capacity. As per the agreement, SJVN would generate 9,680 million units (MU) and NTPC 340 billion units (BU) of electricity in a year. The Power Grid Corporation of India (PGCIL) agreement is related to various parameters such as financial, physical and project execution.

*Source: Mercom India, Oct. 1, 2020*

### JSW Energy to Invest Rs. 9,000 Crore in Two Wind Power Projects in Karnataka

JSW Energy Limited has sought 3,150 acre of land from the Karnataka government to set up two wind energy power projects at an estimated investment of Rs. 8,860 crore to produce around 1,400 MW of captive wind power from plants cleared by Karnataka as part of its goal to reduce dependence on conventional sources of energy and carbon footprint. One project will be set up on 1,350 acres spread across Ballari and Davangere at a cost of Rs. 3,900 crore for 600 MW and the other project will be spread over 1,800 acres in Ballari, Dharwad, Gadag and Davangere at an investment of Rs. 4,900 crore to produce 800 MW wind power.

*Source: Mint, 12 Oct 2020,*

### India to Replace Coal Fired Power Plants with Renewables: R K Singh

India is planning to replace retiring coal-fired power plants with renewable generating capacity in a bid to cut the nation's carbon footprint, power Minister Mr. R. K. Singh said on 6th October. India is the world's second largest coal consumer after China, and the third largest emitter of greenhouse gases.

*Source: Reuters, October 07, 2020*

### India's Solar Power Tariffs Hit a New Record Low of Rs. 2 Per Unit

India's solar power tariffs hit a new record low of Rs. 2 per unit on 22nd November 2020 during a bid conducted by state run Solar Energy Corporation of India Ltd (SECI). Saudi Arabia' Aljomaih Energy and Water Company and Singapore headquartered Sembcorp's India arm' Green Infra placed the winning bids of Rs. 2 per kWh to win the contracts to build 200 MW and 400 MW of solar projects respectively. State run NTPC Ltd placed the second lowest winning bid of Rs. 2.01 per unit to secure the balance 470 MW capacity. The previously lowest recorded solar tariff in the country was of Rs. 2.36 per unit.

# Green Markets: Towards Achieving India's Green Ambitions and Facilitating Efficient Energy Integration

**Rohit Bajaj**
Head, Business Development
Indian Energy Exchange Limited

The Green Market is aimed towards building a vibrant pan India wide market in renewable energy. With benefits such as transparency, competitive prices, standardised contracts, flexibility and payment security that exchange markets offers, a robust green market can greatly facilitate India to meet its renewable energy targets and build a sustainable energy economy. The introduction of Green Markets will facilitate the obligated entities to meet their energy and RPO targets in an integrated way and also achieve RE integration in the most efficient way. The current COVID-19 pandemic is an unprecedented phenomenon which unfolds an opportunity to establish a new, consumer centric and forward-looking and sustainable energy order in the direction of building an 'Aatma Nirbhar Bharat'.

India is seeing a perceptible shift towards green energy, especially with the government's goal to increase renewable energy installed capacities to 175 GW by 2022 and around 450 GW by 2030. As of March 2020, India has installed renewable capacity base of about 87 GW and constitutes 24% of the total installed capacity of 370 GW. Solar and wind energy continue to be the two key contributors contributing about 77 GW and 89% of the total green capacity installed in the country. The launch of Green Markets at IEX platform has been a significant development which will play a key role in achieving India's renewable energy aspirations and facilitate effective and efficient integration of green energy in the energy mix. The new market segment provides pan India market access to the renewable generators to sell beyond their power purchase agreements and the OTC market and realize immediate payments. We will also see emergence of merchant green capacity over a period of time just as in the conventional power sector.

## Meeting the Ambitious Renewable Energy Targets

India has seen a very significant growth in installed renewable energy capacity over the last five years registering CAGR of 17.33% between FY2016–20. India's total solar power capacity alone has increased by more than 11 times since the last five years. From 2014 to June 2020, the solar power capacity of India has increased from 2.6 GW to 38 GW. There has also been a significant increase in the capacity for installed wind power plants. From 2.31 GW of wind power capacity in 2014-15, it has been increased to 37.66 GW of wind power capacity till 2019-20.

As per an IEEFA study, solar power tariffs now in India hover between Rs 2.50-2.87 per kWh which is 20-30% below the cost of existing thermal power in India. Recently, India's first tender for providing round the clock solar power discovered the lowest tariff of Rs 2.90 per unit in which the project developer will have the option of building a hybrid plant with wind and hydro power or have energy storage systems. With a decline in wind tariffs, wind power has also become competitive and cheaper than the thermal power which is much higher in current day supplies for various distribution companies.

To meet the country's ambitious renewable energy target of 450 GW by 2030 under Paris Climate Agreement in an agile and competitive way, we must now embrace a market approach and gradually move away from the structure of long-term power supply agreements where prices are, though competitive, but the long-term contracts bring their own rigidities into play. The markets can help meet ambitious targets and usher a new energy order in a competitive way and with much needed flexibility, payment security as well as customer choice. The green markets can be a great catalyst in energy shift by allowing buyers and sellers to procure green power on an immediate short-term basis for their energy requirement.

## Green Market is Now Live

The green term-ahead market was formally launched by Power Minister Shri R K Singh on September 01. The Indian Energy Exchange commenced trading in green contracts on August 21, 2020 at its platform. The market presently allows trade in intraday and day-ahead contingency contracts in both solar and non-solar category while the trading in daily and weekly contracts will commence shortly.

The market has witnessed an encouraging response since its launch and has traded total volumes of about 352.45 MU for Solar and 49.93 MU for Non-solar till November 21, 2020 at an average price of Rs. 3.46/unit for solar (Average of all trades) & Rs. 3.72/unit for Non Solar (Average of all trades) with a total of 36 participants.

## Merchant Green Capacity

Today, we have about 20 GW of merchant power capacity in conventional power sector who sell power on the Exchange market, however, about a decade back all capacities were tied

up in long-term PPAs and there was no merchant capacity. Similar experience can be replicated for renewable energy as well. The green market, over a period of time, will provide price signals and new avenues to renewable generators to install merchant capacity and sell power through the market. The green merchant generators can be catered to in a similar manner like the conventional power by making markets an attractive hub for open access consumers.

## Green Markets for Meeting RPO Targets

The green markets will facilitate the obligated entities such as distribution companies, industries, captive power producers and open access consumers to buy renewable energy at the most competitive rates as well as meeting RPO requirements. The renewable generators now have an additional avenue to sell power which has been till now largely been sold under long and medium-term contracts. The green markets beautifully supplement the presently available framework of RECs for meeting RPO compliance. As the regulators are being stringent with the obligated entities regarding fulfilment of their RPOs, they can now meet energy and compliance demand in an integrated way through market. Also, the RECs market is presently facing a sell-side constraint due to which many distribution utilities are unable to meet RPO even if they wish to do so.

The markets mechanism will facilitate RE surplus and deficit states to trade renewable energy and meet their RPO targets. It will facilitate short-term inter-state transactions in renewable energy and will also incentivise RE-rich states to develop capacities beyond their own obligation. These markets will lessen the burden on RE-rich state to absorb all their renewable power generated within the state and hence will also address the issue of them having to scale down their renewable capacities due to varied demand or sell their surplus renewable energy. Presently many RE-rich states sell their surplus renewable energy as conventional power which leads to losses for both the distribution utilities as well as the generators. With commencement of green markets, all such issues can get resolved to a large extent.

## Efficient Energy Integration

According to the global Renewable Energy Country Attractiveness index 2018 by EY, India's renewable energy sector is the fourth most attractive renewable energy market in the world. With the increasing penetration of renewable energy, a robust green market framework will address the intermittency issues linked with green power adoption. The distribution utilities and generation companies will benefit through flexibility to buy and sell in 15-minute contracts and for any duration through exchange. It would not only improve accessibility factor from the buyers' side but also provide a wider platform to sellers by enabling optimum demand-supply equilibrium at most competitive prices. The recently launched real time electricity market coupled with the green market will offer the distribution utilities to integrate renewable energy in the most efficient and integrated manner. The introduction of real-time market brings required flexibility in the market to provide real-time balancing which is so critical to ensure optimal utilization of the available resources. Going forward, the introduction of new green market segments such as the day-ahead market, long duration green contracts, Contract for Difference (CfD) etc. will play a crucial role in furthering sustainability goals and ensuring that all the renewable energy generated within the country is dispatched in a most efficient manner through a pan India vide Exchange based energy markets.

## Hybridisation and New Futuristic Market Models

The rapid growth of wind, solar and electric vehicles has shown the immense potential of new clean energy technologies that can be adopted to bring down emissions level. Calls to reduce global greenhouse gas emissions are growing louder every year and to avoid the worst consequences of climate change, the global energy system on the whole must rapidly reduce its emissions by undergoing a radical transformation in the way we supply, transform and use energy. The net-zero emissions will require the clean technologies to be deployed on a far greater scale, in tandem with the development and massive rollout of many other clean energy solutions in the future. Moving ahead, the 4Ds – decarbonisation, decentralisation, digitisation and decentralisation will be the four mega trends driving the energy sector globally. These trends will also drive the industry towards digitalization and intelligent systems. While markets are vital for energy transformation and catalysing innovation, they cannot deliver net-zero emissions on their own without the active support of government. Governments across the globe have an outsized role to play in supporting transitions towards net-zero emissions. Long-term vision needs to be backed up by detailed clean energy strategies to upgrade infrastructure that enables technology deployment at a large scale.

## Building India as a Sustainable Green Economy

We are expecting a significant rise in renewable energy's share in electricity generation to 86% by 2050 from about 28% in 2020 across the world. The covid-19 pandemic has resulted in a global economic meltdown and the need of the hour is a 'green' economic recovery. The growing focus and share of renewable energy underline the relevance and importance of the power markets more than ever before. As India aims to revive the country's industrial and economic growth and strives towards building an 'Aatma Nirbhar Bharat', it is an appropriate time to transition to an efficient power market model. Powered by technology driven solutions, and innovative products and services, a robust market framework has a pivotal role to play in shaping India's energy future. The green markets, thus, will be an enabler in our quest to build India as a sustainable energy economy.

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# Full Value Chain Approach for Wind Industry - Moving Towards Zero Surprise Failure

**Mahavir Ashok Kanwade**
Manager, Application Engineering – Energy & Defense
SKF India Limited, Pune

Wind Industry is changing & changing faster. We see significant growth in the market with increase in wind turbine installations around the globe. In the long run the wind energy will no longer be subsidized. Turbine designs are changing to meet the market trends and needs. Turbines are getting larger & different types of drivetrains are being introduced. The wind industry is under enormous pressure to reduce cost per MWh. This can be achieved by improving turbine designs, raising performance, increasing reliability – all while reducing maintenance costs.

Anything that prevents a service trip can boost return on investment and reduce the levelized cost of energy. We have spent many years working with leading OEMs to optimize turbine performance, reliability and energy output. The design and development of bearings, seals, condition monitoring systems and lubrication systems should enable more cost-effective wind energy generation and lower lubricant consumption.

Also, number of wind turbines which are in the field needs to be serviced sooner or later are also growing quickly. Some companies as a value chain partner has to cater to servicing needs of the wind industry which is aligned with a Full Value Chain approach which focuses on delivering value and unparalleled excellence to customer.

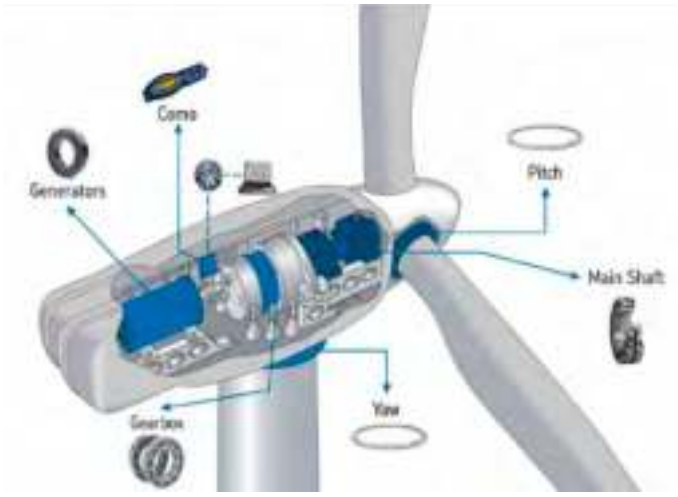


*Figure 1: The Nacelle*

## Full value Chain for OEMs

With current new normal & Industries are hit by Covid-19 pandemic situation, OEMs have hit hard by supply chain disruption and have direct impact on their business goals. Disrupted supply chains have strained project development timelines & project economics. Added to this are new changes in the policy that place restrictions on clearance of goods from certain referred countries in turbine assembly.

It has become imperative and even more relevant to have fully developed value chain in India for OEMs. With OEM's localization drive in mind value chain partner should be focused on delivering the localized products which will enable OEM customers to meet their demands for increased value chain available locally & driving the performance of their wind turbines with best solutions.

Wind industry in India is gearing up for the larger turbine sizes & industry moving towards 3MW+ turbines for Indian market & exports. Local manufacturer and value chain partner can help you achieve your business goals through their fully developed solutions for the Main shaft bearings, gearbox & pitch/yaw bearings from India.


*Figure 2: Different Types of Bearings used in Wind Turbines*

## Full Value Chain for Wind Operators

The cost of operations and maintenance of the wind turbines are vitally important and need to be optimized. Maintenance at wind farms is expensive, due to expensive crane mobilization cost and soaring costs per kWh. Component failures can lead to unplanned stoppages which lead to an additional cost of loss of energy production. Also, spare parts for wind turbines are sometimes difficult to source in a timely manner. That is why, establishment of condition monitoring program together with appropriate tools are needed to forecast such failures.

The business of a wind farm operator is to generate as much energy as possible with maximum efficiency. Replacing spare parts is vital to maintaining efficiency but an operator may not like to get involved in the minute details of this.

Instead, it makes sense to collaborate with a reliable partner – who has expertise in managing large volumes of spares. The partner should be a long standing supplier of consumables like bearings and should also offer training in spare part management and inventory optimization.

Ensuring spare availability is must to boost uptime and maximize profitability. It's important for wind farm owners and operators to find the right balance.

significance, and the likely frequency of replacement. Parts can be broadly classified into three groups, allowing operators to priorities based on their individual needs.

**Consumables:** The shortest-lived and least critical components – such as lubricants and rubber parts

**Operational:** Failure of one of these parts – such as a coupling – could have serious implications

**Insurance:** Machine-critical components like gearboxes are often expensive – and are not expected to fail frequently. If they do fail, it may cause a complete standstill.

## Recording of Inventory Correctly

Without an organized inventory, companies risk recording the same component under different names. For instance, a warehouse employee may use a different naming format to other staff. As duplicates add up over time, they become harder to track. So, it is vital to have a method that clearly identifies and manages spares. One solution is to use software that automatically identifies and names products based on their features.


*Figure 3: Some Enablers to Achieve the Full Value Chain Benefits*

## Key Factors in Spare Parts Management

The following key factors needs to be considered in spare parts management.

## Effective Maintenance Procedures

Having a clearly structured approach, such as condition-based maintenance, gives operators more transparency over the condition of equipment. This helps them predict more accurately when components need replacing. So, it is easier to order parts according to actual needs and avoid tying money up in spare parts with no plan in place.

## Evaluation of Part Requirements

Every spare part is different and has a different level of importance. It is vital to classify components according to their

## Managing Storage Facilities Correctly

Many parts need to be stored under certain conditions. For instance, perishable items, such as lubricants, must be protected against moisture. Failure to do this can cause parts to wear before they have been used. Also, as all stock must be insured, having too much leads to unnecessarily high costs. Operators could find themselves insuring components that they may never use.

## Unleashing the Potential of Data

Data plays a vital role in effective maintenance planning and spare parts management. Having a rough idea of a component's service life is not good enough. If guesswork is the norm, operators faced with unexpected breakdowns will not have the spare parts to resolve the issue.

Operators should have their own data, and many do, but service providers typically have more precise predictive capabilities. The technical expertise and unrivalled service capabilities of the value chain partner helps you provide accurate forecasts for component lifespan and allow for more cost-effective predictive maintenance.

Overall, it is critical to have an effective plan to manage spare parts, which works in harmony with a maintenance strategy. Often, it is best to rely on external partner that specializes in spare parts management. This gives wind energy organizations more time to focus on their core business and leave spare parts management to a reliable value chain partner. There is no one-size-fits-all solution for inventory management. Factors such as the size of the wind farm, the environmental conditions, and even individual uptime targets play a role in determining what is right for each company.

The value chain partner should be able to carefully and strategically plan your maintenance cycle thus developing a harmonious relationship between spare parts, uptime, and power output. At SKF, we would like to summarize what we can do for our customers in just three simple words – Zero Surprise Failures.

## Snippets on Wind Power

### EU's Lending Arm Approves 1 Trln Euro Green Plan

European Union governments approved a 1 trillion euro ($1.2 trillion) green "roadmap" for the bloc's lending arm on 12th November 2020 that will see it stop financing fossil fuel projects and airport expansions; though climate groups said it did not go far enough. The European Investment Bank's (EIB) "Climate Bank" plan had been in discussion since last year when it was laid out as a sign of the EU's intent to lead on the fight against climate change.

*Source: Reuters, November 12, 2020*

### Investment in Renewables Must Triple Annually To $800 Bn by 2050 to Reach Climate Goal: Report

Global renewable energy investment increased between 2013 and 2018, reaching its peak at $351 billion in 2017, according to a new report. It added that while $1.8 trillion were invested during the five-year period, the amount fell short of achieving the global climate commitments. The report titled '2020 edition of Global Landscape of Renewable Energy Finance' was released by the International Renewable Energy Agency (IRENA) and Climate Policy Initiative (CPI). According to the report, the current level of investment was still insufficient, however, to keep the rise in global temperatures within the 1.5 degree Celsius objective by mid-century. To achieve this climate goal, investment in diverse renewables technologies must almost triple annually to $800 billion by 2050, it said.

*Source: ET Energy World, November 11, 2020*

### US President Elect Mr. Biden Will Put US Back On Obama's Climate Trajectory, including Rejoining the 2015 Paris Agreement: Holdren

President Mr. Joe Biden will restore the United States back to the climate action trajectory that former President Mr. Barack Obama had put the country on, the Obama administration's science advisor told Down To Earth (DTE) in an exclusive interview. This will include re-joining the 2015 Paris Agreement, restarting assistance on climate change to developing countries, rebuilding teams of climate science personnel, investing in climate innovation, re-focussing on climate adaptation and rebuilding international cooperation, John Holdren said.

*Source: Down to Earth, 9th November 2020*

### India Can Save Rs 1 Lakh Crore on Crude Oil Imports by Meeting 30% EV Penetration Target: Study

India can save on crude oil imports worth more that Rs 1 lakh crore annually if electric vehicles are to garner 30% share of country's new vehicle sales by 2030, according to an independent study released by the Council on Energy, Environment and Water (CEEW).

This increase could also increase the combined market size of powertrain, battery and public chargers to more than Rs 2 lakh crore, in addition to creating 1,20,000 new jobs in this sector and a substantial number of new jobs are likely to be created in emerging areas such as battery recycling, telematics and allied construction and services. This could also lead to several environmental benefits including a 17% decrease each in primary particulate matter and nitrogen oxide and dioxide (NOx) emissions, 18% reduction in carbon monoxide emissions, and a 4% reduction in greenhouse gas emissions relative to the business as usual scenario (BAU).

*Source: ET Energy World, November 10, 2020*

# Snippets on Wind Power

## UK's PM Mr. Johnson to Sink Millions into Wind Power

British Prime Minister Mr. Boris Johnson is set to pledge that every home in the country will be powered by offshore wind in a decade. He says a "green industrial revolution" will create hundreds of thousands of jobs. He's sinking 160 million pounds into the proposal, with funds going toward upgrading ports and factories to aid in the construction of the next generation of wind turbines.

*Source: AP, October 06, 2020*

## Clean Energy Jobs Can Drive Post-Covid Recovery

The renewables sector in India has the potential to provide large-scale employment. The global renewables sector added half a million jobs in 2019, as per latest annual jobs report by the International Renewable energy Agency (IRENA), taking total employment in clean energy to 11.5 million. Asia, led by China and India, continued to lead the jobs growth in the industry, accounting for as much as 63% of the total employment. A focus on renewable energy investment and spending on energy transition could ensure an eco-friendly recovery from the global Covid-19 crisis and its economic aftershock, IRENA said.

*Source: India Climate Dialogue, Oct 5, 2020*

## CEOs Indicate Business Sentiment Revival: CII

The CEOs of top 115 companies who met at CII's National Council in first week of October indicated revival of business sentiment and a gradual rise in expected corporate performance in a poll, raising hopes that a steady recovery of India's economy is on the anvil. The CEOs, who took the poll, included representatives from across sectors like metals and mining, manufacturing, auto, pharma, health, energy, infrastructure, construction and leading services sector including ITES, health hospitality tourism and e-commerce, the Confederation of Indian Industry (CII) said.

*Source: PTI, October 05, 2020*

## India Third Largest Job Provider in RE Sector after China, Brazil

After China and Brazil, India is the third largest job provider in the renewable energy sector. India's renewable energy sector provides 8.24 lakh jobs, finds a study by International Renewable Energy Agency (IRENA). Solar photovoltaic segment provides the largest number of both direct and indirect 2,04,000 jobs in India. Around 63,000 jobs have been created by the wind energy sector.

*Source: Deccan Chronicle, Oct 3, 2020*

## Global Renewable Energy Consultant ArcVera Renewables Announces India Foray

ArcVera Renewables, a global provider of consulting and technical services for the renewable energy industry announced it has entered into the fast-growing market for renewable energy in India. It has set up new offices in Bengaluru and has assembled a team of international experts to deliver technical expertise to project developers, lenders and investors in India as well as other Southeast Asia and Pacific Rim countries.

*Source: ET Energy World, September 30, 2020*

## Legislation introduced to boost India-US clean energy and climate cooperation

A top Democratic senator on 1st October 2020 introduced a legislation in the US Senate to establish a forum for bilateral cooperation with India on clean energy technologies and energy transmission. The Prioritizing Clean Energy and Climate Cooperation with India Act establish the United States-India Clean Energy and Power Transmission Partnership (CEPTP) as the main forum for cooperation between the two nations on clean energy technologies and energy transmission. The activities under the CEPTP include promoting joint research and development on clean energy technologies, encouraging US private investment in the Indian clean energy market and supporting initiatives to develop new and renewable energy generation capacity in India.

*Source: PTI, October 01, 2020*

## PM Modi Underscores 7 key Pillars of India's Energy Strategy

Prime Minister Shri Narendra Modi highlighted seven key pillars of India's energy strategy going forward and stressing upon India's rise as a major consumer of energy globally. "India's energy plan will have 7 key drivers including accelerating efforts to move towards a gas-based economy, cleaner use of fossil fuels, greater reliance on domestic fuels to drive biofuels, achieving the renewable energy target of 450 GW by 2030, increasing the contribution of electricity to decarbonise mobility, moving into emerging

fuels like Hydrogen and digital innovation across all energy systems," Modi said in his address at the fourth annual Indian Energy Forum.

*Source: ET Energy World, October 26, 2020*

### Covid Saves 2.5 Years Of Emissions, Accelerates Energy Transition: BNEF

The on-going Covid-19 pandemic will save around two-and-a-half years' worth of energy sector emissions due to the stark drop in energy demand between now and 2050, according to research company BloombergNEF (BNEF). Together, wind and solar account for 56 per cent of global electricity generation by mid-century and together with batteries take 80 per cent of the $15.1 trillion invested in new power capacity over the next 30 years. An additional $14 trillion is invested in the grid to 2050.

*Source: ET Energy World, October 27, 2020*

### Renewable Energy Industry Asks for Increased Focus on Wind-Solar Hybrid Projects

The government should push for wind-solar hybrid (WSH) project tenders and should not keep their tariffs too low in order to go full throttle with such projects in India, industry executives said. India's total wind-solar hybrid (WSH) capacity was expected to reach 11.7 GW by 2023, a whopping 80 times increase, according to a recent report by the Institute for Energy Economics and Financial Analysis (IEEFA) and JMK Research. Industry recommendations have been to evaluate the cost of establishing advanced transmission infrastructure to support power evacuation, as compared to governmental push on lowering the tariff for hybrid projects. MNRE has identified 10 locations for setting up hybrid wind-solar parks in the country. Wind-solar hybrid projects, either co-located or being at different locations, mitigate the concerns over the intermittency and seasonality of generation to a larger extent.

*Source: ET Energy World, October 27, 2020*

### Clear 10-Year Roadmap for Clean Energy Needed To Boost Innovation: Amitabh Kant

NITI Aayog CEO Mr. Amitabh Kant while speaking at the India Energy Forum by CERAWeek has stressed on the need for a clear ten-year road map to boost clean energy technologies and creating standards for innovations. He also called hydrogen as fuel of the future especially for commercial vehicles which can ensure efficiency in movement across the country. He added that we should provide policy clarity to innovation stakeholders because a lot of innovation will keep happening as we go along.

*Source: PTI, October 27, 2020*

### India Will Lead RE Upswing in 2021: IEA Report

The International Energy Agency's (IEA) latest report 'Renewables 2020' forecasts impact of COVID-19 on the renewable sector. The report said that India would be the largest contributor to the renewable upswing in 2021, and the country's annual additions are expected to double in 2021 compared to 2020. Many auctioned projects are expected to become operational in 2021, which will lead to growth next year.

*Source: Mercom India, Nov 16, 2020*

### Europe Plans Mammoth Expansion of Offshore Wind Farms

The European Union will need to increase its offshore wind energy capacity 25-fold by 2050 to meet its climate change targets, the European Commission said. The 27-country bloc should target 60GW of offshore wind by 2030 and 300GW by 2050, up from 12GW today, the Commission said in its offshore renewable energy plan. The goals would require nearly 800 billion euros in investment. They are not legally binding, but will serve as a basis for future EU energy policies.

*Source: Reuters, November 19, 2020*

### Deutsche WindGuard Gains Momentum in Indian Market

Two years after its foundation, Deutsche WindGuard India has become an integral part of the Indian wind energy industry. It offers customers full access to the German wind energy consultant's portfolio – including energy yield assessments, power curve verification tests, power quality measurements, load simulations, design consultancy, certification support and technical due diligence, to name just the recently most demanded services from the Indian wind energy market.

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**Editor: Dr. Rishi Muni Dwivedi**

WIND POWER:
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# ANNOUNCING

# windergy
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