Indian Wind Power

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Chintan Baithak
RE Moving Forward
MNRE Initiative

IWTMA
INDIAN WIND TURBINE MANUFACTURERS ASSOCIATION

Expertise offered to Wind & Solar Energy Stakeholders

Wind Resource Assessment

- Carry out Nationwide Wind Resource Assessment
- Estimation of Wind Potential in the country through Wind Atlas preparation
- Design and implement the comprehensive Resource Assessment Programme
- Analysis of wind data to identify Wind Farmable locations
- Verification and vetting of wind data generated by private entrepreneurs
- Consultancy services for Feasibility Studies, Technical Due Diligence, Micro siting and preparing DPR for Wind Farming and Repowering assessment

Offshore Wind Energy

- Nodal Agency for facilitation of clearances for Offshore studies and surveys
- On-site wind measurement campaign
- Demarcation of potential Offshore wind blocks
- Call for proposal for development of Offshore wind energy blocks
- Promoting indigenous research for technology development

Testing (Large & Small) & Forecasting

As per Internationally accepted procedures and stipulations for

- Power Performance measurements
- Load measurements
- Power Quality measurements
- Safety and function tests
- Yaw efficiency test
- User defined measurements
- The services are not limited by type or size of the Wind Turbines

The services are certified as per the requirements of ISO 9001: 2008 and accredited as per the requirements of ISO/IEC 17025 : 2005

- Wind Power Forecasting Services
- Duration Test

Standards & Certification

- Preparation of Indian standards on wind turbines
- Accord Type Approval / Type Certification to Wind Turbines. Type Certification Services are certified as per ISO 9001 : 2008
- Issue the recommendation for grid synchronization to facilitate installation of prototype wind turbines
- Supports Multi institutional research on Wind Energy

Training

- National, International and Customized Training for various types of clients on
- Wind / Solar Resource Measurement & Analysis
- Wind / Solar Technology

Solar Radiation Resource Assessment

- Solar Radiation Resource Assessment
- Consultancy on solar energy projects
- Investor & bankable grade solar / meteorological data
- Consultancy on solar resource assessment
- GIS enabled Indian Solar Atlas on website
- Calibration of solar sensors
- HR training program on solar energy under PPP mode
- Solar Power Forecasting Services

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NATIONAL INSTITUTE OF WIND ENERGY

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INDIAN WIND TURBINE MANUFACTURERS ASSOCIATION

Indian Wind Power

A Bi-monthly Magazine of Indian Wind Turbine Manufacturers Association

Volume: 5 Issue: 1 April - May 2019

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(For Internal Circulation only)

From the Desk of the Chairman - IWTMA

Dear Readers,

Greetings from IWTMA!

India has again demonstrated that the winner of the recent election is "Democracy" – the voice of the people. A free and fair electoral process is an integral part of a robust democracy and is indeed a process to renew vision and targets for the welfare of the people, economic growth and development, goals towards national security, among others. Enhanced demand for power is a positive indicator of the economy and we do hope that wind power is given due importance.

Earlier, the Governments of Australia and the U.K., have declared 'Climate Emergency' as against internal security emergency. Also, it is interesting to note that Delhi students inspired by Greta Thunberg, a 16-year-old Swedish climate activist, led protests on the ill effects of climate change and global warming and have asked for the declaration of climate emergency. Their message is loud and clear "climate change is more important than homework". This has been the Association's platform not merely to sell turbines but our real concern for climate change and global warming while making renewable energy affordable for all. We are glad to inform the readers as the new Government is ready to take charge, our Ministry (MNRE) called for a 'Chintan Baithak' – an industry body meet that is representative of all stakeholders. Through this meeting, there was a free exchange of ideas that would further help us to reach our renewable targets and will also allow us to mainstream wind power with land allotment, connectivity (evacuation) and a meaningful tariff to attract investments.

This wasn't just a model of procurement but also gave a sense of belonging and shall help in fulfilling Renewable Portfolio Obligation (RPO) and Renewable Generation Obligation (RGO).

Every year 15th June is celebrated as Global Wind Day, through this day we advocate the importance of a fossil-free society. The requirement of the industry and the policy of the Government may not always match as a "best fit" but multiple procurement models inclusive of state bids, level playing field for small investors and export to different geographies of the world, power transaction across the nation under Open Access are the key takeaways of achieving the renewable targets by 2022.

The theme for the current issue of Indian Wind Power is "Chintan Baithak: RE Moving Forward: MNRE Initiative" incorporating the presentations and other details of the meeting.

Let us continue to fight Climate Change with more green energy in the grid.

Happy Reading!

With regards,

Tulsi Tanti
Chairman

Indian Wind turbine Manufacturers Association

Welcomes

Shri Raj Kumar Singh

Hon'ble Minister of State (Independent Charge) Ministry of Power;
Minister of State (Independent Charge)
Ministry of New and Renewable Energy;
and
Minister of State, Ministry of Skill Development and Entrepreneurship

Chintan Baithak Conducted by MNRE - 7th May 2019 Renewable Energy Moving Forward

Ministry of New and Renewable Energy (MNRE) had conducted Chintan Baithak (meeting) with the stakeholders in renewable energy industry at FICCI Auditorium, Tansen Marg, New Delhi on 7th May 2019. The Baithak, the first of its kind organised by the ministry had the following purposes:

i. To review the progress made in Renewable Energy (RE) sector so far

ii. Debate upon new and innovative ideas for catalysing the growth of this sector

iii. To discuss various issues relating to Renewable Energy sector in the country

iv. Give suggestions for catalysing development and deployment of renewables

v. Provide the ideas to be considered for inclusion in the future plan of the Ministry and

vi. To get renewable energy included in the priority lending sector

Shri Aanand Kumar, Secretary, MNRE Chairing the Chintan Baithak

The meeting was chaired by the MNRE Secretary Shri Aanand Kumar. Shri Praveen Kumar, Additional Secretary, MNRE and other senior officials of the Ministry were also present during the meet. Development issues relating to solar, wind, biomass and small hydro segments of renewable energy were discussed. The discussions were held on a vide subjects like regulatory hurdles, energy storage, transmission constraints and low cost, long-term funding, etc.

At the Baithak (meeting) Chief Executive Officers of various organisations and companies had made the presentations on the following subject matters.

1. Developing Make in India Wind Turbines
2. Demand Forecasting - 2030 & Bidding Roadmap for 5 years
3. Energy Storage & Batteries - Way Forward
4. Financing – Low Cost and Long-Term Funding and Desired Fiscal Incentives
5. Hybrid with Storage - A RTC Future
6. Regulatory Framework - Bankable PPAs/ Change in Law
7. Renewable Energy Parks - Land/Wasteland Availability
8. Renewable Energy Parks: Transmission Constraints
9. Wind Development and Deployment in India by 2024 - Bidding & Pricing

Senior Officials from Various Government Departments and CEOs of various RE Stakeholders Companies Attended the Meet

All these presentations have been given after this report.

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The meeting saw very good participation from the renewable energy sector inclusive of the representatives of the major RE developers, equipment manufacturers, think-tanks, industry bodies, and skill developers; besides financial institutions, Planning Commission, NTPC, POSOCO and regulators.

Bird Eye View of the Proceedings

The day long meet deliberated upon various issues pertaining to the renewable energy sector viz. solar, wind, bio-energy, small-hydro, regulatory issues, bidding & pricing, demand forecasting, financing of renewable energy projects, energy storage, Make in India, skilling India's renewable energy workforce, etc. Various policy interventions were suggested for the sector by the stakeholders at 'Chintan Baithak' and the Ministry of New and Renewable Energy noted to consider these suggestions.

Mr Manoj Kohli, Chairman, FICCI, Renewable Energy CEOs Council & Executive Chairman, Softbank Energy addresses the Chintan Baithak

Mr. Anand Kumar, Chairman, Gujarat Electricity Regulatory Commission putting a point in the meeting

Some issues faced by the industry were examined in detail and discussed upon, like the challenges related to the usage of land, the issues faced in converting it from agriculture to other uses, and also the challenge of land ceiling.

This brainstorming session is of prime importance for all stakeholders in the renewable energy sector amid a slowdown in commissioning of various projects mainly due to differing viewpoints between the government and developers over issues such as ceiling tariffs and land acquisition. This meeting was like a 'voice of the industry' which MNRE will present to the government.

The brainstorming session also discussed about the ideas for the next edition of RE Invest, the ministry's yearly flagship event. RE Invest is expected to be held between October 31 and November 2 this year.

It is hoped that the actions taken on the points discussed during the meet will kick start manufacturing of solar equipments and enhance the wind turbine manufacturing in India. To summarise, the Chintan Baithak will provide the Renewable Energy Industry a green signal to move forward.

The Ministry of New and Renewable Energy has also held discussions with state governments to check the extant land they are willing to set aside for renewable energy parks. This follows a recent announcement by the ministry that it will

Shri Aanand Kumar, Secretary, MNRE addressing the Meet

ensure that land and transmission facilities are in place for developers who win wind and solar projects in auctions conducted by the Solar Energy Corporation of India (SECI), its nodal agency.

Ministry of New and Renewable Energy officials held discussions with their counterparts in Gujarat, Andhra Pradesh, Rajasthan and Madhya Pradesh. Meetings with Tamil Nadu, Maharashtra and Karnataka are also in the offing.

Shri Aanand Kumar, Secretary, MNRE Replying to a Question

Mr. Sunil Jain, Chief Executive and ED, Hero Future Energies Putting a Point

(All Photos Courtesies - FICCI)

"We want the states to identify actual parcels of land where projects can be set up," the official told ET. "Developers can bid comfortably knowing they won't have to hunt for land. We will make sure Power Grid Corporation of India provides connectivity in these places too. PGCIL is already working on extending its transmission."

Indian Wind Turbine Manufacturers Association (IWTMA) actively participated in the brainstorming sessions; 'Chintan Baithak' organized by the Ministry of New & Renewable Energy (MNRE) and submitted their recommendations to the Ministry.

Chairman, Indian Wind Turbine Manufacturers Association has added that the wind energy sector has been reeling under tremendous pressure and is struggling with the transition from FiT to reverse bidding with tariff cap regime resulting into the very low tariff. The tariff discovered is so low that it is neither bankable nor sustainable. Due to this, irrespective of bidding of 17GW, the actual installation is around 700MW. Also, in the last two years, against the country's annual installed manufacturing capacity of 10GW, only 15% capacity is utilized. This low capacity utilization is not sustainable by the sector and has severely affected 4,000 SMEs and 2 million jobs. At this rate, achieving the national target of 175GW by 2022 will be a big challenge.

Indian Wind Turbine Manufacturers Association has filed it views with the Ministry of New and Renewable Energy.

The ministry hopes that this meeting will help move forward not only capacity addition but an all inclusive growth.

(With inputs from the meeting and newspaper reports)

Chintan Baithak Presentation
May 7, 2019

Venue – FICCI Federation House
Tansen Marg, New Delhi

Developing Make in India Wind Turbines

About the Industry

Wind Sector

- Fully matured **30 years** old industry
- Achieved **90%** localization
- **Created** 2 million direct/ indirect jobs
- **4000** SMEs
- Total installed capacity of ~**36GW**
- 10GW/year manufacturing capacity
- **$5mn investment** in manufacturing capacity

Current Status

- **E-reverse** bidding – **Cap** on tariff
- Lack of **executable volume –** only **15%** capacity utilization
- **Non allotment** of Land
- Unavailability of **connectivity** infrastructure
- States stopped bidding – SECI **tariff low**
- No investment in **<25 MW** by small investors
- Inadequate **incentives** for manufacturing & export

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Impact

- Only **0.7GW** installed against ~17 GW of bidding
- Very low **15%** capacity utilization in manufacturing
- Banks **not funding** projects at current tariff
- **Undersubscribed** bids
- 2 Million jobs at **high risk**
- **Survival** of OEMs at risk
- 4000 SMEs under threat of **NPA**
- **Lower** exports

Recommendation

Implement **FIT** & 5yrs firm policy framework to develop **50GW**

- NIWE certified **3 wind zones** across the country
- **5yrs. tariff** for each wind zone by CERC with yearly tariff reduction of 5p.
- The tariff fixation should be as per **national tariff policy**
- SECI will provide **PPA** based on CERC tariff

- SECI to offer PPA after **land allotment** (State Govt.) & **connectivity** (PGCIL)
- For RE manufacturing **30% Capital subsidy** (from carbon cess), **uniform 5% GST**
- **FIT** policy for **25MW** for small domestic investors in states
- Export **incentive** 10 %

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Renewable Sector – A catalyst to stimulate our Economy

We are Catalyst

- Will **Make in India** successful in all sectors
- **Job creation** for renewable and other **job creating sectors**
- Will provide **Affordable, Reliable, Sustainable** energy to all
- Will provide **Energy Security** for our nation
- Will establish India as a **Global manufacturing hub**

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Chintan Baithak Presentation

May 7, 2019

Venue –FICCI Federation House, Tansen Marg, New Delhi

Demand Forecasting - 2030 & Bidding Roadmap for 5 years

Indian RE sector – Good news

#	
1.	Ranks **5th globally** in terms of installed RE capacity, **4th in Wind** & **5th in Solar**
2.	**77.4 GW** RE installed capacity, accounting for **9.35%** of energy produced in FY'18
3.	Since 2014, capacity addition of solar grew by **10.6 times** & Wind by **1.7 times**
4.	**US$ 42b** invested since 2014; 2018 alone accounted for **US$ 11.1b**
5.	Ujala scheme saved **~US$ 2.28b** and reduced CO_2 emission

Source: NPP, ET, IBEF, MNRE

Chintan Baithak; May 7, 2019 – FICCI, New Delhi

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Indian RE sector – Bad news

#	
1.	**Delayed payments** by DISCOMs seriously impacting the project viability
2.	Shortage of investment capital & NPA risk, need more than **US$ 550b*** **by 2030**
3.	• **Non-allocation** of waste land in states • **Inadequate** transmission capacity for future growth
4.	• **15%** wind manufacturing capacity utilization; **2m** jobs at risk • PV Module dumping by Chinese, causing **injury** to domestic manufacturers
5.	**5 GW RE bids cancelled** in FY'18, adversely affecting global investor confidence

* RE investment: US$ 300b; Transmission investment: US$ 250b

Chintan Baithak; May 7, 2019 – FICCI, New Delhi

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Energy Mix 2030 – 863 GW + ~200 GWh storage

#	Source	Capacity 2030	Total
1.	Coal	250 GW	Non renewable 296 GW
2.	Gas	26 GW	
3.	Nuclear	20 GW	
4.	Hydro	67 GW	Renewable 567 GW
5.	Wind	140 GW	
6.	Solar	350 GW	
7.	Biomass	10 GW	
8.	Storage	200 GWh	ESS 200 GWh

- Expected demand by 2030 – 2,600 TWh; CAGR of 5.89%
- PLF sources based on data of MoP & CEA sources; large hydro included in RE

Chintan Baithak; May 7, 2019 – FICCI, New Delhi

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Primary expectation from the new government - Consistent policy & stable 5 year bidding plan

All figures in GW

Source	Target 2024 demand - ~1,850 TWh	Present installed capacity	Projects under const./ tendered	New capacity required by 2024	Bids required each year (FY20/ FY21/ FY22)	Investment (In $ b)
Wind (Incl. Hybrid)	76	35	~ 11	**30**	10	**$ 50b** Wind: 30; Trans.: 20
Solar	140	28	~ 46	**66**	22	**$ 90b** Solar: 45; Trans.: 45
Total	**216***	**63**	**57**	**96**	**32**	**$ 140b**

*Other RE sources (Biomass & Large Hydro) to have a net installed capacity of ~68 GW by 2024

Annual & quarterly bid plan – clear pipeline visibility is critical

Chintan Baithak; May 7, 2019 – FICCI, New Delhi

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Key issues impacting new growth

#	Key issue	Industry recommendation
1.	**Frequent RfS changes** (e.g. Tariff Cap, Payment Terms/ Security)	• Strict adherence to standard bidding guidelines by states and center. No tariff cap
2.	**Frequent bid cancelations** (5 GW in 2018)	• Honor tariff discovered transparently through E-RA • Will enhance global investor confidence
3.	**Tariff adoption by SERCs**	• In case of no deviation from standard bidding guidelines, deemed adoption within 30 days
4.	**Storage & Solar + Transmission bids** (Ladakh + Kargil)	• Structured VGF to achieve sustainable tariff

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Overall goal of the new government

- Aspiration of converting fossil based power capacity to RE in the next 2 decades,
- **Next 5 years crucial for building financially healthy RE sector,** as per expectations of international investors and banking system

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Chintan Baithak Presentation
May 7, 2019

ENERGY STORAGE & BATTERIES-WAY FORWARD

BESS Projects in India- Snapshot

Sl.No	Project details	Contractor/Developer	Remarks
1	NTPC – Andman 8.6 MW solar + 8.6 MWh BESS Andaman	BHEL	EPC Bid cancelled
2	NTPC – Andman 2 MWh + 2 MW PCS BESS Andaman	Hero Future Energies	EPC bid awarded, Under construction
3	NLC 16 MW solar + 8 MWh BESS , Andaman	L&T	EPC bid awarded, Under construction
4	CEL 1 MWh + 1 MW PCS	Raychem RPG	EPC bid awarded, Under construction
5	BSES – Reliance 1.2 MWh BESS	Raychem RPG	EPC bid awarded, Under construction
6	REIL 1 MW solar + 1 MWh BESS Andaman	Bid to be concluded (EPC)	EPC bid awarded, Under construction
7	SECI – 5 MWh Leh & 1 MWh Kaza	Sunsource/Raychem	EPC bid awarded, Under construction
8	SECI 20 MW Solar + 60 MWh Lakshadeeep		Bid to be concluded (EPC)
9	SECI 160 MW hybrid solar + wind + BESS in Andhra Pradesh		Bid on hold - EPC bid
10	MES 2.5 MWh J&K		Bid on hold – EPC bid
11	Tata – Fluence 10 MWh (PCS 10 MW)	TPDDL	Operational project – T&D deferral
12	SECI 1.2 GW solar + 3.6 GWh BESS ISTS bid		IPP based bid announced – RfP awaited
13	SECI 200 MW solar + 300MWh BESS Karnataka		IPP based bid announced – RfP awaited
14	APTRANSCO 3.2 GWh storage system for 400 MW supply (8 hrs)		EOI to be concluded

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Developing Make in India: Energy Storage and Batteries

#	Key Issues	Industry Recommendation
1.	Investment Barriers • Large Initial Investment • Lack of Eco system	• Incentives for capital investment • Partnership through JV between users and battery suppliers • Incentivize/ ensure establishment of sufficient supply chain participants
2.	Higher upfront cost	• Subsidy which reflects the advantage of ESS – Air quality improvement, oil import dependence.. • Subsidy to reflect Energy throughputinstead of design capacity
3.	Safety Concern	• Enforcement of International Safety Standard
4.	Eco-System Sustainability	• Establishment of metal refining & purification facilities for used LIB to minimize operation/ transportation costfor recycling.

Chintan Baithak: May 7, 2019 – FICCI, New Delhi 3

Developing Make in India: Energy Storage and Batteries

#	Key Issues	Industry Recommendation
5.	Low demand	• Ensure base demand for the manufacturing capacity utilization. • Incentivize exports to justify establishment of factories.
6.	Frequent Bid Modifications & Cancellations	• Cost economics and technical parameters to be fixed before the bids • Industry to be consulted, if needed

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Global Storage Market

Chintan Baithak; May 7, 2019 – FICCI, New Delhi 5


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May 7, 2019
Financing – Low Cost and Long-Term Funding and Desired Fiscal Incentives

Background

- $400bn (Rs.28 lakh crores) debt required to meet $550bn investment target
- Therefore domestic and overseas lenders both need comfort about the credit quality (PPA quality, tariffs, payment security, change in law etc.)
- Credit quality impacts interest rates and loan covenants (1% interest rate ≈ 10-15 paise/kWh; unfavourable covenants dampen investor appetite given IBC)
- Current status: poor liquidity, high interest rates
  - Lukewarm participation from Indian private lenders
  - Negligible participation from Indian PSU lenders
  - Restrictions on accessing overseas debt
- RBI's mandatory bond financing requirements pose a challenge. Renewables sector ideally suited for bonds, but low liquidity in Indian bond market

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Risk mitigation to enhance credit quality (1/2)

Key Issue	Industry Recommendation
1 Payment security	• Enforce payment security creation (LC/Escrow) through Regulators • Late payment surcharge to have first priority for payment • Enable bill discounting with recourse to buyers – Discom receivables listing on RXIL/TReDS – FIs/Banks to finance with RBI Tripartite Agreement or State Govt Guarantee • Improve transparency on outstanding payments – Update on PRAAPTI platform – SERC orders required for enforcement
2 Timely compensation	• Change in law to cover all changes including laws, regulation, policy, rates to ensure same economic position (time value of money) • Time bound resolution by CERC & SERCs – 30 days • Principle that buyers pay 80% first, contest later, as applied to statutory payments • Full compensation for grid curtailment as per scheduled generation

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Risk mitigation to improve credit quality (2/2)

Key Issue	Industry Recommendation
3 Land	• State land policy changes to be covered in change in law • Evaluate pros and cons of wind solar zone identification akin to Case 2 bidding
4 Robust PPA	• REWA PPA as model
5 GST	• Power sale to be included in GST category • Recommend 5% rate

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Measures to improve liquidity (1/2)

Key Issue	Industry Recommendation
1 Ease access to overseas debt	• ECBs / Foreign Currency Bonds other than from parent company to be allowed to refinance Rupee loans and for Working Capital –RBI would need to issue revised circular
2 Improve bond market liquidity	• Indian insurance companies to be permitted to invest in private developer bonds. They are already permitted for loans to BBB - or higher rated entities
3 Enable interest rate swaps	• Fixed rate loans reduce risk for fixed tariff projects. A national long term benchmark rate (similar to LIBOR) will enable interest rate swaps between floating and fixedrate loans. MIBOR does not offer long term rates currently

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Measures to improve liquidity (2/2)

Key Issue	Industry Recommendation
4 Increase PSU lending	• Priority Sector Lending without Rs.15 cr borrower limit • Exposure limits for renewables not to be clubbed with overall power sector limits • Maintain PFC, REC independent limits till merged entity limits are established • Increase IREDA capitalisation
5 Enable capital recycling	• Streamline InvIT rules to enable capital recycling, e.g., – Allow 75% debt for InvITs rated BBB- and above – Relax 90% dividend rule to 50% considering Discom payment delays – Flexibility in number of investors

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Chintan Baithak Presentation
May 7, 2019
Hybrid with Storage – A RTC Future

RTC – Various Forms

RTC Forms	RE Solution	Description
1 Intermittent Power	Hybrid Plant	▪ All generation dispatched ▪ Inherent nature leading to variations ▪ Must Run
2 Predicted Power	Hybrid Plant with Storage	▪ Power which is predictable ▪ Smooth power output with ramp rate control ▪ Must Run
3 Demand & Supply Balanced Power	Hybrid Plant with Storage	▪ Scheduled power based on demand and supply ▪ Grid infusion moderated by CTU/STU operator ▪ Must run essential to keep cost non-prohibitive
4 Power on Demand	Storage (Source Independent)	▪ Instant Power available on Demand ▪ High Ramp rate compared to Gas and Hydro ▪ Can act as ancillary services

RE Solution for RTC power is possible with various configuration of Wind + Solar +/- Storage

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RTC – Nature of various forms

	Hybridization	Storage & Cost	Forecasting & Sch.
1 Intermittent Power	– Hybridization lead to CUF >50% – Better Grid utilization	– Storage not required – Low cost	– Potentially Higher % Error
2 Predicted Power	Scenario 1 + – Hybrid with Storage – Smooth ramp rates. – Better Grid Balancing	– Low storage required – Marginal higher cost	– Better accuracy possible
3 Demand & Supply Balanced Power	Scenario 2 + – Hybrid with Significant battery/Storage. – Scheduled power by Grid Operator	– Blended cost close to total tariff of new thermal power plants if must run status is maintained	– Compatible with Conventional DSM
4 Power on Demand	– Source independent – Only stored power	– Very high cost as only stored power used. – Needs both Capacity and Energy Charge	– Completely controlled power injection.

"Predicted Power" with low cost & better accuracy provides acceptability among various stakeholders

Chintan Baithak; May 7, 2019 – FICCI, New Delhi

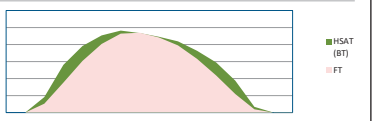
Inherent Grid Flexibility - integration of 175 GW Renewables

- **CEA recently conducted a study and demonstrated that it is feasible to integrate the new renewable capacity of 175 GW, with various options.**
  - Hydro and Gas Generation – Reduce in Solar Hours and Shift to Peak Hours (CEA simulated 6 GW and 3 GW only, current Capacity 45 GW Hydro and 25 GW Gas)
  - Two shift operation of Small Thermal plants (<150MW) of ~ 5 GW out of ~10GW
  - Flexible Power generation from Thermal Plants within Technical minimum PLF of 55%
  - Flexible power from Pumped Hydro and/or Battery Storage, if needed
- **Demand Side Management options are further available**
  - Agriculture Demand load shift to Solar Peak hours.
  - Levy of Peak consumption charges and incentivising off-peak consumption
  - Promoting Smart Grid and appliances
  - EV penetration and consumption in Solar Hours
- **Frequency Band of 49.95Hz to 50.05Hz provides significant flexibility for Renewable Variations in Indian Grid of ~ 200GW which works as virtual storage.**
- **RE Variations itself nullify when combined for larger geographical area.**

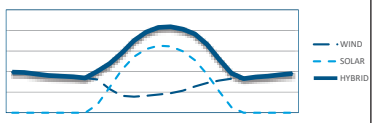
RTC Form 3 and 4 has very limited requirement in near future

Potential RE response

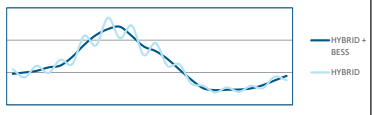
A. Solar Plants with Trackers : Larger period of constant generation 6-7 Hrs Vs 3-4 Hrs.



B. Wind + Solar Hybrid : Inherent complementary daily and seasonal generation profile.



C. Wind + Solar + Battery Storage Hybrid : Flexible generation but dearer based on use case parameters.



Judicious use of above options for effective implementation

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Storage Options

Battery

- Modular approach
- Flexible and instant response
- Sizing based on use case
- Co-location not a constraint.
- Faster implementation cycle
- High Cost but declining (~ Rs. 11/kWh Capacity Charge, Rs. 3.5/kWh Energy Charges)
- Duties @28% applicable.

Pumped Hydro:

- Very Limited Potential
- Environment, R&R issues,
- Water Availability
- Long gestation period – 5 to 7 years
- Limited Sites for Co-location with RE sources
- Suitable only in limited use cases
- Competitive cost **if constructed** (Capacity Charge ~ Rs. 4.75/kwh, Energy Charge ~ 3.7/kwh)

Battery cost reduction in next few years, along with flexibilities shall compensate any cost advantage of Pumped Hydro in near future

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Best Fit for India in near future

Solar + Wind Hybrid plant with Battery Storage for Ramp rate control

- Predictable Power
- Higher PLF closer to Thermal (Some power clipping in peak generation hours)
- Better use of Transmission Infrastructure
- Better Grid Balancing

50 GW+ Hybrid power Potential in State of

- Gujarat
- Rajasthan
- Tamil Nadu
- Maharashtra
- Karnataka
- Andhra Pradesh

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May 7, 2019

Regulatory Framework
Bankable PPAs/ Change in Law

Regulatory Framework Bankable PPA/Change in Law

Issue #1 **Payment Security**: Delays and Defaults in Payments by Purchasers (Discoms)

Industry Recommendations:

1. Strengthening of Payment Security Mechanisms
   - LCs
   - Escrow Accounts
   - Payment Security Fund
   - Tripartite Agreements: Between purchaser, State govt. (guarantee), RBI, Developer (viz. Rewa)
   - Securitization: PPA should allow for securitization of receivables through discom balance sheet
   - Transferability to be permitted after a mandatory cooling period
2. RE Payments to be treated at par with thermal/conventional payments
3. RE Payments to be taken up by MNRE with states
   Payments to be linked with PRAAPTI Platform
4. Benchmarking of state Discoms on payments and funding to be linked to the same
5. In case any Discom disagrees with the orders of the regulator and goes to appeal, prior to the appeal, at least 80% of the disputed/ outstanding amount to be deposited with the appellate authority
6. Termination of PPA in Buyer event of default (due to non-payment of dues) should not be an allowable recourse

Current / Proposed

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2

Regulatory Framework Bankable PPA/Change in Law

Issue #2 **Change in Law**: Clause does not adequately address financial impact of change in laws and impact due to change in regulations

Industry Recommendations:

- Change in law to include any change in law having a financial impact on the project/ developer with the exception of interest costs — **Financial Impact**
- To include change in regulations, policies, Technical Specifications (retrospectively) by SERCs/CERC causing financial impact, e.g. impact of DSM penalties, installation of LVRT, HVRT — **Change in Regulations**
- Stipulated time period for making payments related to change in law to be specified under the policy or the PPA — **Payment Timelines**

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3

Regulatory Framework Bankable PPA/Change in Law

Issue #3 **Regional Regulatory Framework:** Variability in regulations from state to state

Industry Recommendations:

1. Formation of Regional Regulatory Bench rather than at an individual state level to eliminate bias
2. Legally binding link between CERC and State Regulators to be created
3. CERC to be given civil and judicial rights to enforce orders
4. Guidelines for Solar, Wind, Storage (standardized bidding documents) to be fixed for a term for 5 years

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Regulatory Framework Bankable PPA/Change in Law

Issue #4 **Project Timelines and Effective Date:** Impact of events outside the control of developer should be taken into consideration

Industry Recommendations:

TIMELINES AND DELAYS

- **Effective Date**
  - Should be considered from the date of adoption of tariff by the SERC as opposed to date of signing of PPA
- **Multiple Approvals**
  - Single window clearance to be provided for all approvals related to material movement, connectivity and land
- **SCOD**
  - Should be proportionally increased basis the increase in incremental capacity
  - Interim milestone dates should be linked to government approvals (e.g. Financial closure, power evacuation approval, land handover, etc.)
- **Liquidated Damages**
  - Parity in damages/ penalties imposed on delay due to Developer and buyer/Discom
- **Equity Infusion**
  - Flexibility in terms of size and timing of equity infusion (e.g. REWA Project)

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5

Regulatory Framework Bankable PPA/Change in Law

Issue #5 **Force Majeure:** Does not cover all the events outside the control of developers

Industry Recommendations:
Include Adverse weather conditions, grid congestion, actual delays in government approvals

Issue #6 **Grid Curtailments/Backdown:** Developers have to bear the impact

Industry Recommendations:
Deemed generation at 100% of applicable tariff in case of grid curtailment/backdown and formula for calculation of the same to be specified in the PPA (Industry can sit to finalize the formula)

Issue #7 **Termination of PPA due to non payment of dues by buyer:** Termination of PPA in Buyer Event of Default (due to non-payment of dues) should be forbidden

Industry Recommendations:
Termination of PPA on non-payment of dues by Discom should not be an allowable recourse.
(Precise clause to be legally drafted)

Issue #8 **CUF declaration and CUF revisions**

Industry Recommendations:
CUF lower band to be expanded to cover 75% of declared CUF (currently 80%)
Allow CUF revisions ever 3 year – weather patterns are changing (currently allowed only within a year from CoD)

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6

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May 7, 2019
Renewable Energy Parks - Land/Waste land Availability

Issues Regarding Land for Setting up of RE Projects

#	Key Issues	Industry Recommendation
1.	**Identification of Wasteland & Allocation for RE Projects**	• Wasteland in all States to be identified • Policy formulation for allocation of wasteland to RE Projects with associated infrastructure
2.	**NA Conversion of land**	• Allow exemption for NA Conversion / Deemed Conversion of land for RE Projects (no fees to be paid)
3.	**Exemption from Ceiling Limits**	• RE Projects may be exempted from taking approval for land ceiling limits

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Issues Regarding Land for Setting up of RE Projects

#	Key Issues	Industry Recommendation
4.	**Time Bound Approvals**	• States to formulate policy – timelines for approvals, if any reg. land (post facto approvals)
5.	**Acquisition of Patta land /Khatedar Land**	• Allow acquisition of patta land /leased land on right to use basis
6.	**Exemption from payment of Registration Fees & Stamp Duty**	• Payment of Registration Fees & Stamp Duty for setting up of RE Projects
7.	**Digitization of Land Records**	• States to speed up digitization of land / revenue records

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Issues Regarding Land for Setting up of RE Projects

#	Key Issues	Industry Recommendation
8.	**Simplify VGF Disbursement Procedures (NE Region – SECI VGF Scheme)**	• Release 100% VGF on COD against BG. The BG can be released once security is created on project land

Action:

- Request MNRE to lead a delegation along with Industry leads to 7-8 states for meeting with Chief Ministers/ Chief Secretaries to resolve the above issues for RE projects.
- Powergrid/States to develop evacuation infrastructure in a time bound manner.

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May 7, 2019
Renewable Energy Parks: Transmission Constraints

Transmission Constraints

#	Key Issues	Industry Recommendation

1.	**Transmission Grid Infrastructure**
	• Network designed on the basis of fossil power plants and not as per the generation behavior of wind & solar
	• Synchronization between Transmission Infrastructure plan and Renewable targets
		• The transmission infrastructure upgradations and extensions must consider the following:
		  • green energy goal (175 GW)
		  • pattern & peaks of renewable sources
		  • future scalability

2.	**Transmission Grid Stability** • To absorb increasing quanta of green power without destabilizing the grid	• Losses due to non-availability of adequate evacuation infrastructure, and takeover delays, should be covered by **Deemed Generation** clauses in the PPA • Scheduling & Forecasting at State Level aggregation, instead of aggregation at the plant level

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Transmission Constraints

#	Key Issues	Industry Recommendation
3.	**Bid Support** • Data on transmission infrastructure availability is scarce at bid stage, which increases developers' risks • 400 kV vs 220 kV Substations	• MNRE with nodal agencies must provide details of current and planned transmission infrastructure, with timelines
4.	• The present line voltage constraints causes overdesign and increases costs for smaller developers	• Flexibility to design the line as per the plant capacity
5.	**O&M Issues** • Post construction O&M issues hamper smooth operations	• STUs to takeover plant O&M, under an O&M contract with the Developer

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Transmission Constraints

#	Key Issues	Industry Recommendation
6.	**Statuatory & Other Approvals** • Section 68, Section 164 & PTCC • Forest Clearance/GIB/Bird Sanctuary Area • Crossing Approvals • Route Change Approvals	• Single Window system for expedited approvals for renewable energy projects
7.	**ISTS WAIVER** • Waiver for solar and wind projects ends on March 31, 2022	• The ISTS waiver to be maintained till 2027

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Wind Development and Deployment in India by 2024 - Bidding & Pricing

Issues related to Bid

#	Key Issues	Industry Recommendation
1.	**Extension of timelines** Any inordinate delay in relation to Govt. approvals/ allotment should be considered Force Majeure	• Govt support is required for providing extension in timelines of SCOD • Time bound resolution on representation made by developers
2.	**ERA vs Ceiling tariff** Ever reducing ceiling tariffs - ceiling tariffs combined with ERA are putting undue stress on bidders	• One of these (ideally no ceiling tariffs) is enough to ensure the spirit of competition
3.	**Support in long lead approvals**	• Long lead approvals like MOD need better coordination and there MNRE should facilitate

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Evacuation Issues

#	Key Issues	Industry Recommendation
1.	**Transmission / Connectivity / Grid Availability**	• Time bound LTA operationalisation and levy penalty in case of delay • SCOD of the plant should be delayed in line with CEA projection of commissioning of transmission line. • Waiver of ISTS charges should apply, in case WPG is ready for commissioning before 31st Mar 2022 • Reporting and compensation mechanism for curtailment by the grid through a centralised online portal • At state level lot of capacity of wind sites are blocked by aggregators, agents; which needs to be harnessed

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Evacuation Issues

#	Key Issues	Industry Recommendation
1.	**State Level issues**	a. No retrospective policy changes or reopening of PPAs b. Payments: Multi party agreement between developers, Discom, State Govt. & RBI. RBI should intervene and compensate developers in case payment delay is beyond 6 months
2.	**Scheduling & Forecasting** Developers despite using best forecasting tools, are paying penalties	a. Scheduling to be carried out by respective SLDCs Generators to be charged a fixed scheduling fee. b. Data to be shared by wind generators, penalties for not providing adequate and accurate data with the SLDC's scheduling partner(s) c. In the interim, allow aggregation at state level

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Wind offshore

#	Key Issues	Industry Recommendation
1.	**GoI Plan of 30 GW by 2030 should not be delayed** • Lidar installation in TN is delayed • Gujarat Bid is delayed	a. Issuance of bid documents for 1 GW tender in Gujarat b. Issue additional bids at same time, offering scale of deployment c. Exempt import duties and levy concessional 5%GST, like in Indian Oil & Gas sector.

Taxes / Duties	Offshore oil and gas projects	Offshore wind projects
Customs - Duty Implication	Nil	Tower cum Support Structure/ Nacelle and its Components - 7.5% BCD + 10% Surcharge; Blades - 5% BCD + 10% Surcharge; Transmission related equipment - BCD 10% + 10% Surcharge;
GST Implication	5%	5% - WTG Tower, Nacelle and Blades 18% - transmission related equipment (transformer, substations, cables etc.) and services

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Wind Energy Leading India's Transition to a Green Economy

J.P. Chalasani, Group CEO
Suzlon Group

Developing nations are now driving the world's rapid shift towards renewable energy with India leading the pack to accelerate its goals towards embracing renewables. Renewable Energy (RE) already accounts for nearly 21% of the country's total installed capacity. According to global credit rating agency Moody's Investors Service, India will exceed the compliance of its commitment made to address climate change through green energy installations under the landmark Paris agreement. India is currently running the world's largest renewable energy programme with the target of 175 GW renewable energy by 2022.

While, the pace of renewable energy growth in 2018 slowed down owing to some policy changes, however, this is only a temporary lull. The Government of India (GOI) is cognizant of the fact that scaling up of renewables is not a choice anymore, it is an imperative need to meet the Paris Agreement goals. The government is progressively working in this direction through various policy actions. Upon assuming office for the second consecutive term post the National Democratic Alliance (NDA) government's victory in the General Elections, the Union Power Minister Mr. Raj Kumar Singh, reiterated the commitment to provide sustainable, 24x7 power to all.

The BNEF 2018 Climatescope report states that the installed capacity of renewable energy has more than doubled in the past three years from 32 GW to 72 GW. Wind energy has been the largest contributor to the RE basket with around 36 GW of installed capacity.

India is positioned to witness more than 35 gigawatt additional capacity with respect to wind auctions over the next three years. Given the strong long-term volume visibility of the wind sector, the sectoral opportunity is positively inclined towards a healthy growth phase. The transition from Feed-in-Tariff (FiT) to competitive bidding led to wind power becoming one of the cheapest sources of energy. Capacity addition was low, which resulted in some turmoil temporarily, but tariffs are stabilizing and volume growth is inevitable. With approximately 14 GW auctions already completed there is clear visibility of volumes.

As these projects take-off the ground, installations of the auctioned capacity will rise in H2 FY2019-20 onwards and volumes will significantly grow in the next three years.

A major thrust in the form of GOI's new initiative entitled "Wind Solar Hybrid Power Policy 2018", allows the setting up of wind power projects at solar power projects sites and vice versa. It is the right step to boost both wind and solar power generation in the regional corridors and States which have the inherent wind and solar capacities, but lie largely untapped. While both solar and wind energy is efficient and inexhaustible sources of power on their own, when combined into a hybrid system, they have the innate capability to not only saving money but also stem transmission loss through the grid.

Solar Energy Corporation of India (SECI) has concluded two rounds of wind-solar hybrid auctions and 1,560 MW capacity has already been awarded for development. Further, the government of Andhra Pradesh announced a new wind-solar hybrid policy and set a target to achieve 5,000 MW capacity over the next five years. The government of Maharashtra too floated a wind-solar hybrid tender.

Harnessing these two power source types, variable as they may seem, when combined – offer a complementary strength pooling which enables enhanced stability of the grid besides optimising the infrastructure including land and transmission system.

National Institute of Wind Energy (NIWE) floated Expression of Interest (EoI) for establishment of 1 GW offshore wind farm off the Gujarat coast, and it received interest from over 30 national and international investors. The government has set a target of 5 GW auctions until 2020 for Offshore. In summary, this seems like a critical inflection point for the renewables energy market.

However, there is a lot more that needs to be done to boost the potential of wind energy sector in India. The measures that should be considered include:

- Boost investments from Small and Medium Enterprises (SMEs) for captive power:
  - FIT regime should continue for projects below 25 MW - this will help SMEs to secure energy for a long duration.
  - Need for uniform Wheeling and Banking policy for captive power SMEs customers.
  - Under Open Access, provide ISTS charges waiver.

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- Policy to enforce and ensure that the bidder obtains State government approval for land availability prior to the bidding. This will ensure no delays due to land non-availability. The bidding guidelines should allow adequate time to acquire government land e.g.: Land acquisition by 18 month (COD).
- Ministry of Power has also reduced the bidding volume and introduced a price cap on tariffs. This makes the projects unviable for a meaningful Internal Rate of Return (IRR) for the investors.
  - Recommended to remove the cap on tariff. It is neither a global practice nor followed in any similar industry e.g. infrastructure, road and defense bidding.
- Sub-station wise auctions - Bidders may quote their tariffs based on wind speeds at the sites that connect to the sub-station. This becomes more pertinent as the newly discovered tariffs are only viable in wind rich states of Tamil Nadu and Gujarat.
- Transmission grid infrastructure:
  - Grid enhancement and management are key for the integration of wind power.
  - Policy execution is a challenge and better synergy between Centre & State will help in faster roll-out and commissioning of projects particularly with respect to power evacuation infrastructure.
  - Need for alignment with the SECI plan. e.g.: SECI project completion timeline is 18 months whereas PGCIL execution timeline is of 36 months. So there is execution timeline mismatch.
  - PGCIL taking proactive planning of at least 18 months and ensure execution plan is aligned with SECI projects schedule.
    - Allocation of resources in advance is important.
    - Ensure timely execution of projects.
- E-bidding to be undertaken instead of E-reverse bidding. While the e-reverse bidding resulted in low tariffs, it has severely impacted the wind energy sector since it resulted into non-bankable and unsustainable projects due to very low tariff.
- Banks and financial institutions need to allocate funds for companies to achieve the overall renewable energy and wind target by 2022.
- Repowering in India remains constrained by policy and regulatory barriers; although manufacturers would like to do more in this area. Improvements in the technical capabilities of a wind farm are central to repowering; the industry and the government must enable an environment that helps in the further development of repowering opportunities.

India has the potential to become a global wind energy technology and equipment exporter and a manufacturing hub for renewables in a few years. With the right policy framework, India can be a major wind export economy of more than 5 GW of equipment by 2022, due to its cost competitiveness, mature wind energy value chain and technological-edge.

The road ahead will depend on how smartly and how creatively the energy ecosystem collaborates, and relentlessly innovates to ride the strong sectoral growth story. The ever-increasing demand for energy in India can no longer be met through traditional energy sources alone. Renewable energy must be a major part of the solution and the key enabler for India's Green Economy. The time to act is NOW!

Snippets on Wind Power

Election Results: Renewable Energy Industry Expects Government to Sharpen Focus on Policy Stability

As India seems to have voted for a majority government for yet another term, the renewable energy industry wants the government to continue with a sharp focus on policy stability to spur growth, gaining from the likely continuity in administration.

Source: ET Energy World, May 23, 2019

Renewable Energy: Centre Looking to Set Up Portal to Disclose Payment Delays by Discoms

The Ministry of New and Renewable Energy (MNRE) is considering setting up a web portal to publicly disclose payment delays to renewable energy players from power distribution companies (Discoms). The move is expected to usher in more transparency in pending payments.

Source: Hindu Businessline, May 23, 2019

Tamil Nadu Discom to Halt Wind and Solar Auctions

Tamil Nadu, will stop conducting auctions for wind and solar energy projects following poor response to its tenders which set limits on tariffs. Instead, it will buy clean power from the Solar Energy Corporation of India (SECI) to fulfill Renewable Purchase Obligation. Tamil Nadu has the highest wind energy capacity in the country with 8,631MW (as of end-2018) and 2,055MW of solar capacity. SECI's margin will be around 5 or 7 paise which may still work out to less than 3 rupees for us.

Source: ET Bureau, May 20, 2019

Normalized Parametric Model for Wind Turbine Power Curve

Abhik Kumar Das
del2infinity Energy Consulting, India

1. Introduction

Wind power plays a significant role in our transition to a sustainable future and such massive global interest has encouraged extensive research in this sector. The conversion of wind energy to electrical energy is generally done by a wind turbine. The wind stream produces aerodynamic forces on the turbine blades to rotate them, thereby capturing the kinetic energy contained in the wind and converting this energy into a rotation of the turbine's shaft. The captured energy is transferred through a gearbox to an electrical power generator, which sends the power into the electrical grid system[1].

Performance of a wind turbine can be characterized by a power curve. Though one can generate the power curve of a wind turbine using experimental values, an approximate explicit analytical representation of the power curve is useful to simulate the energy output of the turbine. Without detailed knowledge of a turbine and its components, the power curve helps in predicting turbine power output, capacity factor and energy production. The power curve has four distinct region[1].

a. For wind velocity from 0 to the cut-in velocity (V_I), the turbine does not produce any power

b. Between the cut-in velocity and rated velocity (V_R), the power increases with wind velocity

c. From rated velocity to cut-out velocity (V_0), the power remains constant irrespective of the change in wind velocity and

d. Beyond the cut-out velocity the turbine is shut down due to safety reasons. In the region between the cut-in velocity (V_I) and rated velocity (V_R), the power-curve characteristics can be expressed using different models like linear, quadratic, cubic and polynomial.

Existing power curve models for WTGs are widely used for various project planning purposes including estimating total wind power production, matching optimum turbine-site and ranking potential project sites. Now the wind turbines are becoming bigger and bigger with more hub height and rotor diameter reaching to 10MW and beyond. Hence from data analytics perspective, it is better to represent the characteristics of turbine in normalized form rather than in direct form to accommodate the turbine characteristics in the energy analysis to simplify the calculation.

2. Normalized Power Curve Model of Wind Turbine

Let us consider P_V is the power at wind-speed V and P_R is the rated power at speed V_R. The parametric model is required to represent the curve in the non-linear region of the power curve. Denoting the normalized power as p and the normalized wind velocity under consideration as v, p can be defined as P_V/P_R and v can be defined as V/V_R. This normalization enables a compact representation of P_V and V, when $0 \leq V \leq V_R$ for different wind turbines in [0,1] x [0,1] space. The normalized representation shows that the velocity power curve fits a wide variety of $[P_V - V]$ values accurately and the power curve can be represented as:

$$p = f(v) \text{ for } v\_i \leq v \leq 1 \quad (1.A)$$

$$= 0 \text{ for } 0 \leq v < v_i \quad (1.B)$$

Here v_i can be viewed as normalized cut-in velocity defined as V_I/V_R, where V_I is the cut-in velocity of the turbine. The actual power curves of two turbines are shown in Figure 1(a) and their equivalent normalized power curve is shown in Figure 1(b). Table 1 presents the turbine data. Since $f(v)$ represents the non-linear region of the normalized power curve, we can state that the function $f(v)$ must satisfy the following conditions:

A. $f(v)$ is continuous function of v (2.A)

B. $f(v)$ satisfies the boundary conditions: $f(v_i) = 0$ and $f(1) = 1$. (2.B)

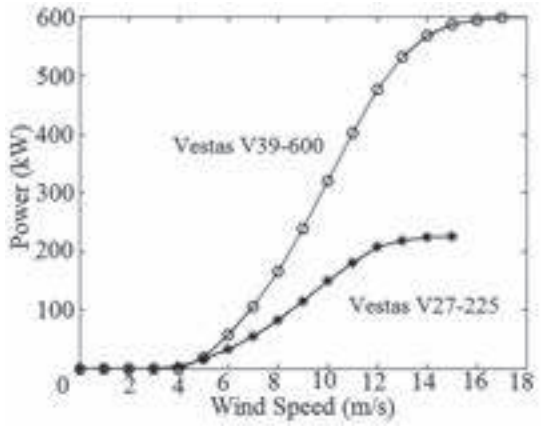
C. For $v_i < v < 1$, $f(v)$ is a monotonic increasing function of v *i.e.* $df(v) / dv > 0$. (2.C)

The continuity of the function $f(v)$ is obvious. The boundary conditions come from the definition of the cut-in velocity and rated velocity of the turbine. Since cut-in velocity of a turbine is defined as the velocity where power is zero and small positive change in wind speed generates power, it is easy to see that at V_i, $P_V = 0$ and hence $f(v_i) = 0$. At the rated wind velocity (V_R), the turbine generates the power of its maximum capacity P_R, hence $f(1) = 1$. Since the power generated by the

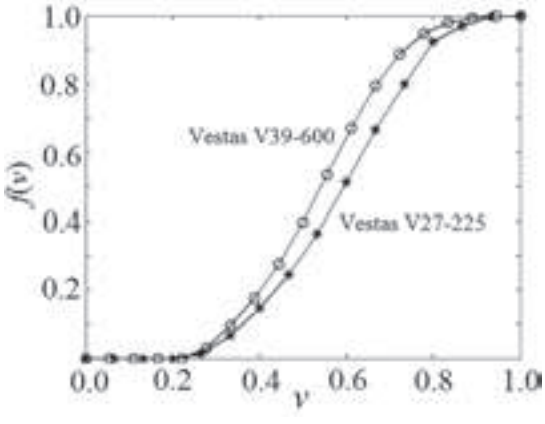
turbine increases with the velocity of the wind stream, the last condition $df(v) / dv > 0$ is obvious to consider. As shown in fig. 2(b), $f(v)$ is continuous and monotonic increasing function satisfying $f(vi) = 0$ and $f(1) = 1$.

Table 1: Manufacturer Data of Two Selected Wind Turbines

Wind speed [m/s]	V39-600	V27-225	Wind speed [m/s]	V39-600	V27-225
	Power [kW]			Power [kW]	
0.00	0.00	0.00	10.00	320.00	150.00
1.00	0.00	0.00	11.00	402.00	180.00
2.00	0.00	0.00	12.00	476.00	208.00
3.00	0.00	0.00	13.00	532.00	218.00
4.00	0.00	3.00	14.00	568.00	224.00
5.00	18.90	15.00	15.00	587.00	225.00
6.00	57.40	33.00	16.00	595.00	225.00
7.00	106.00	55.00	17.00	599.00	225.00
8.00	166.00	82.00	18.00	600.00	225.00
9.00	239.00	115.00	18.00	600.00	225.00



1(a)



1(b)

Figure 1(a): Power Curves of Turbine Vestas V39-600 and V27-225 (b) The Equivalent Normalized Power Curves of the Turbines

3. Power Curve Models

The parametric model of f(v) is a major focus of research in modelling approaches of wind turbine power curve and the most popular parametric model representing f(v) are discussed below.

3.1. Linear Model

The simplest normalized power curve can be represented as a linear model considering a linear increase in the turbine power. The linear model can be represented as:

$$f(v) = \frac{v - v_i}{1 - v_i} \tag{3}$$

It is easy to see that the function in (3) is continuous and satisfies the boundary conditions. Here $df(v)/dv = 1/(1\text{-vi})$ which is a positive constant value. The linear model is useful for a simple representation of power curve and easy for computation, but it overestimates the wind power value when the velocity is near cut-in velocity V_I and underestimates the same when the velocity is near the rated velocity V_R.

3.2. Cubic Model Type I

A better estimation of the power curve can be achieved by using the cubic model[2]. This model assumes a constant overall efficiency of the turbine in the region between the cut-in speed (V_I) and rated speed (V_R) as:

$$f(v) = \left(\frac{v - v_i}{1 - v_i}\right)^3 \tag{4}$$

This model satisfies all the properties of $f(v)$ described in Section 2.

3.3. Cubic Model Type II

Without considering the cut-in velocity (V_I), another approximate version of the cubic model described in[3,4] can be represented as:

$$f(v) = v^3 \tag{5}$$

This model does not satisfy the lower boundary condition 2.B (Section 2), but is useful for approximating the power curve behaviour.

3.4. Quadratic Model Type

The quadratic model of the velocity-power curve of a wind turbine can be represented as[5-7]:

$$f(v) = a_0 + a_1 v + a_2 v^2 \tag{6}$$

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The coefficients can be calculated using the values of the cut-in velocity V_I, rated velocity V_R and rated power P_R as[6]:

$$a_0 = \frac{1}{(V_R - V_I)^2}\left\{V_I(V_I + V_R) - 4V_I V_R\left(\frac{V_I + V_R}{2V_R}\right)^3\right\} \quad (6.A)$$

$$a_1 = \frac{V_R}{(V_R - V_I)^2}\left\{4V_I V_R\left(\frac{V_I + V_R}{2V_R}\right)^3 - 3V_I - V_R\right\} \quad (6.B)$$

$$a_2 = \frac{V_R^2}{(V_R - V_I)^2}\left\{2 - 4\left(\frac{V_I + V_R}{2V_R}\right)^3\right\} \quad (6.C)$$

These coefficients were determined based on the assumption that the output of the turbines follows a cubic model[8]. According to equation 2.C, since $df(v)/dv > 0$, we can state that $a_1 + 2a_2 v > 0$.

3.5. Quadratic Model Type II

A simple representation of quadratic model is available in[8] and can be represented as:

$$f(v) = \frac{v^2 - v_i^2}{1 - v_i^2} \quad (7)$$

This model does not consider any coefficient like (4) but is very useful for simple computation.

3.6. n-order Model

The quadratic model (5) can be generalized as[1]:

$$f(v) = \frac{v^n - v_i^n}{1 - v_i^n} \quad (8)$$

Here n can be defined as the velocity power proportionality constant. In[9], a third order polynomial was used to represent the turbine output and regression was used to find the coefficients.

3.7. Two Parameter Model

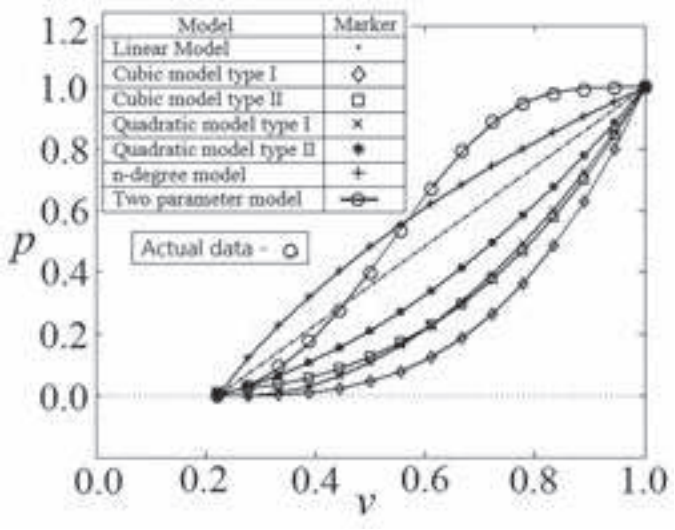
A generalized two parameter model of the velocity-power curve can be represented as in[10]:

$$f(v) = 1 - \left(\frac{1 - v}{1 - v_i}\right)^{\alpha} e^{\beta(v - v_i)} \quad (9)$$

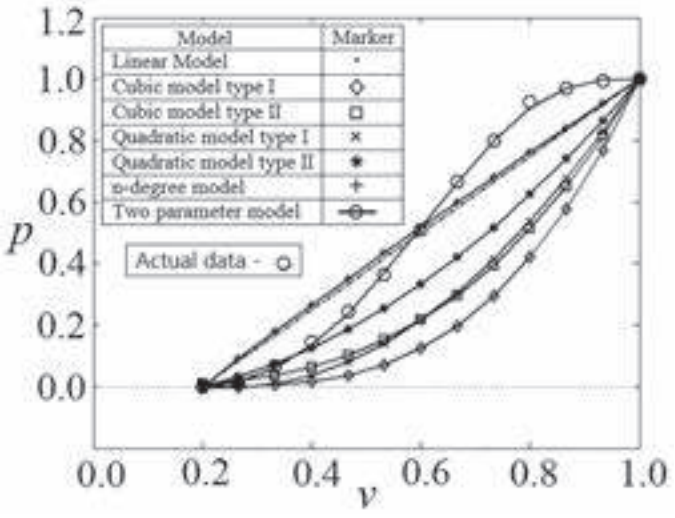
Here the empirical factors α and β can be determined using simple curve-fitting method (error minimization) of limited available data points of the turbine.

4. Results

The power curve models described in Section 3 are applied on manufacturer data of over 150 different wind turbines. In Figure 2, the different models described in Section 3 are compared for two selected wind turbines. For the turbine Vestas V39-600, the estimated power using different models are shown with respect to their reference power value in figure 3. The reference power value is available from manufacturer power data (Table 1). It is easy to see that the estimated power values using the two parameter model show a close match with the actual manufacturer power data of WTG. The n-degree model and linear model over estimates the power curve when power is low and underestimate the power curve when the power is high and near the rated power of the turbine. The other models (Cubic model Type I and Type II, Quadratic model Type I and Type II) underestimate the power curve.



2(a)



2(b)

Figure 2: Actual Normalized Data and Normalized Wind Velocity-Power Curves Using Different Models Described in Section 3 for (A) Vestas V39-600 and (B) Vestas V27-225 Turbines

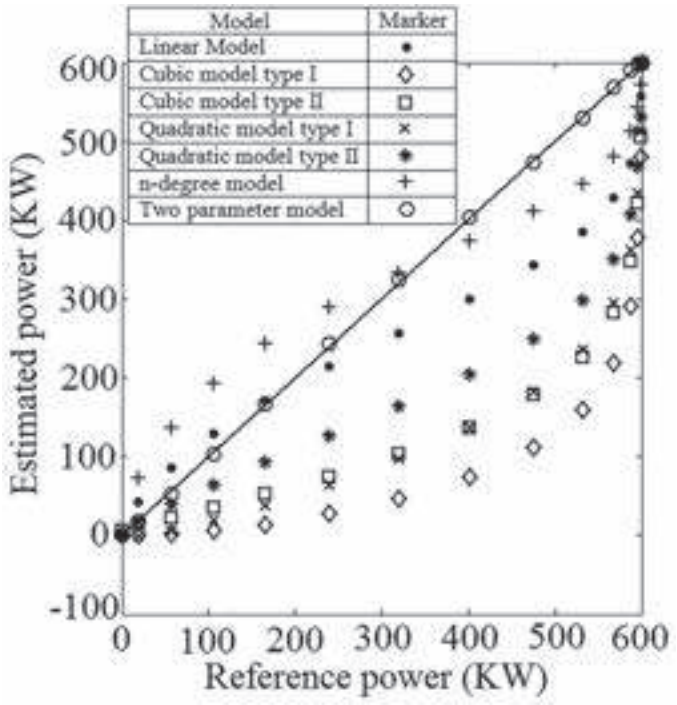


Figure 3: Plot of the Estimated Values of Power Versus Their Reference Values of Different Models for the Turbine Vestas V39-600. The Line with Slope 1 Represents the Ideal Situation Where Estimated and Reference Values are Equal.

5. Conclusion

The comparison between power curve models has been done using RMSE and R2 values with respect to manufacturer data for over 150 commercially used wind turbines. The study considers linear, cubic, quadratic, n-order and the two-parameter models for the wind power curve. In comparison to the other models, the RMSE values for the two-parameter model are the lowest while the R2 values are the highest. The results show that the normalized two-parameter model proposed by Das[10] represents the best fit with manufacturer data on turbine velocity and power, compared to the same for the other models. Considering the fact that there is limited evidence on the effectiveness of different existing models for wind power curve, the results presented in this work can be of great importance to wind industry stakeholders.

References

1. M. Sathyajith, *"Advances in Wind Energy Conversion Technology."* Springer-Verlag Berlin Heidelberg, 2011
2. E.N. Dialynas and A.V. Machias, *"Reliability modelling interactive techniques of power systems including wind generating units,"* Arch. Für Elektrotechnik, vol. 72, no. 1, pp. 33–41, Jan. 1989.
3. Z.M. Salameh and I. Safari, *"Optimum windmill-site matching,"* IEEE Trans. Energy Convers., vol. 7, no. 4, pp. 669–676, Dec. 1992.
4. S.H. Jangamshetti and V.G. Rau, *"Site matching of wind turbine generators: a case study,"* IEEE Trans. Energy Convers., vol. 14, no. 4, pp. 1537–1543, Dec. 1999.
5. C.G. Justus, W.R. Hargraves, and A. Yalcin, *"Nationwide Assessment of Potential Output from Wind-Powered Generators,"* J. Appl. Meteorol., vol. 15, no. 7, pp. 673–678, Jul. 1976.
6. P. Giorsetto and K. Utsurogi, *"Development of a New Procedure for Reliability Modeling of Wind Turbine Generators,"* IEEE Trans. Power Appar. Syst., vol. PAS-102, no. 1, pp. 134–143, Jan. 1983.
7. J. Wen, Y. Zheng, and F. Donghan, *"A review on reliability assessment for wind power,"* Renew. Sustain. Energy Rev., vol. 13, no. 9, pp. 2485–2494, Dec. 2009.
8. R. Pallabazzer, *"Parametric analysis of wind siting efficiency,"* J. Wind Eng. Ind. Aerodyn., vol. 91, no. 11, pp. 1329–1352, Nov. 2003.
9. A.N. Celik, *"Energy output estimation for small-scale wind power generators using Weibull-representative wind data,"* J. Wind Eng. Ind. Aerodyn., vol. 91, no. 5, pp. 693–707, Apr. 2003.
10. A. K. Das, *"An empirical model of power curve of a wind turbine,"* Energy Syst., Mar. 2014.

India: Wind Power Installations Update April 2019

(MW)

S. No.	State	Total Installed till FY 2018-19	Installation in April, 19	Total Installations in FY19-20	Total Installed capacity till FY 19-20
1	Andhra Pradesh	4090.50	2.00	2.00	4092.50
2	Gujarat	6161.95	29.60	29.60	6191.55
3	Karnataka	4595.95	19.80	19.80	4615.75
4	Kerala	52.90	0.00	0.00	52.90
5	Madhya Pradesh	2519.90	0.00	0.00	2519.90
6	Maharashtra	4794.50	0.00	0.00	4794.50
7	Rajasthan	4299.65	0.00	0.00	4299.65
8	Tamilnadu	8968.89	158.32	158.32	9127.21
9	Telangana	128.10	0.00	0.00	128.10
10	Other	4.30	0.00	0.00	4.30
	Total	35616.64	209.72	209.72	35826.36

Epoxy Resin Systems for Offshore Wind Turbine Blades

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Wind energy as a renewable source of energy has come a long way in being recognized as a major alternative source to the conventional energy derived from fossil fuels. With an addition of 50.6 GW in 2018, the global cumulative installed capacity of wind power generators reached to 589.7 GW at the end of 2018 (source: GWEC). The growth and maturation of the industry has been duly supported by technological advancements in wind turbine rotor blades with continuous development of aerodynamically advanced and robust designs which can harness optimum energy from the wind.

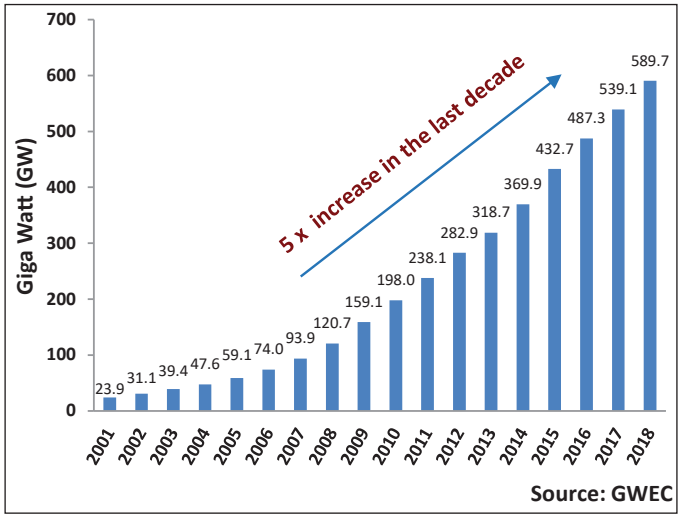


Figure 1: Global Cumulative Installed Wind Power

Since last few years – the offshore wind power installations have been experiencing exponential growth due to higher efficiency and competitiveness compared to onshore installations. The year 2018 experienced highest growth for this segment with 4.49GW of new offshore wind installations, increasing the global installed capacity to 23.3GW at the end of 2018 (source: GWEC). The offshore wind market is projected to exceed USD 60 billion by year 2024. In specific context of India- the Ministry of New and Renewable Energy (MNRE) has plans to install at least 5GW of offshore wind capacity by year 2022.

With the offshore blade segment poised to witness an escalating growth there is an increased focus on new design blades which are longer, lighter, stronger and aerodynamically advanced. This need has necessitated demand for new materials. Material suppliers have been continuously working to develop new products and solutions. Latest developments include new glass fabric reinforcements which enable higher mechanical strength, stiffness and improved coupling with matrix. In some blade designs the glass fabrics are being replaced selectively by carbon fabrics as the reinforcement, example for prefabs such as spar cap.

Epoxy resins are preferred matrix materials for blade shell infusion and as bonding paste or adhesive to join the two halves or shells of the blade. With emergence of new designs for offshore blades and increasing use of carbon fabrics as reinforcements, it is imperative that new resin systems are developed to align with blade manufacturer and the designer's requirement.

In principle there are two major types of epoxy resin systems which are used for wind blades- 1. For shell infusion and 2, Bonding paste or adhesive for gluing the shells.

Epoxy resin systems for infusion of pressure & suction shells, spar cap and root segment of wind blades, are two component systems comprising of epoxy resin and hardener or curing agent, designed to provide optimum combination of process and performance properties.

Considering the extra-large lengths of offshore blades, the epoxy resin systems, are required to have slower reactivity compared to the conventional resin systems to ensure complete impregnation of reinforcements and also avoid process defects such as dry spots, wrinkles triggered by the uncontrolled exotherm during curing. The slow reacting resin systems enable better control of the process however increase the curing time leading to increased cycle time and reduced productivity. The desired process properties of epoxy infusion systems for offshore include:

- Low viscosity, easy to degas components
- Chemically compatible with the fabric sizing
- Suitable to process between 15-50°C
- Slow reacting (viscosity development with time)
- Provide long working/open time
- Faster strength development (linked to blade cycle time)
- Cure with low exothermic heat of reaction

Comparative process properties of conventional epoxy infusion system and system for offshore blades are depicted in Figure 2. The profiles of viscosity development and working time are indicative of reactivity differences between the conventional and the resin system for offshore. The profile of strength development, based on measurement of glass transition temperature (Tg) with time is indicative of the curing speed. Comparable or faster strength development is ideal from a blade manufacturer's perspective as this means that the cycle time of the system for offshore would be identical or lower than the conventional system.

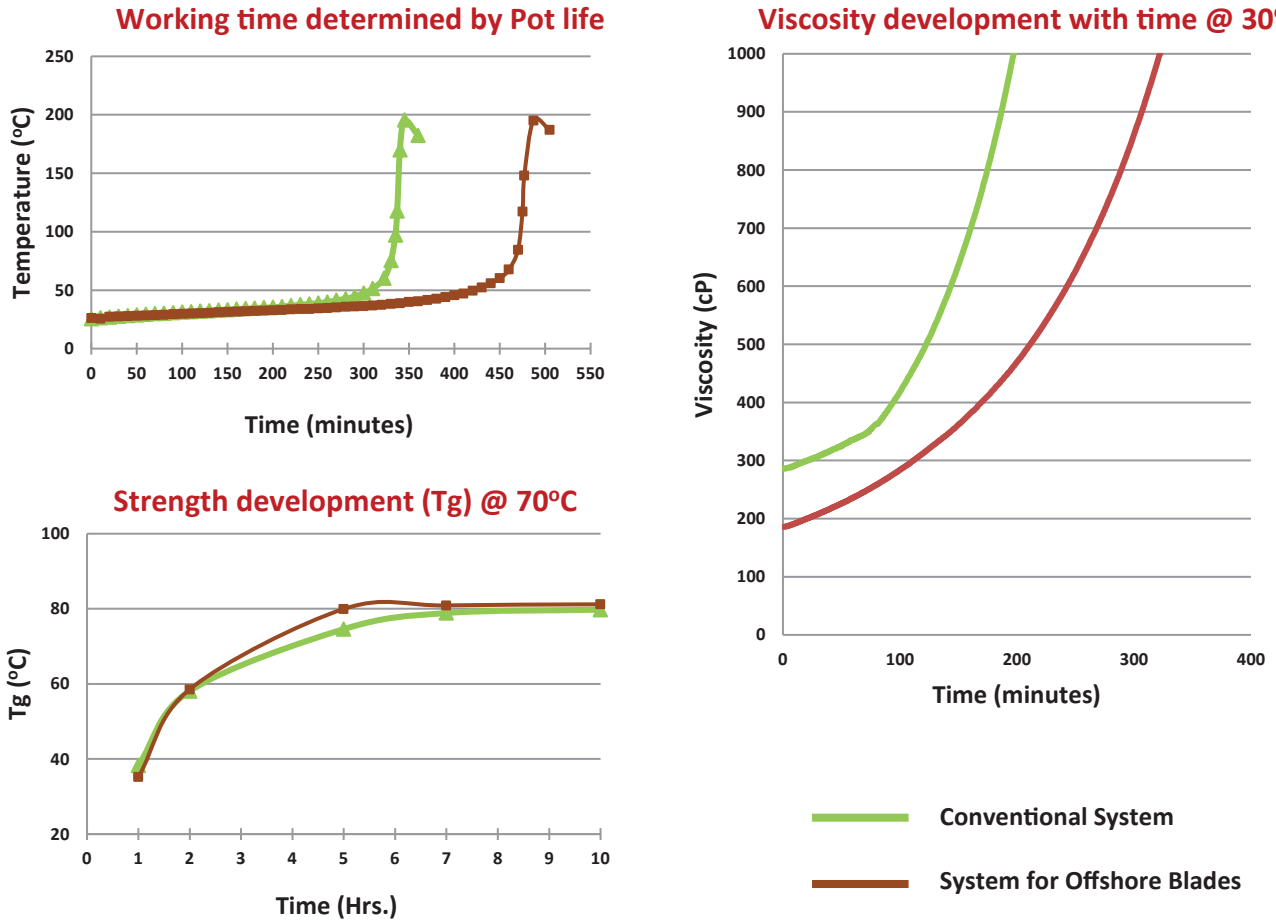


Figure 2: Comparative Process Properties of Infusion Systems
(Conventional v/s System for Offshore Blades)
Note: Test data of typical batches for Epotec Epoxy Systems

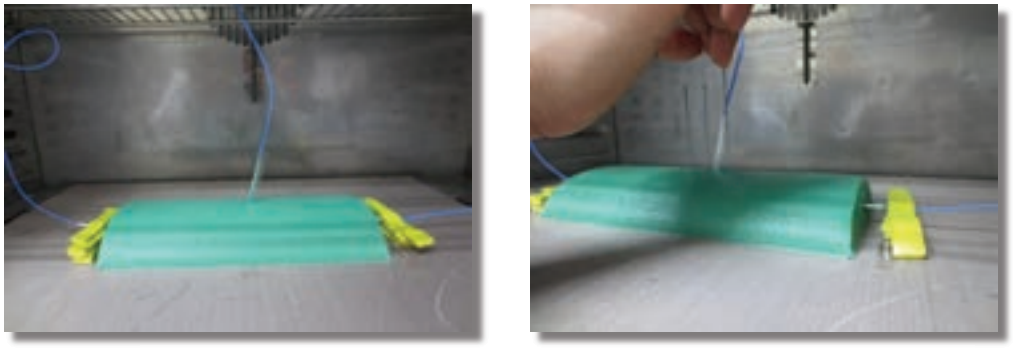
Performance properties of the resin systems for offshore need to be at-least similar to the conventional systems. Typically these properties are determined for composite laminates under static condition in tension, compression, flexural & inter-laminar shear modes and at varying load levels in tension-tension and tension-compression modes to determine the fatigue behavior under dynamic conditions.

The second major epoxy system used for wind blades is the bonding paste or adhesives used for gluing the shells and shear web. These are two component systems and comprise of resin and hardener however unlike the infusion systems which are low in viscosity, the components of the bonding paste are designed to provide high level of thixotropy and for being non-sagging and slump resistant. Extra-large blade lengths of offshore designs need epoxy adhesives which can provide longer open time and higher mechanical strength & stiffness compared to the current structural adhesives. The desired properties of epoxy bonding paste for offshore include:

- Visually distinguishable resin and hardener components
- Suitable to process between 15-50°C
- Thixotropic, Non-Sagging and Slump resistant
- Easy to dispense by 2K static mixing machines
- Suitable for filling gap up-to 45 mm
- Provide long working/open time
- Faster strength development (linked to blade cycle time)
- Cure with low exotherm and shrinkage
- High mechanical strength and stiffness
- Toughened and resilient

Comparative working time of conventional epoxy adhesive and high strength-stiffness adhesive system for offshore blades is depicted in Figure 3.

The adhesive system for offshore is designed to provide longer working time and also to cure with lower exotherm. This feature enables longer application time which is essential for offshore blades due to their longer length compared to onshore blades.



Adhesive Bead, W X T, 40 x 30 mm applied on GRE substrate at 25C/ 50% RH

Property	Conventional System	High strength- High stiffness System
Time for mass to gel / temperature	96 minutes/ 68.0°C	135 minutes/ 67.3°C
Maximum temperature	83.7°C	72.9°C

Figure 3: Comparative Working Time
(Conventional and High Strength-High Stiffness Adhesive for Offshore Blades)
Note: Test data of typical batches for Epotec Epoxy Systems

Conventional System

Specimen-No.	Tensile Strength [MPa]	Modulus [MPa]
Conventional System_1	66.11	4720
Conventional System_2	66.67	4818
Conventional System_3	67.69	4626
Conventional System_4	68.65	4824
Conventional System_5	67.44	4884
Conventional System_6	68.12	4545
Average value:	**67.45**	**4736**

High Strength - High Stiffness System

Specimen-No.	Tensile Strength [MPa]	Modulus [MPa]
High Strength System_1	77.43	5196
High Strength System_2	76.32	5203
High Strength System_3	78.90	5375
High Strength System_4	78.50	5484
High Strength System_5	77.00	5341
High Strength System_6	76.80	5385
Average value:	**77.49**	**5331**

Instron UTM 5569, Clip-on Extensometer GL-50 mm, Specimen Type 1B, Test temperature: 23°C, 50% RH

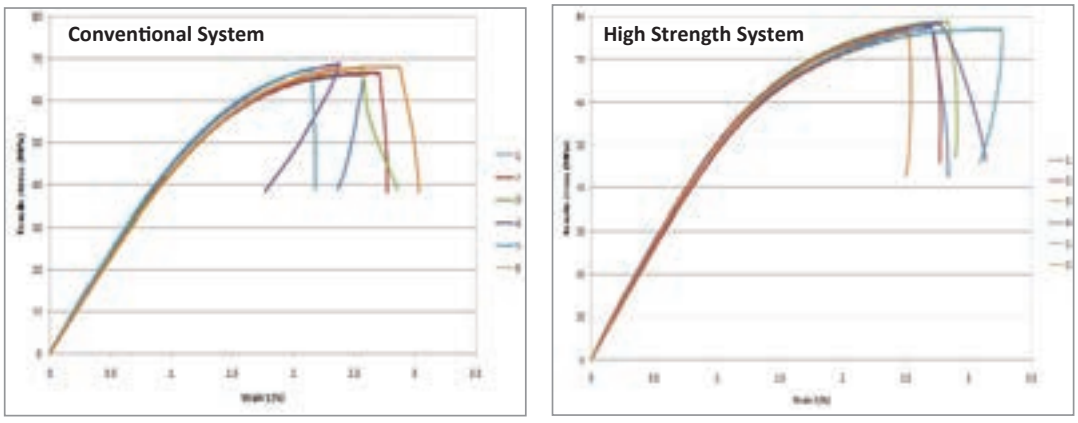


Figure 4: Comparative Tensile Strength - Stiffness (Modulus)
(Conventional and High Strength-High Stiffness Adhesive for Offshore Blades)
Note: Test data of typical batches for Epotec Epoxy Systems

The performance properties of Epoxy Bonding Paste are determined by mechanical and adhesion strength measuring the tensile strength and stiffness, lap shear strength, fracture toughness and fatigue behavior. For offshore blades the adhesive system is designed for higher strength, stiffness and resilience.

Comparative tensile strength, stiffness (modulus) and fracture toughness determined by critical stress intensity factor (K1c) and critical strain energy release rate (G1c) of conventional epoxy adhesive and high strength-stiffness adhesive system for offshore blades are depicted in Figure 4 and 5 respectively. The values indicate step-level improvement in the mechanical performance, in line with the requirements for offshore blades.

Conventional System

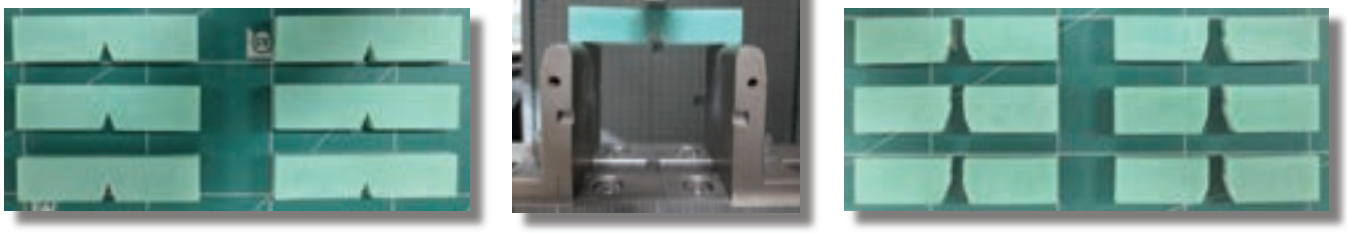
Specimen-No.	K_{1c} [MPa .m1/2]	G_{1c} [J/m2]
Conventional System_1	2.948	2783.61
Conventional System_2	2.860	2479.62
Conventional System_3	2.890	2384.03
Conventional System_4	2.892	2257.01
Conventional System_5	3.003	2680.75
Conventional System_6	2.896	2334.77
Average value:	**2.915**	**2486.63**

High Strength - High Stiffness System

Specimen-No.	K_{1c} [MPa .m1/2]	G_{1c} [J/m2]
High Strength System_1	3.390	3291.29
High Strength System_2	3.279	3216.19
High Strength System_3	3.320	3326.72
High Strength System_4	3.227	3401.83
High Strength System_5	3.263	3242.00
High Strength System_6	3.538	3493.14
Average value:	**3.336**	**3328.53**

Note: Specimen dimension: 70.4L × 16W × 8H mm.

Higher K1c and G1c are indicative of Higher Toughness



Specimen (Before Test) **SENB Mode** **Broken Specimen (After Test)**

Figure 5: Comparative Fracture Toughness (SENB mode)
(Conventional and High Strength-High Stiffness Adhesive for Offshore Blades)
Note: Test data of typical batches for Epotec Epoxy Systems

Summary

Materials play an important role in ensuring quality and robustness of rotor blades which in turn determine the reliability, performance and lifetime of a wind turbine.

In case of matrix, the epoxy resin systems for infusion of offshore blades are designed for long working time and slow viscosity development with time. Such systems enable controlled infusion and guarantee complete impregnation of the reinforcement thereby contributing to reduced defects and re-work. The systems also cure faster and possess potential to improve productivity in blade manufacturing. Similarly the extra-longer length of offshore blade demands, epoxy structural adhesives with longer open time and higher mechanical strength, stiffness and toughness.

Success and future growth of offshore blade segment will largely depend on how well the new materials complement the needs of blade designers and manufacturers.

Wind Turbine Generators Operations and Maintenance - Preventive Maintenance Musings

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The terminology gets you into meaning already known and understood - we need to prevent failure of operating asset, in our windfarm by doing preventive maintenance. There is another similar word used for the same/similar function i.e. 'Scheduled maintenance'. One expects that if we carry out good preventive maintenance job as per agreed schedule, in every turbine, the WTG should not stop or break down at all. However, this does not happen. Failure or break down happens now and then. Preventive maintenance is the job of operating team in every windfarm. While analyzing sometimes, the type of failure, it calls for questioning whether the preventive maintenance was done related to this stoppage and how it still failed. There has never been right answer to this question. At the same time, there is a possibility we tune up the preventive maintenance process, add bit of additional care in line with the type of break down and also making changes to once decided schedule or scope of work, what is assigned by manufacturer. This is prepared at the time of introduction of the WTG in the market. Interestingly the content of work almost remains same for all turbines, except the volume of work is increased related to changes in systems or parts in the new WTG, due to technology advancement, compared to previous series of turbines. The list which is prepared and given to site teams is seldom questioned. There shall be a situation after doing this job again and again; people are not even referring to this at the time of doing the job. Only setting values, torque values are referred, generally taken into a separate list and for filling the work done or ticking.

The preventive maintenance work content is classified under different sub-groups - visual, electrical and mechanical maintenance (including blade inspection from ground using binoculars, which these days are extended for specialized drone inspection sometimes). It is expected visual inspection is to be done every time preventive maintenance is carried out, whereas electrical and mechanical preventive maintenance is done at different periods. Generally it is expected that skills are different and hence should not be combined to carry out at the same time. It is also difficult to do the job same time up the tower. These preventive maintenance jobs are generally these days assigned to contract teams who are not regular employees and also they were never part of the site O & M teams. There is plus and minus in doing so. The people who are regularly attending the break downs, which are generally carried in rush hours to complete, shall have the background of the problems faced and they can be more attentive to find more of such defects, which can flag for future break downs in other turbines. Yes, it is generally intended to make additional job lists when the WTGs are taken for preventive maintenance, shut downs to do thorough inspection to prevent such break downs.

Of course, when there is repeated break downs due to same faults in different turbines at one site, the team is generally expected to make full investigation of the cause of such break downs in all turbines once and also make drastic parts change in all turbines. The observation opportunity during such shut down is most advantageous and people who have the skills to get the lead for future problems are very critical. This is where it is important to observe the noise of the moving parts and gear box noise, etc. need to be precisely identified, which can only be understood by experienced staff and not teams taken on job contracts. Unfortunately, such teams are assigned to save manpower costs (not permanent employees and hence now there are so many maintenance companies, who only carry out such routine jobs), even the torqueing of bolts are expected to be done by such teams.

It is also happening that there is target generally for completing preventive maintenance in a specific number of turbines for the period day/week/season, etc. Such number targets affect the quality of jobs done even though the turbines are taken for shut down and customer loose the generation. The allocation of this preventive maintenance is always in the lean season. The investor continuously studies the time taken, work carried out and also assesses approximate loss of generation possibly happening comparing the generation of neighboring WTG. Only when the site manager is able to assess the seasonal change and winds being good, can force O & M agency to postpone the schedule and avoid deeper loss of generation.

It is most critical during the preventive maintenance to give due attention for the torqueing of bolts. First of all, having the right tools and care is needed to understand the behavior of bolts, firstly the foundation, then Tower sections (tubular and also in the case lattice towers). It is my scare that people when not guided, can do the mistake of re-torqueing even when the tension is lost and completing the assignment. This is also essential to ensure that the gap generated between the tower sections are attended by spacers and re-torqued… but needs utmost care of reusing the bolts. Yes, the strength of carrying

and doing the jobs at heights and also at odd locations in wind turbine certainly calls for a different skill and hard task masters. Here again use of safety tools for self-protection is also important. The periodical calibration of such tools and giving them to the O & M agency/contract teams is most important.

Generally, it is understood once in 4 years, there is a separate check list for master maintenance and a sort of overhaul inspection and replacement or repair exercise is expected once 10 years are completed.

It is generally known that the turbine technology when borrowed, does not go through adjustment in such procedures and also necessarily to make changes in the check lists for items which are not used or might not have been fitted as they are not appropriate for the local regions of use, like Ice detection, aviation lamps, heaters, use of different types of sensors, etc.

It is interesting to point out while carrying out the hydraulic check; one should not meddle unnecessarily with these joints/ fittings. There is a separate set of tools and it needs specific skill (not plumbing quality) and items which are assembled in factory –better not to be disturbed unless there is a necessity to leakage prevention?

One of the most important aspects of preventive maintenance is to ensure the housekeeping check at all areas of the turbine. This upkeep is so important from the point of fire hazard prevention, by ensuring the removal of waste materials and oil spillage, if any, from previous maintenance activity. Also attention is needed to clean up any omission which can cause accidents, while working in the turbine. This housekeeping is not only to take care of cleanliness but also to ensure that the factory set status of dressing of wires, plugging the passage for the insects, reptiles, etc. into the electrical system. It is advisable to record the missing screws in fastening the covers or closure of panels during the last carried out maintenance works. It is better to record the current software version running in the turbine to ensure the latest update in vogue.

There is generally a check on all functioning of sensors and settings. If there is any malfunction, the same needs to be attended. Thus, the spare part availability is very critical before starting this preventive maintenance exercise. It is criminal to consider bypassing these sensors, apart from checking the settings. Here there is a need for the reference of the updates carried out while attending the breakdowns and the setting changes made known to the preventive maintenance team, instead of them resetting to the document they carry, thus defeat the improvement which has gone through.

Apart from the main turbine, there shall be plans to carry out work on balance of plant items, viz. transformer, switchgear, yard, etc. at the same time. Added to this, the work should extend to all the power lines up to the evacuation point belonging to project and investor. This check can ensure snapping of connection, prevention of sparking & deterioration of connectivity, especially during the good power generation times. Re-calibration of protection relays, etc. need to be taken.

It is interesting that the investor shall notice occasionally the turbines get into break downs after preventive maintenance job done. There is some learning for future similar exercise and also to make improvements in skills of the team members involved, thus avoid such unnecessary downtime.

In conclusion, the management should inculcate a philosophy for seriousness in this activity, which otherwise can be overlooked and attempt to carry out only to satisfy the investor. The benefit from a good job having given due importance to all that is said above can be seen consistently throughout the life of the WTG.

Snippets on Wind Power

ExxonMobil may Tie up with GAIL to Set up Green Energy Platform

ExxonMobil Corp. may shortly form a partnership with state-owned GAIL (India) Ltd to set up a green energy platform in India. The US oil firm's increasing focus on India is an acknowledgement of the growing importance of the world's third largest energy consumer. The proposed joint venture (JV) to be announced shortly by the Irving, Texas-based firm also marks a change in the global energy architecture, with India at the centre of oil majors' future growth plans. The proposed ExxonMobil-GAIL tie-up comes against the backdrop of Infrastructure Leasing and Financial Services Ltd (IL&FS) agreeing to sell its 874 megawatts (MW) operational wind energy portfolio to the state-run gas utility for ₹ 4,800 crore.

Source: Live Mint, 17 May 2019

Renewable Energy Certificate Sales Down 65 Per Cent to 3.68 Lakh in April 19

The sale of renewable energy certificates dropped by about 65 per cent to 3.68 lakh units in April as compared to 10.62 lakh in same month last year due to lower supply, according to official data. Indian Energy Exchange (IEX) and Power Exchange of India (PXIL) are the two power bourses in the country which are engaged in trading of renewable energy certificates (RECs) and electricity.

Source: PTI, April 28, 2019

Utility Scale Wind-Solar Hybrid Energy Systems Latest Trend in Renewable Energy Technologies

Subbian. S, Vice President, Regional Engineering
Siemens Gamesa Renewable Power Private Limited, Chennai

Hybrid energy system typically utilizes two or more renewable energy sources together in order to achieve higher system availability, lower cost of energy and efficiency. In the recent years, hybrid energy systems are gaining enormous importance in view of increasing power demand and enhanced scope for better utilization of renewable energy. The wind-solar hybrid concept introduced to make use of the existing wind power plant's infrastructure with the introduction of solar as a brownfield or to develop a new green field hybrid system involving wind and solar systems.

With drop in tariff of more than 40% in India from Feed in Tariff (FiT) to auction business scenario, stakeholders are finding difficult to maintain the business without affecting the bottom line. One of the best ways to improve the utilization factor of land is by bringing together wind, solar and energy storage, so that, we can improve the plant load factor (PLF or CUF). The hybrid system is going to be the future of renewable energy with wind as a primary source, for the reason that solar irradiation area/land is much easier to identify than wind potential land.

The system with combination of different sources of energy, i.e. the hybrid system is not new concept. It has gained more consideration during the last two decades by many researchers due to various techno-commercial benefits. They presented a methodology to perform the optimal sizing of an autonomous hybrid PV/wind system. Their methodology aims at finding the configuration, among a set of systems components, which meets the desired system reliability requirements, with the lowest value of levelized cost of energy.

With market potential more than 10 GW/year; India is a perfect market for hybrid projects as we have many states that are rich in both; wind and solar energy resources. Wind and solar power when fed into the same transmission lines, will allow developers to efficiently use the available infrastructure, thus lowering the cost of energy and tapping the best of PLF from the available sources of energy. There is a need to push for more Indian states to formulate hybrid energy policies and create a market for Brownfield Hybrids to utilize the existing capacities.

The average solar insolation available across India is 1700 Kwh/sq. meter (30% more than Europe). i.e., 5-7 kwh/sq. meter per day potential. In addition to this, India is having advantage of having the wind-solar seasons that are complementing to each other to sustain the PLF of solar-wind hybrid and hence lesser COE.

The sketch below is showing emerging technology of hybrid systems.

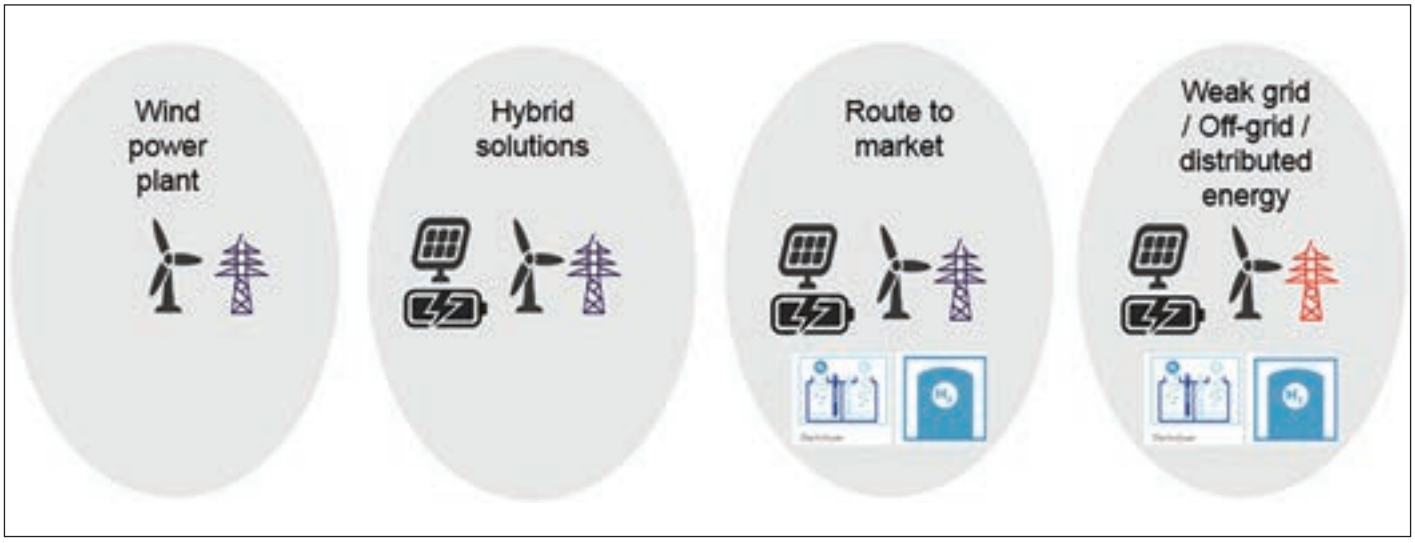


Figure 1: Emerging Technology of Wind-Solar Hybrid Systems

Classification of Hybrid Energy Systems

The wind-solar hybrid systems has variety of options namely interconnection at pooling substation, interconnection at MV side, and common converter for wind and solar as illustrated in the diagrams below.

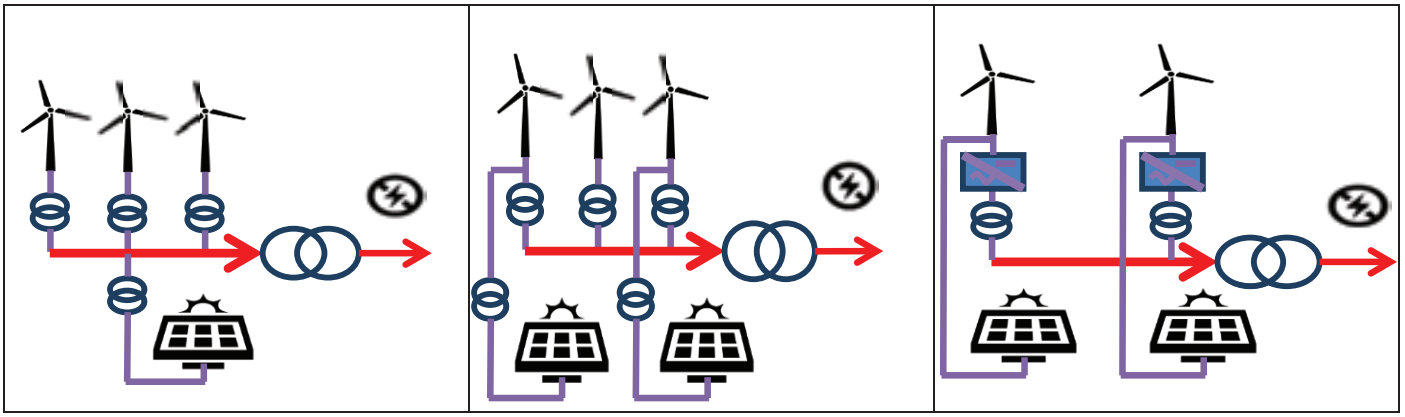


Figure 2: Different Wish Configurations at Utility Scale

Advantages of Wind-Solar Hybrid Systems

The combination can provide cost reduction up to 8 to 10% through the following advantages.

- Solar and wind sources complement each other by nature
- Windy winters and sunny summers + Windy nights and sunny days
- Optimize energy generation, capacity factor and grid stability
- Cost savings due to shared land, transmission infrastructure and O&M
- Profitability improves through higher AEP
- Grid friendly, reliable, stable and balanced supply
- Tailored energy storage system gives additional generation

The major advantage of system lies in the realization of higher Plant Load Factor, lower Capex and optimised Opex using common power evacuation system and common infrastructure (SCADA, Service facilities, land/pathway, etc). It is possible to provide stable and balanced energy supply to the grid at any point of time irrespective of seasonal variations and grid under extreme circumstances.

There are various flexible solutions available to bring down the cost energy through hybrid. Siemens Gamesa has installed hybrid solution with wind-solar-diesel-battery solutions as an off-grid solution and is successfully running it as a prototype installation.

The Ministry of New and Renewable Energy (MNRE) has recently released the wind-solar hybrid policy, aiming to achieve hybrid capacity of 10 GW by 2022. Few states (Gujarat, Andhra

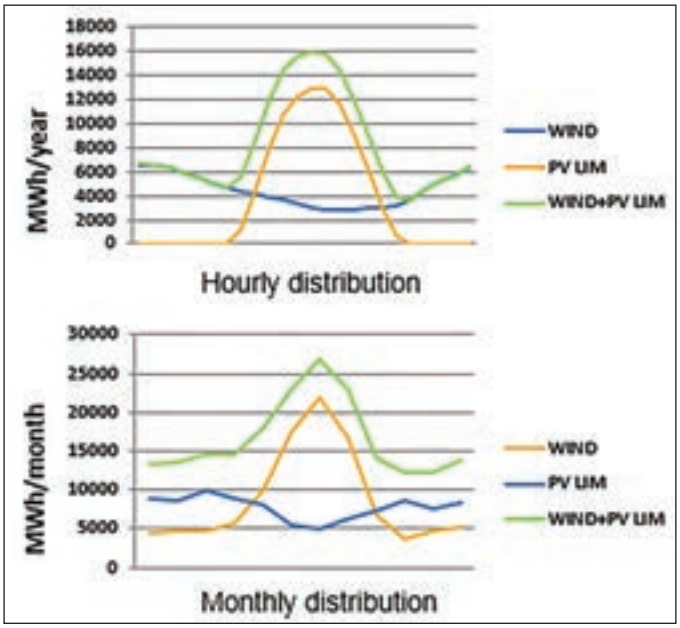


Figure 3: Complimenting Nature of Wind and Solar Sources

Figure 4: Benefits of Making Hybrid System by Adding Solar

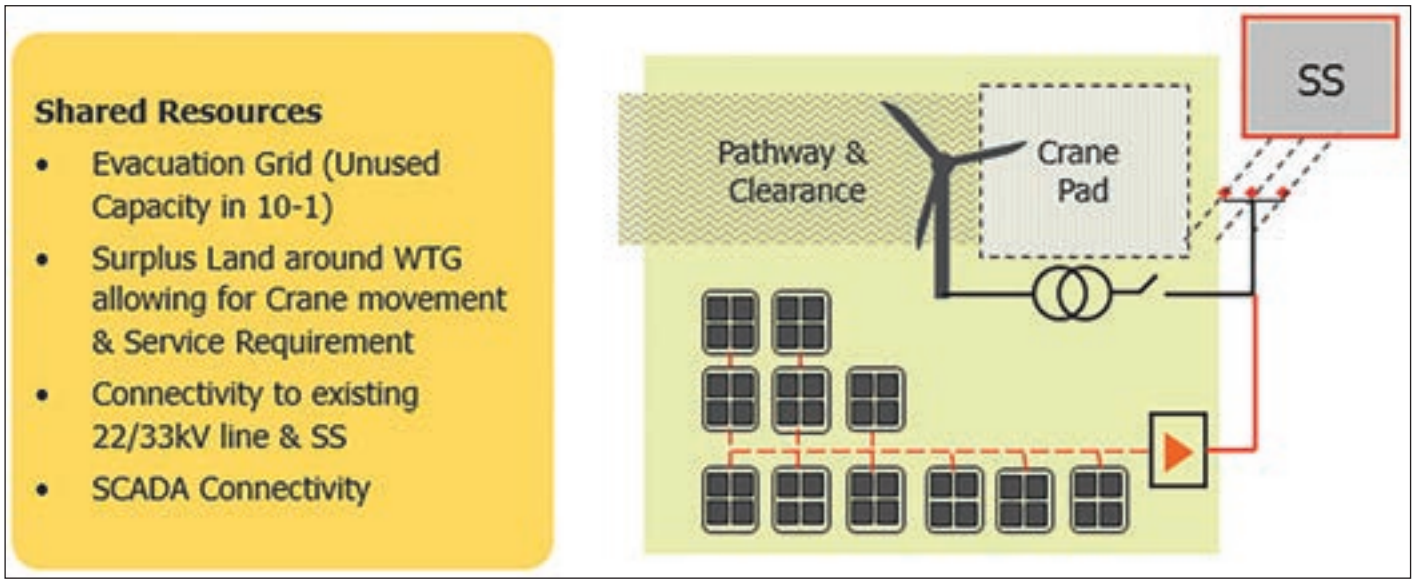


Figure 5: Hybrid System Proto Model with Energy Storage

Pradesh), realizing potential of hybrid power plants, have also released draft policies (hybrid policy of Gujarat is finalized and notified). With more states realizing its potential, the number of such plants would increase in years to come.

However, the said policies are very primordial in nature. Extensive adoption of wind-solar hybrid solution in the country is still being limited by some of the factors such as: regulatory framework for such systems, the non-availability of low-cost financing and limited awareness about the benefits of the systems, especially when combined with battery storage.

From a regulatory standpoint, the policy states that the Central Electricity Authority and Central Electricity Regulatory Commission (CERC) shall formulate necessary standards and regulations including metering methodology and standards, forecasting and scheduling regulations, REC mechanism, grant of connectivity and sharing of transmission lines, etc. However, a clearer roadmap of implementation of such regulations will further act as a catalyst thus pulling the industry to actively pursue the technology.

Further, at the initial stages, it is important to introduce suitable incentives to promote these systems. Low-cost financing for hybrid projects can be made available through IREDA and other financial institutions, including multinational banks. There is also a need for the regulators to define the guidelines for determining generic tariffs for solar-wind hybrid systems. Overall, the regulators and policymakers need to draw up a roadmap to promote the development of solar-wind hybrids; work out the optimum investment for evacuation and substation infrastructure; and define tariff, net metering and other guidelines to bring utilities on board to buy power from such systems.

To summarize, it is possible to increase PLF to higher levels which results in faster payback with reduced development costs per MW. It is also possible to optimize the O&M as well as site management scenarios to greater extent. With the available modern energy storage options, it is possible supply continuous high quality power and meeting grid requirements as well.

Snippets on Wind Power

Centre to Invite Bids for 40 GW Battery Plants

The government is considering a plan to establish battery making capacity of 40GW to give a boost to its electrical vehicles and renewable energy initiatives, an official said. It will ask states to compete for the opportunity to set up internationally competitive facilities that will also service global markets. Domestic and global battery makers will be asked to bid for setting up plants in the selected states.

The proposal is expected to entail investments of $40 billion in the next two-three years and is likely to garner interest from global battery manufacturing firms and renewable energy players such as SoftBank, Tesla and Panasonic, a government official said. Batteries and battery cells are imported from the likes of China and the US. With plans to add 175 GW renewable energy generation capacity by 2022 and ensure that 30% of India's vehicles are electrically powered by 2030, the demand for battery storage is pegged at 300 GW.

Source: ET Bureau, 8th May 2019

Snippets on Wind Power

TANGEDCO Opts for GPS to Get Wind Power Generation Real Time

TANGEDCO has started measuring wind power generation real time with the help of GPS over the last few months. GPS system has been installed in all windmills across the state and discom has been able to measure the power generation from a windmill without going to the spot. Till now an assessor with the help of an equipment was recording the generation and there were several lacunae in such measurement, causing losses to the discom. TANGEDCO has also set up smart meters in all high tension consumers. Due to this, TANGEDCO is able to get the bill from the wind power companies for selling wind power within 5 days of a new month, as against a delay of over a month earlier. Tamil Nadu is the first state to have used GPS in windmills.

Source: TNN, April 25, 2019

Gujarat Electricity Regulatory Commission Keeps Power Tariffs Unchanged for 2019-20

With electricity distribution companies (discoms) not seeking any increase in power tariffs, the Gujarat Electricity Regulatory Commission (GERC) has kept the tariffs unchanged for 2019-20. The regulator has also merged two slabs of power consumption into one, which will reduce energy charges for residential consumers falling under this category. In order to simplify the tariff structure for residential consumers, GERC has reduced the number of slabs from five to four by merging 100-200 units and 200-250 units slabs into one slab of 100-250 units.

Source: TNN, April 26, 2019

India's Power Goals Further Out of Reach as Discom Losses Rise

The losses by India's power retailers are set to rise, reversing two years of declines they enjoyed since government unveiled a plan to make the ailing utilities profitable. Combined losses by state distributors that signed up for the federal government's reform plan in the first nine months of the fiscal year rose to about 240 billion rupees ($3.4 billion), a 62 percent jump from a year earlier, amid an increase in coal and power costs, according to Mr. Ajay Kumar Bhalla, India's power secretary. As part of Modi's power industry revival plan, called UDAY, states took over 75 percent of the debt of their distribution utilities to help ease their debt burdens.

Source: Bloomberg, April 30, 2019

Oil Industry under Pressure to Respond to Climate Change

Paris: The oil industry, under mounting pressure from environmental activists to react more quickly to counter climate change, has begun to adapt its strategy but is struggling to convince critics it is doing enough. The pressure isn't only coming from environmental activists. "Investment funds are now requiring oil and gas companies to explain how climate change might affect a company's value," said David Elmes, a professor at Warwick Business School. " - Oil to gas - The big actors in the sector -- BP, Chevron, ExxonMobil, Saudi Aramco, Shell, Total and others -- have banded together in the Oil and Gas Climate Initiative (OGCI), which has a billion-dollar war chest to fund initiatives to reduce climate change emissions. The companies are trying to limit their methane emissions, which escape when fossil fuels are taken out of the ground and transported.

Source: AFP, April 29, 2019

India to Install 54.7 GW Wind Energy Capacity by 2022: Fitch Solutions

"We remain cautious on India meeting its ambitious 2022 targets for wind power capacity growth, as land acquisition issues and grid bottlenecks will lead to delays to project implementation in the sector. We forecast India to install 54.7 GW of wind capacity by 2022, compared to the 60 GW government target," Fitch Solutions Macro Research, unit of Fitch Group, said in its outlook for the country's renewable energy sector.

The agency also said it believes that concerns about the economic viability of low tariff projects from India's wind capacity auctions raise the risk that investor appetite will weaken and auctions will be postponed. "The combination of several challenges in the country's wind power sector will hit near-term growth momentum, including land availability hurdles, grid access bottlenecks and concerns over the viability of low tender bids. This informs our view that India only will add on average 4.5 GW of wind capacity annually between 2019 and 2022, with the aforementioned risks highlighting further downside risk," the report said.

Source: PTI, April 28, 2019

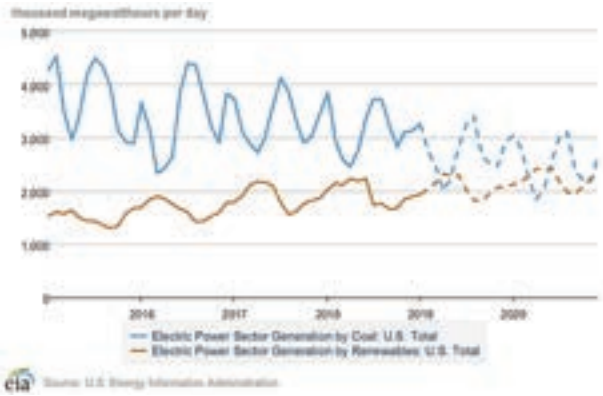
Several Wind Energy Projects in Slow Lane Since 2017 Auctions

A large number of wind energy projects have been bid out since auctions for such projects began in early 2017, both by Solar Corporation of India (SECI) and state agencies, but only a small fraction of them have been commissioned so far. TANGEDCO auctioned 500MW of wind capacity in August 2017. The PPA was signed in October 2017,

with project completion time of 15 months. So far only 50 mw has been commissioned. The winners have the time till June to complete the project, after which the bank guarantee will be encashed proportionate to the period. But it is clear that neither project will be completed by June.

ET Bureau, April 22, 2019

Renewable Energy Output Exceeds Coal in US for the First Time



The coal-fired power plants accounted only for 20 percent of total U.S. electricity generation in April, while renewables made up 24 percent. It's the first time on record that renewable energy generated more than coal on a monthly basis. The trend is expected to continue in May.

Natural gas is the largest source of electricity in the U.S. at this point, taking home 35 percent in April and expected to account for 36 percent in May. An analysis by Energy Innovation shows that in 74% of cases it is cheaper to build new wind and solar than to keep running existing coal plants today and that number will increase to 86% by 2025. Still, renewables account for less than 10% of all electricity generated in the United States overall at the moment.

Source: Saur Energy International, 3rd May, 2019

KKR, GIC Betting on India's Power Sector with $400-Mn Investment

Global investment firm KKR & Co Inc together with Singaporean Sovereign wealth fund GIC, will acquire up to 57 percent of India Grid Trust (IndiGrid) for about $400 million. The deal would mark KKR's first infrastructure investment in Asia since it set up a team late last year that focuses on the sector in the region. The pair will invest 20.64 billion rupees ($295 million) for a 42 percent stake in the trust via a preference equity issuance. KKR, having applied to become sponsor of IndiGrid, will then acquire a 15 percent stake from its current sponsor, Sterlite Power Grid Ventures Ltd, pending regulatory approval.

Source: REUTERS, April 30, 2019

Costa Rica has run on 100% Renewable Energy for 299 Days

In the last four years, Costa Rica has generated 98.53% of its electricity from renewable sources. How? With its unique geography, forward thinking solutions, and commitment to sustainability, Costa Rica has used its rivers, volcanoes, wind, and solar power to generate its country's power. That means the government did not burn any oil, coal, or natural gas to power the country. No other country this size has done this. Costa Rica invested early in the power of renewable energy resources and made it a priority to become environmentally sustainable.

TANGEDCO Moots Repowering of Old Low-Capacity Wind Mills

TANGEDCO has mooted repowering of old wind energy generators with higher capacity and modern equipment. As Tamil Nadu had taken major strides in wind energy generation quite earlier than other states, some of the mills are as old as 33 years and many are below 1 MW capacity. The discom has asked wind power companies to come forward with proposals to rejig the mills on or before April 30. Along with upgradation of windmills, Tangedco will also go for capacity addition of sub-stations. Most of the machines installed around 1986 are having the capacity of 200 KW, 225 KW and 250 KW. New machines are available in capacities like 750 KW, 850 KW, 1500 KW, 2000 KW and 2100 KW.

Power Producers Demand Level Playing Field in Allocation of Transmission Projects

The Independent Power Producers Association of India (IPPAI) has written a letter to the Power Ministry demanding level playing field for private sector players via-a-vis state-run Power Grid Corporation of India (PGCIL) in allocation of electricity transmission projects. The industry body pointed out that in view of the dominant position of PGCIL reflected in its predatory bid pricing, the ministry should ensure that the low-cost pool of funds raised by the company are not allowed to cross-subsidise TBCB (tariff based competitive bidding) projects.

Source: PTI, May 05, 2019

Cyclone Fani Fails to Bring Rain, but Wind Power Generation Picks Up

Cyclone Fani may have failed to bring rain to Tamil Nadu, but the heavy wind it generated has been powering the wind mills in the state over the past two days. Tangedco evacuated 74 million units of wind energy on May 1 and 90 MU on Thursday, which was more than 25% of the total power consumption in the state. The increasing wind power generation and evacuation has helped to keep nearly 1,700MW thermal units owned by Tangedco

on standby mode saving coal and supporting a clean environment.

Source: Times News Network, 5th May 2019

Over 1000 MW Wind Projects Running Behind Schedule

Many of the projects won by developers in the two wind auctions conducted by Solar Corporation of India in 2017 have not been completed yet, according to sources close to the development. The commissioning deadline for the first tranche of projects of 1050 MW was October 2018 and for the second of 1000 MW was May this year. But only 690 MW of the first lot and a mere 200 MW of the second are complete. Industry insiders say delays could largely be attributed to obtaining connectivity.

Source: ET Bureau, May 06, 2019

India to Exceed Climate Compliance under Paris Agreement: Moody's

India will exceed the compliance of its commitment made to address climate change through green energy installations under the landmark Paris agreement, according to global credit rating agency Moody's Investors Service. The share of generation capacity from non-fossil-based fuel sources in the country will likely increase to 45 per cent by 2022 as India plans to increase its renewable energy capacity, excluding hydro, to 175 Gigawatts (GW) and both wind and solar have already achieved grid parity, according to Moody's analysis. "This is higher than India's commitment under the 2015 United Nations Climate Change Conference (UNFCCC) in Paris (the Paris Agreement) to have 40 per cent of the country's total generation capacity from non-fossil-based fuel sources by 2030," the agency said in a report titled "Power Asia - Climate goals, declining costs of renewables signal decreasing reliance on coal power".

Gujarat Wind Auction Winning Tariff Remains Unchanged at Rs 2.80 per Unit

Wind power tariffs remained unchanged from the beginning of the year in the 745 MW of capacity awarded through auction by Gujarat's state utility on 13th May 2019, several developers told ET. Tariffs in the wind auction conducted by the renewable energy ministry in February were in the range of Rs 2.82 to Rs 2.83 per unit. "This bid reflects the positive health of utilities in the state of Gujarat and excellent support from partners," said UB Reddy, managing director of Enerfra. The state utility's tender was undersubscribed—of the 1,000 MW of capacity put up for auction, bids were received for only for 853 MW, of which the 745 MW was allotted.

Source: ET Energy World, May 14, 2019

Energy Technology: Why India Must Adopt a New Policy to Boost Energy Security

In the recent past we have been forced to stop buying oil from Iran, dragged to the WTO for wanting to encourage indigenous solar technology as part of our solar policy, denied technology transfer and funding as promised by the Paris Climate Change accord, etc., etc. In the renewable energy sector, the four priority technologies are: (i) Highly efficient solar PV Cells (ii) Commercially viable scaled up solar thermal power plant (iii) Higher capacity and higher efficiency wind machines for onshore and offshore use. (iv) Commercially viable energy storage device like a battery or other novel technologies without the need for lithium and cobalt. This technology is also needed in electric vehicles. Renewable energy technologies can possibly offer a complete solution only in the long term. A medium term solution demands a judicious mix of fossil and renewable resources with coal gradually reducing its share.

Source: ET Energy World, 20th May, 2019

India Becomes Fastest-Growing Energy Market in the World

"Among major areas, energy investment has risen most rapidly in India in the past three years, up 12 per cent," The International Energy Agency (IEA) has said in its latest World Energy Investment (WEI) 2019 report." The report said that the lower-middle and low-income countries accounted for less than 15 per cent of the energy investment in 2018 despite containing well over 40 per cent of the world's population. "In recent years, the fastest investment growth within this group has come from India with rising power sector spending," the report said.

Source: ET Energy World, May 14, 2019

Renewable energy is now a Commercially Attractive Investment Opportunity!

Dr. Frank Rijsberman, Director General, Global Green Growth Institute offers an encouraging tour d'horizon across the world's fast changing energy markets. Renewable energy has gained a foothold in many countries as the technology of choice, accounting for one-third of the world's total energy capacity. According to a recent report by the IRENA, renewables and electrification can help achieve more than three-quarters of global emissions-reduction goals, demonstrating a positive outlook for energy sources. The energy transformation has picked up momentum over the past few years due to a combination of better technology, lower prices, and the benefits of scale, leading countries to realize the immense renewable potential, which could meet the global energy demands by 2050.

Recharge Time for Renewable Power

Though they face headwinds, developers of green energy remain upbeat while gearing up for a mid-course correction It's not all tailwinds and sunshine for the country's renewable energy sector. It's actually time to take stock of the various issues impeding the sector's progress, say industry watchers. Significantly, with 70 per cent of fresh power generation capacity set to come from renewable energy, a concerted effort is required for its sustainable growth, they stress. Interaction with leading players in solar and wind energy shows that while they are bullish about the prospects, they expect some mid-course correction towards the larger goal of achieving the target of 175 giga watt (GW) by 2022. Developers are faced with payment concerns, discoms are hard-pressed to honour payment commitments, large-scale auctions (giga watt plus) are getting tepid response, integration of renewables with fossil fuel-based projects has been tough, and old power purchase agreements continue to dog discoms. All of these, in turn, are making it tough for developers to raise funds.

Regulatory Assets of Power Sector Stand at ₹ 76,963 Cr: Report

Regulatory assets include receivables from consumers allowed by regulatory authorities. With total outstanding regulatory assets of thermal power sector across the country reaching Rs 76,963 crore, the proposed bond issuance programme through the securitisation of such receivables will be beneficial to both investors and borrowers, according to India Ratings. According to the quantum of existing regulatory assets analysed by the rating agency as per the latest tariff orders till FY2017-18-FY2018-19, the top three states including Uttar Pradesh, Maharashtra and Jharkhand, account for around 87 per cent of the current regulatory assets market worth Rs 76,963 crore.

Source: PTI, May 21, 2019

Adani Green Energy, ReNew Power only Bidders in Hybrid Auction

Renew Power and Adani Green Energy made techno-commercial bids for 300 MW and 600 MW, respectively in the latest tranche of Solar Energy Corporation of India's wind solar hybrid tender for 1,200 MW of capacity. The poor response was attributed to the ceiling tariff set at Rs 2.70 per unit, which experts said is too low to be viable for most developers. The tender also specifies that the capacity utilisation factor (CUF) has to be at least 30%. CUF is the standard for measuring the performance of a plant. "In wind projects usually the CUF is 35% at the best sites and solar it is about 21%. Because the CUF is specified at such a high level, most of the capacity will have to be wind based, he added.

Source: ET Energy World, May 21, 2019

Suggestion to Merge Renewable and Power Ministries: RK Singh

The Ministry of New and Renewable Energy (MNRE) and the Ministry of Power (MOP) may be merged to form one integrated Ministry if a suggestion for the same finds favour within the government. Newly-appointed Minister of State (Independent Charge) for Power and New and Renewable Energy, Mr. R. K. Singh, confirmed that such a suggestion has been received, but said that there has not been enough deliberation for it to become a proposal within the government.

Source: Hindu Businessline, June 02, 2019

Panasonic to set up 1 lakh charging sites for e-vehicles

Japanese electronics giant Panasonic is planning to set up one lakh charging stations and telematic solutions across top 25 Indian cities by 2024 to power over a million vehicles. The company – a key partner (battery cell supplier) of American electric vehicles maker Tesla – plans to set up mini charging facilities at parking areas, malls, petrol pumps, and specially developed zones across cities such as Delhi, Pune, Bangalore, Chennai, Amravati, Hyderabad, Gurgaon, Noida and Ghaziabad. The telematics solution – that has been developed at the company's India R&D facilities – will be pitched to utility providers as well as manufacturers of vehicles, equipment and lithium-ion battery to help them better understand user patterns, and calibrate their products and services accordingly.

Source: TNN, May 16, 2019

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Know Your Member

Envision

ENVISION - To Solve the Challenges for a Sustainable Future

About Envision

- World's Largest Energy IoT platform, Connecting 100GW Energy Assets
- Global Leading Smart Wind Turbine Company, Ranking #5 worldwide, Ranking #2 in China
- Integrator of Global Energy IoT & Smart City Ecosystem and Major Shareholders of Leading Energy Tech Companies: ChargePoint, AutoGrid, Bazefield

Envision is a leading digital energy company with deep industry expertise. It owns the world-leading energy IoT Operating System, EnOS™, which currently manages 100 GW of energy assets globally. By integrating with technology partners such as ChargePoint, AutoGrid, and Bazefield, Envision is able to deliver a comprehensive energy IoT platform and smart city ecosystem. Envision also has deep wind industry expertise, thanks to its comprehensive wind farm, turbine, and digital energy product development and R&D efforts. It includes wind farm smart micrositing, wind resource assessment, wind farm engineering design, and wind farm asset operation, all designed to optimize performance and improve the rate of return on the wind farm investment.

Smart Wind Turbines

Envision turbines are precisely engineered for performance and reliability. Sensor-integrated turbines optimize wind farm performance and financial return by means of machine learning. The 2MW, 3MW, and 4MW turbine platforms are designed for a full range of wind speeds onshore and offshore applications.

Envision has taken lead in the industry to develop the "smart turbine" with its exclusive core technology of smart controls, advanced measurement methods, expert data analysis, and active performance controls. The effective combination and application of these groundbreaking technologies have enabled these turbines to accurately perceive their own status and external environmental conditions. This ensures that the turbine will function at its optimal working condition for maximum power generation and longer service life. Through a "software-defined turbine" approach, Envision has surpassed the technological limits of traditional wind turbines, and increased the efficiency of wind power generation by 15%.

India Presence

Envision has set up its wholly owned subsidiary in India i.e. Envision Wind Power Technologies India Pvt. Ltd. and bagged orders from two leading independent power producers in

2018 for turnkey wind power projects aggregating to 232.5 MW. The projects are at advanced stage of construction in Gujarat and first phase of one project has already been commissioned. Envision inaugurated its new India headquarters and a state-of-the-art remote digital control centre at Concorde block of UB City, Bangalore in January 2019.

Envision is the first Chinese company to have two of its wind turbine generators (WTGs) included in the Ministry of New & Renewable Energy's Revised List of Models & Manufacturers (RLMM). These include the 2.3 MW WTG with a 115 m rotor diameter and the 2.5 MW WTG with a 131 m rotor diameter, which is amongst the largest in the country.

Envision has invested $25 million to set up a manufacturing (assembly) at Chakan, Pune. Nacelles and Hubs are assembled at this state-of-the-art facility with a capacity of producing 20 each of these per month, with a flexibility to double the production capacity within couple of months. Manufacturing of steel tubular towers and rotor blades in the country, is scheduled to commence towards the end of 2019 achieving complete indigenization of all major components for the WTG.

Mission

Envision's mission is to "solve the challenges for a sustainable future"; the company is committed to creating a world of beautiful energy where everyone has access to clean, secure and affordable energy. Founded in 2007, Envision's heritage is in the wind sector and is currently one of the industry's leading wind technology companies. Headquartered in Shanghai, Envision has regional offices across India, Asia, Europe, North and South Americas and has established global R&D and engineering centers in Singapore, Denmark, Germany and the United States. Presently, Envision has a total worldwide annual wind turbine manufacturing capacity of 10 GW across all platforms.

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