Indian Wind Power

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In this issue...

Technical focal point for development of wind energy

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Ministry of New and Renewable Energy, Government of India

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IWTMA
INDIAN WIND TURBINE MANUFACTURERS ASSOCIATION

Indian Wind Power

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Contents

Indian Wind Turbine Manufacturers Association

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(For Internal Circulation only)

From the Desk of the Secretary General – IWTMA

Dear Readers,

The COP27 Climate Meet at Sharm El Shaikh, Egypt has just concluded. India has urged mindful use of resources as a key in climate fight. India has also urged the world for a paradigm shift from "mindless and destructive construction to mindful and deliberated utilization of resources" and every nation to undertake a collective journey to deal with the global problem with equity and climate justice.

It is interesting to note that the COP27 also appeals for the sustainable global transport system at an all-time high. Maritime and Aviation sector has promised to take action at the event. This is a welcome move as the transport sector is one of the top polluters globally.

India has pledged towards Net Zero by 2070 with 50% of all power from Renewables in the energy mix by 2030. It is interesting to note that per capita consumption of power will increase rapidly for a developing country like India. It is said that coal will continue to play a large role despite the green energy push and the key question is how we absorb the emission. The Ministry of Coal is working out aggressive strategies of plantation using mined water for plantation, irrigation and drinking purposes.

India has taken the stewardship of G20 and post COP27 meetings will see a bigger thrust towards renewables. Hon'ble Prime Minister has said that it shows the country's commitment to *'Vasudhaiva Kutumbakam' (the world is one family).*

Government is going ahead in auctioning of blocks for offshore and it is heartening to note the active participation of both Denmark and U.K. This move is the "right step in the right direction" to harness nearly 70 GW of offshore potential both in Gujarat and Tamil Nadu.

It may not be out of place to mention that the domestic investment primarily from the retail sector has been neglected in the current renewable procurement process. MSME plays a large role on both demand and supply side and goes well with "Make in India" and "Atmanirbhar Bharat".

While affordable tariff to all consumers is prime, unsustainable and non-bankable tariffs in the long run can damage the entire eco-system, and we are witnessing that exports are far exceeding the domestic requirements.

As we are nearing the end of 2022, we wish our readers a "Bright, Windy Prosperous Year in 2023" and our long endless march towards "Clean Green India".

With regards,
D.V. Giri
Secretary General

Welcome to Secretary, MNRE

Shri Bhupinder Singh Bhalla, IAS, 1990 batch, UT cadre is the new Secretary in the Ministry of New and Renewable Energy (MNRE). Indian Wind Turbine Manufacturers Association (IWTMA) heartily welcomes Shri Bhupinder Singh Bhalla and extends all support and cooperation.

Farewell to Sri Indu Sekhar Chaturvedi, IAS, Secretary, MNRE

Indian Wind Turbine Manufacturers Association bid farewell to Sri Indu Shekhar Chaturvedi, IAS, Secretary, Ministry of New and Renewable Energy, Government of India on his superannuation in October 2022. Sri D. V. Giri presented a memento to Sri Chaturvedi in the presence of IWTMA members.

HYBRIDDRIVE – The Promising Mid-Speed Drivetrain for Offshore Wind Turbines

Ms. Rieke Stening
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Flender GmbH, Bocholt, Germany

Over the last years, climate change has become an increasingly central concern for governments and society. The geopolitical situation as well as the Paris Agreement and COP26 are forcing the renewable energy transition and presenting the wind industry with new challenges. In order to meet the future energy demand of the world, capacities must be massively expanded. Offshore wind is particularly promising in this respect, as there is still great performance potential to be tapped. It used to be common practice in the wind industry for the turbine OEM to break down a planned drive system into individual main components and specify each component separately. However, this has been changed, particularly due to the huge pressure to reduce LCoE (Levelized Cost of Energy) in many major markets. Leading OEMs are already focusing on developing mid-speed drivetrains and the associated system-level cost savings.

The HybridDrive is characterized by high reliability, compact design and high-cost efficiency at system level in increasing power classes.

As a solution the HybridDrive was invented. Already in 2012, its visionary idea was born, directly connecting the gearbox and generator, thus realizing the most compact and lightweight drivetrain. Through years of test and field experience with systems between 3 to 6 MW the design, guidelines and competences could be refined continuously. Instead of being connected by a coupling, the gearbox and generator now share only one common bearing and housing, without need for any safety clutch.

Increasing System Reliability with the HybridDrive

Today, increased operational reliability and short downtimes are particularly important for offshore applications, as the turbines are difficult to reach and service measures are therefore very costly. The system concept of the HybridDrive will support and optimize this as follows:

The modular design of the HybridDrive enables a drivetrain development with reduced technical risk. Mechanical and electrical components also have been developed optimally and manufactured reliably for over 40 years. The functional integration of gearbox and generator allows a compact and lightweight design with only one common bearing for the generator and

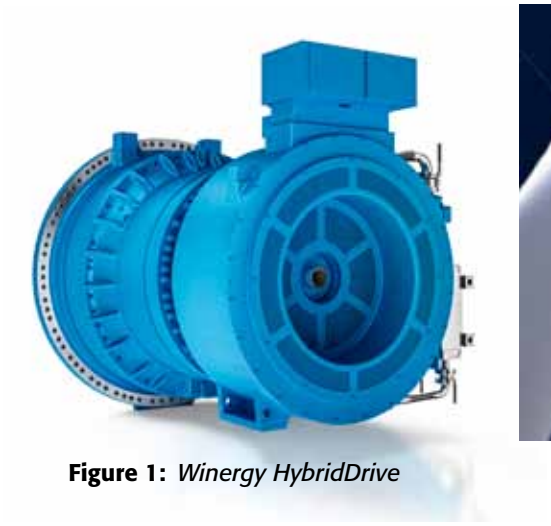

Figure 1: *Winergy HybridDrive*

Figure 2: *HybridDrive - Inside a Turbine*

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Start your journey at:
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Figure 3: *HybridDrive - In the making*

Figure 4: *HybridDrive - Assembly and Completion*

the sun shaft of the intermediate stage (IMS) and without need of a Non-Drive-End (NDE) bearing for the generator. Depending on the required level of braking torque, the brake disc can be integrated internally to the drive end side (DE) of the generator.

Due to the mid-speed drive technology, the noise level decreases significantly along with the reduced output speed of the gearbox. In addition, the HybridDrive may feature an oil-water-cooled generator without an additional fan usually used for air-water-cooled or direct air-cooled generators. Next to the high-power density, the outstanding encapsulation of the stator winding increases system safety. Immediately after assembly, end-of-line system tests are carried out at factory to ensure the highest reliability on all components of the drivetrain.

The HybridDrive is characterized by high reliability, compact design and high-cost efficiency at system level in increasing power classes. The supplier for the HybridDrive system offers its customers mechanical and electrical competence to support the growth in renewable energies in onshore and especially offshore wind application.

SnippeTs

Adani Green Energy Forms 3 New Step Down Subsidiary Companies for Renewable Energy

Adani Renewable Energy Holding Four Limited has incorporated three new subsidiary companies for renewable energy business with the main objective to generate, develop, transform, distribute, transmit, sale, supply any kind of power or electrical energy using wind energy, solar energy or other renewable sources of energy. The three new subsidiary companies are Adani Renewable Energy Thirty Six, Adani Renewable Energy Forty Limited and Adani Renewable Energy Forty Seven Limited.

Source: Livemint.com, 3 October 2022

India's First 4.20-MW Wind Turbine Generator to Be Commissioned Soon in Tirunelveli District

India's first 4.20-MW wind turbine generator, a single unit with the largest generation capacity, has been installed at Vadalivilai near Valliyoor in Tirunelveli district. The Brazil-based WEG has installed the state-of-the-art gearless wind turbine generator at a cost of Rs. 88 crore at Vadalivilai, which is close to the advantageous Aralvaimozhi Pass. It is only a prototype machine as the WEG had planned to install 7-MW wind turbine generators in this region in future to augment non-conventional energy generation.

Centre Ramping up Measures to Increase Green Hydrogen Generation: Union Minister

The Centre is ramping up measures to increase volumes of green hydrogen generation, Union minister Mr. Bhagwant Khuba has reiterating government's commitment for making India carbon-emission free in future. He highlighted that India is "growing vigorously" in the sector of renewable energy and alternative sources such as solar, wind and electrical energy.

Source: Intellismartinfra.in, 29 September 2022

Government in debut green bonds plans to raise Rs. 16,000 Crore

India plans to issue Rs.16,000 crore ($2 billion) of sovereign green bonds in the fiscal year ending March, as it seeks cheaper funding to meet renewable energy targets. The government will provide details of the planned green debt issuance for the year later, according to a statement from the nation's finance ministry on the second half borrowing plan released. Corporate green bond sales in India has already got going, with companies issuing more than $26 billion of debt, mostly for renewable energy projects.

Source: Livemint.com, 30 September 2022

Experience in Certification according to the Indian CEA Grid Connectivity Standard and German Grid Connection Certification Scheme

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Abstract

The aim of this paper is to exploit the long experience of certification in the field of grid connection according the German Grid Codes in order to propose a relevant Certification Scheme for India considering the latest developments in the Indian Regulations released by the Central Electricity Authority of India (CEA) in February 2019[12]. The proposed scheme will also consider the latest progress within the working committees of the FGW and IECRE. This committee develops and issues the Technical Guidelines for Certification, Testing and Modeling/ Simulation to ensure the high quality of the certification process of decentralized power generation.

I. Introduction

Grid compliance is a relatively young topic in the field of conformity assessment and at present there are only a few countries that have a dedicated procedure or guideline (grid codes) providing the requirements for a grid compliance certification. In the last years, these grid codes have undergone substantial development and the new requirements have been introduced for the grid connection requirements of Power Generating Units (PGU) and Power Generating Systems (PGS). The initial versions of the grid codes were mostly concerned with harmonics, flicker and Low Voltage Ride Through Capability (LVRT). But recent developments in the international grid codes have introduced more sophisticated control requirements like active and reactive power control functions for grid support during normal operation or Fault Ride Through (FRT) events, frequency control with respect to voltage or active power, etc. Not all grid codes have the same complexity of requirements however the grid codes that are available today are broadly categorized under four major areas:

i. Power Quality requirements
ii. Control requirements
iii. Testing requirements
iv. Model validation
v. Site specific requirements

Recent efforts are being made for harmonization of the requirements for grid connection internationally, in order to facilitate the Original Equipment Manufacturers (OEMs) to design and fulfill their PGUs for most grid codes, as well as make the integration process of Renewable Energy Sources (RES) into the grid faster and more efficient for the regulatory bodies and grid operators.

In India, the Central Electricity Authority (CEA), has published an amended Regulation in February 2019[12], with modifications of the requirements from the previous regulations from 2007[10] and 2013[10]. The new regulations include further control requirements like Overvoltage Ride Through Capability (HVRT), frequency control, etc. We gained experience with certification of certain international grid codes which encompass these requirements with more stricter evaluation criteria as compared to the ones required by CEA 2019[12]. We wish to use this experience in order to propose innovative solutions for certification according to CEA 2019[12] to facilitate a faster conformity assessment with more efficient utilization of resources and available evaluation works in other international grid codes. The proposal will include specific suggestions and recommendations for processes, for example on how the test results from a different PGU model can be evaluated to verify if parts of the existing test and evaluation is technically comparable to the PGU under certification or not, how to transfer test results to other PGU variants, how to use software simulations to verify certain control requirements of the CEA 2019[12], etc. The proposed procedure will be based mostly on the transfer rules out of the IEC 61400 series and the FGW TG8[9]. The use of these rules ensures a transfer which is technically feasible and internationally recognized and ensures sufficient accuracy of the transferred results.

In addition, the requirements for conformity assessment according to CEA 2019[12] will be discussed in detail and proposals for the improvement and optimization of this procedure will be presented, based on the extensive experience of certification.

Regarding the structure of the paper, in Section II, the summarized requirements for grid compliance, generalized for

international grid codes is presented. In Section III, the amended requirements of the CEA standard for grid connectivity are presented. Section IV includes proposals for transfer of test results of power quality or electrical characteristics like flicker, harmonics, etc. between different grid codes or different PGU models based on technical similarity and use of software simulations for verification of control requirements like Fault Ride Through (FRT), active and reactive power control, frequency control, etc. The conclusions of the present work are summarized in Section V.

II. Generalised Grid Compliance Requirements

As mentioned in the previous section I, in general the grid codes that are available today are broadly categorized under four major areas:

i. Power Quality requirements
ii. Control requirements
iii. Testing requirements
iv. Model validation
v. Site specific requirements

Among the power quality requirements topics like electrical characteristics of the PGU are verified. These can be harmonic or flicker emission (during continuous operation or switching events), DC current injection, maximum active and reactive power capability (at steady or transient time instances). These are verified based on measurement results.

Among the control requirements, the dynamic performance of the PGU as a response to transient events is verified. Others can be FRT capability verification, active and reactive power control during FRT events, frequency response with respect to active power or voltage. These can be verified based on measurement results or software simulations performed on a software model of the PGU, that has been previously verified based on measurement results.

The testing requirements are based on the required control requirements. The testing of the power quality, active and reactive power capability, FRT functions, etc. has to be done by an accredited test lab according DIN/IEC/ISO 17025 to ensure the quality of the test results which are the basis of the further assessment. The testing has to be done on the specific PGU type.

Software model validation is a specific requirement according to the FGW guideline TG4[8]. For the control requirements like FRT are initially measured on a real test grid. The test results are then matched with the performance of the software model under simulation with the exact test conditions. This model can be used for further studies like FRT simulations in a modelled PGS, in case additional control requirements are added or the parameters of the connected grid are substantially different from the test grid.

The site specific requirements can be verifying local requirements, or fulfillment of the communication procedure of the PGU with the local load dispatch center (LDC), or fulfillment of the requirements of the connecting substation, etc. These can be verified only site specific and cannot be covered under the scope of a grid compliance conformity statement issued for a specific PGU type.

The conformity assessment for the grid compliance is very extensive according to the German Grid Code (BDEW)[1], VDE-AR-N 4110 medium voltage[2], VDE-AR-N 4120 high voltage[3], VDE-AR-N 4130 extra high voltage[4], FGW technical guideline 8 (TG8)[9]. This is categorized in three parts as presented below as an example.

1. Unit Certification

i. Testing and evaluation of the power quality (harmonics, flicker) and control (active and reactive power capability and functions, LVRT, HVRT, etc.)
ii. Evaluation of the design, control and functions of the PGU
iii. Validation of simulation model based on FRT results
iv. Issuing unit certificate for a specific PGU type

2. Systems Certificate

i. Evaluation of the design (cable laying, transformer, etc.), control, protection, functions of the PGS comprising of multiple PGUs with existing unit certificates
ii. Modelling and simulation of the PGS to analyze the FRT capability and other control requirements of the entire PGS at the grid connection point
iii. Issuing of systems certificate for the specific PGS before commissioning of the first PGU

3. Conformity Declaration

i. Evaluation of the commissioning, protection test, parameterization and As-built protocols
ii. Inspection of erected PGU
iii. Inspection of Grid Connection Point like substation/ transformer or transfer station in case of protection, communication, parameter and control system
iv. Issuing of conformity declaration based on the PGS certificate

III. CEA Requirements for Grid Compliance

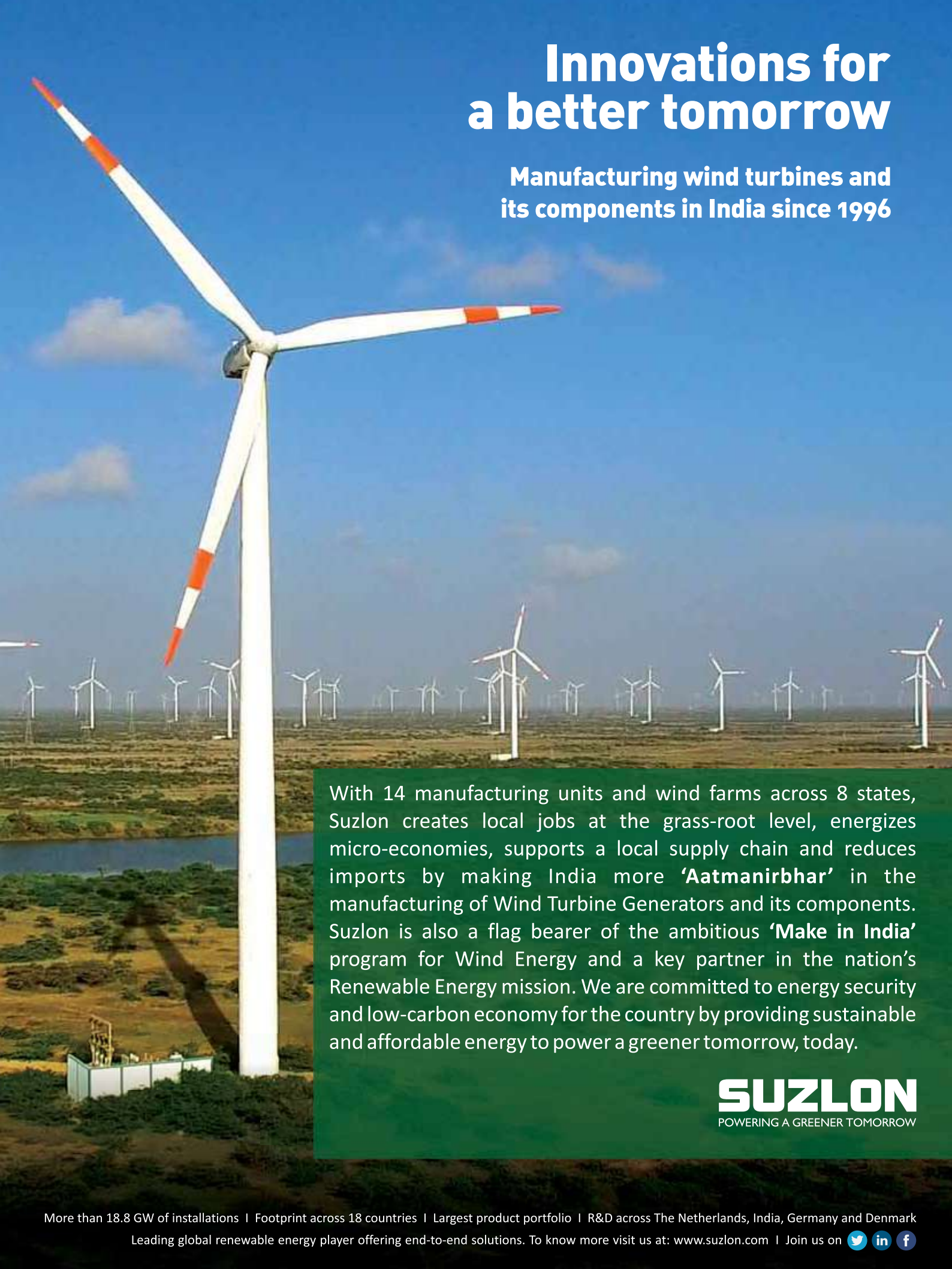
A summary of the complete scope of CEA requirements[10,11,12] in power quality, control capability and response in transient events is given below.

A. Electrical Characteristics in Normal Operation (Power Quality Requirements)

The CEA notification[11] does not refer explicitly to any measurement guideline (method) but only on the acceptance criteria (limits):

i. Harmonic current emissions should be within the limits specified in the standard IEEE 519[13].
ii. DC current injection of the PGUs at the point of connection should not be greater than 0.5% of the rated current I_n.
iii. Flicker emissions should be within the limits specified in the IEC 61000. Since IEC 61000 is published as parts dealing with different topics UL interprets the requirements of flicker should observe the IEC/TR 61000-3-7[14] .

The above requirements have remained unchanged in the new CEA amendment 12.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B. Control Requirements

The following requirements apply:

i. Reactive power capability: PGUs shall be capable of supplying the necessary reactive power in order to ensure that power factor is kept within the limits of 0.95 lagging and 0.95 leading.

ii. Frequency range test: PGUs shall be capable of remaining connected to the network and operate within the frequency range of 47.5 Hz to 52 Hz. In addition, they should be able to deliver rated power in the frequency range of 49.5 to 50.5 Hz, subject to availability of the primary energy source (i.e. wind speed or solar radiation). This performance shall be also achieved with a voltage variation of up to ± 5%.

iii. Undervoltage ride-though (LVRT) capability: The required voltage profile is shown in Table 1 and Figure 1. The requirements for grid support during the voltage dips are the following:

- During the voltage dip, the supply of reactive power has first priority, while the supply of active power has second priority.
- Active power after voltage dips clearance shall be restored to at least 90% of the pre-fault level within 1 sec of restoration of voltage.

iv. Overvoltage ride-though (HVRT) capability: Fault-ride-through (FRT) capability in the amended CEA Regulation1212, includes also the requirement for HVRT Capability of PGUs. The required voltage profile is shown in Table 1 and Figure 1. For overvoltage events, the only requirement is that the PGUs shall remain connected to the grid.

v. Active power set-point control: PGUs shall have the capability of set-point control of the active power following the orders given the relevant LDC.

vi. Active power ramp rate limitation: PGUs shall be equipped with the facility for controlling the rate of change of power output at a rate not more than ± 10% per minute.

vii. Frequency sensitive mode: PGUs shall have the capability to control active power in case of over- and under-frequency at a droop between 3 to 6% and a dead band ≤ 0.03 Hz.

viii. Synthetic inertia: For frequency deviations < 0.3 Hz, the station shall have the facility to provide within 1 second power frequency response of at least 10% of the maximum active power capacity.

It should be noted that, according to CEA, requirements from (v) to (viii) apply for generating stations with installed capacity of more than 10 MW connected at voltage level of ≥33 kV.

C. Grid Protection System

According to CEA initial Technical Standard10 the protection system shall reliably detect faults on various abnormal conditions.

Table 1: *Minimum Requirements of LVRT/HVRT Capability of PGUS according to CEA Requirements*

Percentage undervoltage at the interconnection point V_T/V_n[a]	Fault Duration [ms]
0.15	300
0.85	3000
0.90	10000
0.90 ≤ V ≤ 1.10	Continuous
1.10 < V ≤ 1.20	2000
1.20 < V ≤ 1.30	200
> 1.30	0 (Instantaneous trip)

a. V_T/V_n is the ratio of the actual voltage to the nominal system voltage.

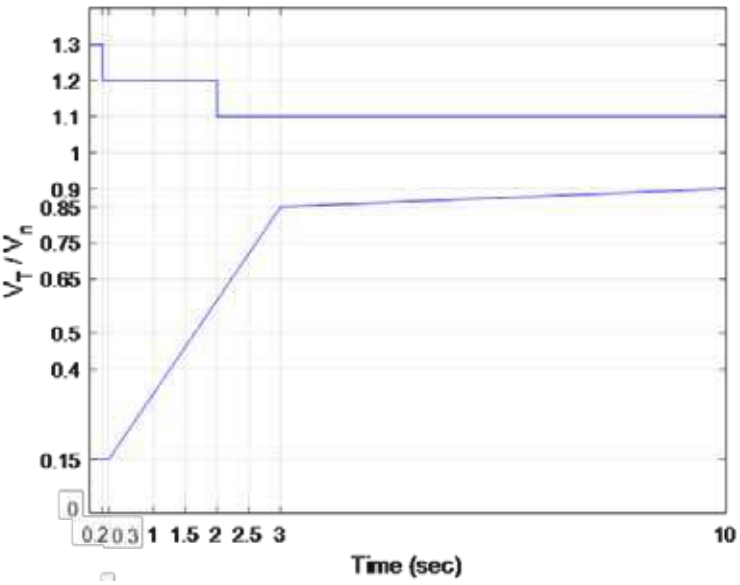

Figure 1: *Lower and upper limit of the voltage-against-time profile of any or all phases at the interconnection point according to the amended CEA Grid Connectivity Standard[12]*

IV. Proposal for Certification Procedure Based on Existing Test Reports and Software Simulations

A. Harmonics and Flicker Measurements

CEA[10] requires that the harmonic current injection of PGUs shall not exceed the limits specified in standard IEEE 519[13]. The flicker emissions of PGUs should comply with the limits imposed in IEC 61000 series of standards, which in turn corresponds to IEC/TR 61000-3-7[14]. These requirements remained also unchanged in the latest CEA Regulation[12].

CEA only informs about the limits, but does not clarify measurement procedure. Based on the experience with international standards we propose that the harmonics measurement procedure to be followed with either IEC

61400-21[5] or IEC 61400-21-1[6]. Since these are internationally recognized standards most OEMs have already measurement reports for their PGUs according to these standards, therefore the results can be transferred much faster with efficient use of resources, without the need for new measurements. A basic difference between this new IEC standard, compared to the old IEC 61400-21[5], is the harmonic aggregation method, which is now common with the IEEE 519 method. However, there are still differences, which have to be taken into account when assessing the relevant grid compatibility. The basic differences between the two guidelines are presented in Table II. In the same table, the contents of the old IEC 61400-21 are also included to highlight the changes in the procedure followed up to now. For flicker measurements, the test procedure of IEC 61400-21-1 is sufficient, as it illustrated the behavior of the tested unit over the complete active power range. The flicker report shall be based on 10-min flicker measurements in continuous operation of a duration, which is long enough so that sufficient data in all 10% power bins from 0% to 100% of the nominal power are collected.

Table II: *Comparison between IEC and IEEE Standards with Regard to the Harmonic Evaluation Procedure*

Parameter/ procedure	IEC 61400-21, Ed.2	IEC 61400-21-1, Ed.1	IEEE 519
Instrumentation	Compatible with IEC 61000-4-7 and 61000-4-30		
Averaging time	10 min	10 min	3s / 10 min
Number of measurements	≥ 3 for each 10 % power bin	≥ 7 for each 10 % power bin	≥ 24h for 3s and ≥ 7days for 10 min
Aggregation method	Arithmetic	Arithmetic	Geometric
Harmonic frequencies	up to 9 kHz	Up to 9 kHz	Integer harmonics up to 50th order
Statistical assessment	Max of all measure-ments per power bin	95th percen-tiles of all measure-ments per power bin	95th and 99th percentiles for each 24h
Parameter	Current	Current	Current / Voltage

In addition to flicker in continuous operation, the relevant flicker produced during switching operations shall be calculated as well as the relevant voltage change. The measurement reports typically do not include any assessment of compliance with the limits included in the IEC 61000-3-7[14].

Regarding transfer of measurement results between two PGUs, technical similarity needs to be investigated at first and as a second step the parameters that effect harmonics needs to be identified. This can be complex and depends highly on the scenario and type of PGU, however, to make the proposal clear two examples with most popular type of PGUs, wind turbine (WTG) and photovoltaic (PV) is presented in Table III. Mainly the transfer rules are leaned on the requirements of the FGW technical guideline 8 (TG8) and IEC61400-22.

B. Measurement of DC Current Injection

Measurement of DC current injection and subsequent data analysis can be performed according to IEEE standard 1547.1[18]. There are no international grid codes which require this measurement at present. However, UL suggests that PGUs which includes a unit transformer as a part of the PGU may be relieved from this requirement.

C. Testing of Control Requirements

Control requirements like FRT, frequency response, active and reactive power capability during FRT are defined in most international grid codes however the specific limits or associated voltage or other electrical parameter functions may differ. Few examples of differences between the FGW guidelines and CEA regarding control requirements are given below:

i. *LVRT:* according to the FGW requirements has a different limit than the CEA requirement[12] as illustrated in Figure 1.

ii. *Frequency response:* FGW regulations define the frequency variation as a function of active power, while the CEA does not define such an exact mathematical function.

iii. *Reactive power during LVRT:* FGW regulations define a function of the reactive current during LVRT events, while the CEA does not define such an exact mathematical function, only that it should be maximized.

However, if we have a unit certificate according to FGW technical guideline 4 (TG4)[8], it means that the PGU has a validated software model. Model validation means that the software

Table III: *Example of Transferability of Harmonics Measurement Results Between Two PGUS*

PGU	Parameters effecting harmonics	Example of transferability
WTG1	Rotational speed, switching frequency of converter, generator, etc.	If rotational speed of WTG1 > WTG2 then measurement report from WTG1 can be transferred to WTG2 conservatively
WTG2		
PV1	Switching frequency of inverter	If switching frequency for PV1 > PV2 then the measurement report from PV2 can be transferred to PV1 conservatively
PV2		

model's dynamic behavior is exactly similar to the PGU in reality. Therefore, instead of performing new tests for specific CEA limits on the control behavior, a software simulation with the validated model and the events as defined by CEA should also prove the behavior of the PGU with sufficient accuracy.

V. Conclusions

In this paper, an alternative certification procedure for grid compliance of all types of PGU (including wind turbines and inverter-based generating stations) in accordance to the latest CEA requirements (2019) is proposed. According to this alternative procedure specific suggestions and recommendations for processes for example on how the test results from a different PGU model can be evaluated to verify if parts of the existing test and evaluation is technically comparable to the PGU under certification or not, how to transfer test results to other PGU variants, how to use software simulations to verify certain control requirements of the CEA 2019[12] are provided. Additionally it is recommended that the measurement reports that will be evaluated under the certification procedure shall follow the latest international standards and guidelines, like the IEC 61400-215 or IEC 61400-21-1[6], regarding the testing procedure.

The proposed procedure should facilitate grid compliance of PGUs according to requirements of the CEA 2019[12] and more make it more efficient in terms of utilization of available measurement and evaluation work.

Acknowledgment

The author would like to acknowledge the contribution and express their appreciation to the colleagues of UL in Germany and India, for their continuous support in the testing and certification campaigns in India.

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Benefits & Challenges of Digitalizing Wind Turbine Blades Design Processes

G. Borstnar
Design Engineer

M. Jacobsen
Head of Digitalization
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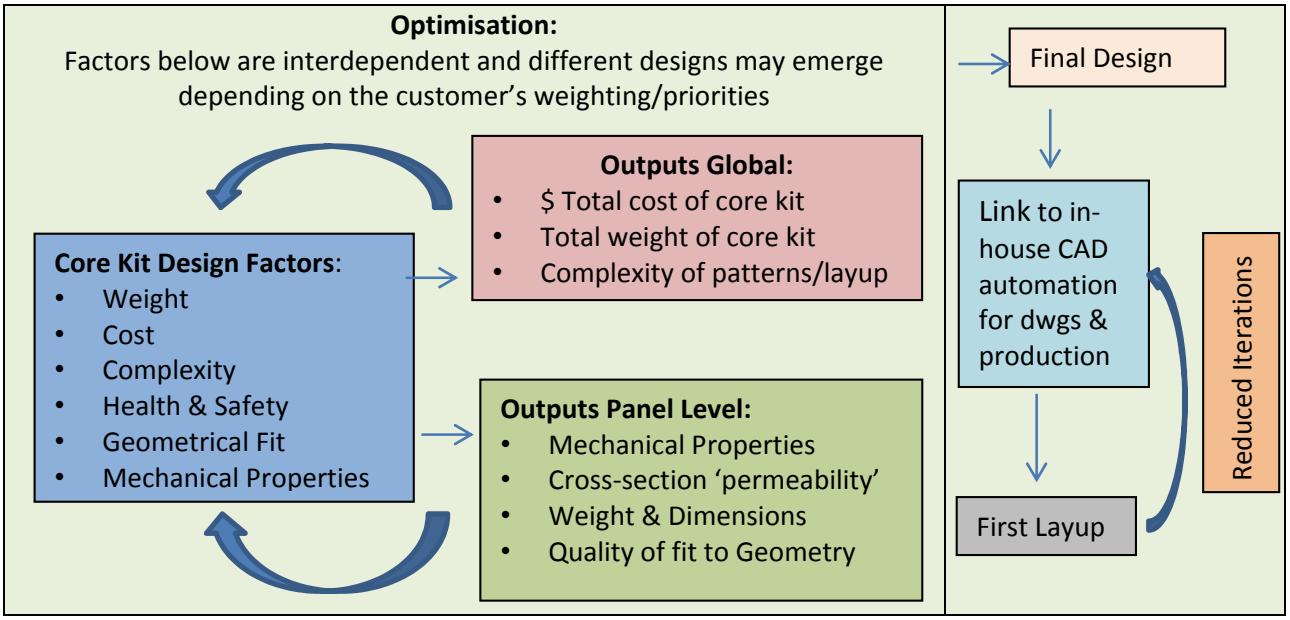
Gurit Group, Switzerland

Innovation is paramount to improve the Levelised Cost of Energy (LCoE) of wind turbines, yet many innovation processes remain limited to the human cognitive abilities, which limit the number of product design parameters that can be considered simultaneously. This is a challenge as design parameters are often interdependent; you cannot optimize one design parameter without impacting the others.

Harvesting the processing power of computers to explore the solution space defined by end-users design parameters and constraints can enable solutions that were previously unconceivable to be identified with an unprecedented speed. With an outset in digitalizing core material design this case study show cases the benefits and challenges of digitalizing design processes.

Objectives

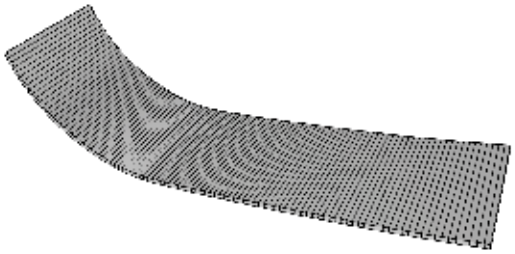
- Develop a parametric design platform that allow us and our customers to explore the core kit solution space considering the following design parameters for core material kits: geometrical fit, blade weight, resin uptake cost, manufacturing costs, health and safety/panel weight, panel permeability and infused mechanical properties.
- Link design optimization platform with existing CAD platform to ensure the final manufacturing documentation is updated automatically.
- Align design data flow across the supply chain to ensure effective design processes, reduced time-to-market and a minimum documentation level.



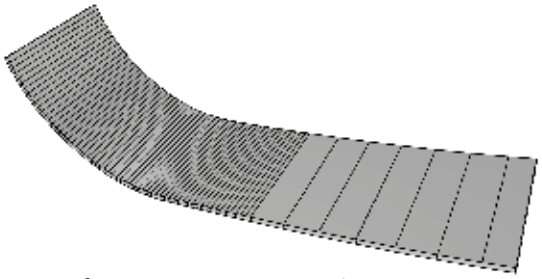
Methods

1. Develop numerical models and scripts for each individual design parameter.
2. Convert numerical models into one programming language
3. Align data flow across the supply chain, systems and design tools.
4. Implement multidisciplinary optimization methods to optimize design considering multiple design parameters and allow design optimization to be tuned according to customer focus or preferences.

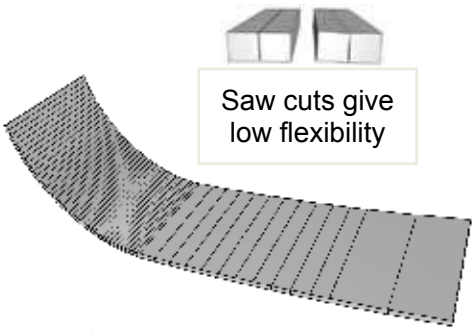
The example below show-case how the core material pattern design can be optimized to reduce resin uptake and ultimately help reduce blade weight, while still fulfilling manufacturing and resin flow constraints.



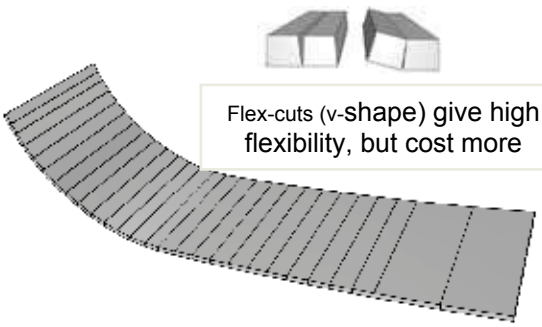
Reference case: Conservative cut pattern (lots of surface area & free-volume)



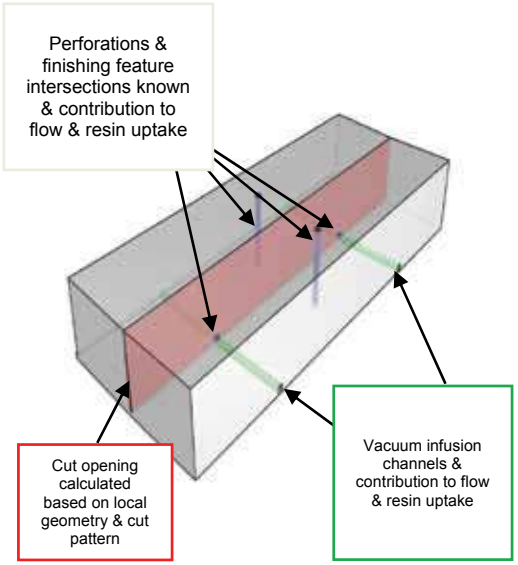
Reference case: Conservative cut pattern (lots of surface area & free-volume)



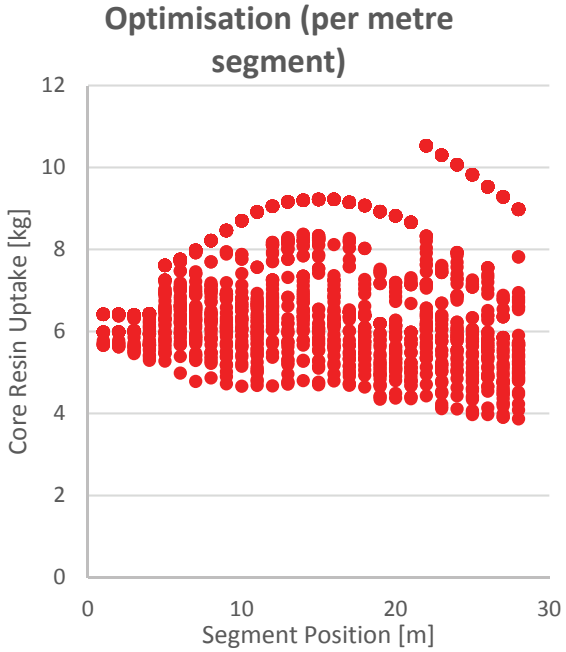
3 panels: Increasing complexity with more precise cut spacing w.r.t. local curvature



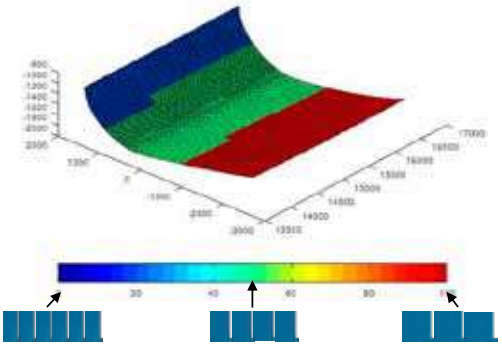
2 panels + flex-grooves: Flex-cuts can be used to optimise resin savings further



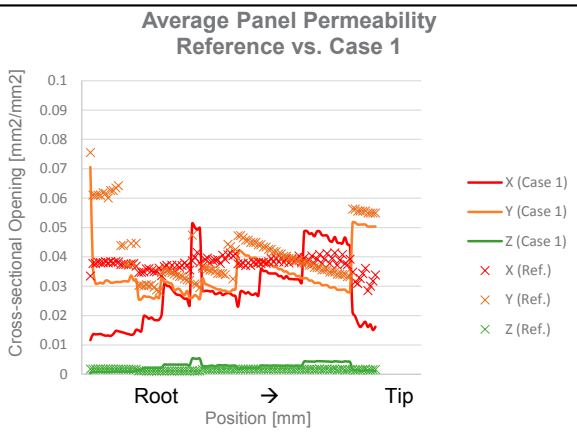
Panel properties & finishing features are known at every location, allowing for data rich approach enabling a kit design to be automatically modified locally to meet customer criteria & feed into downstream calculations.



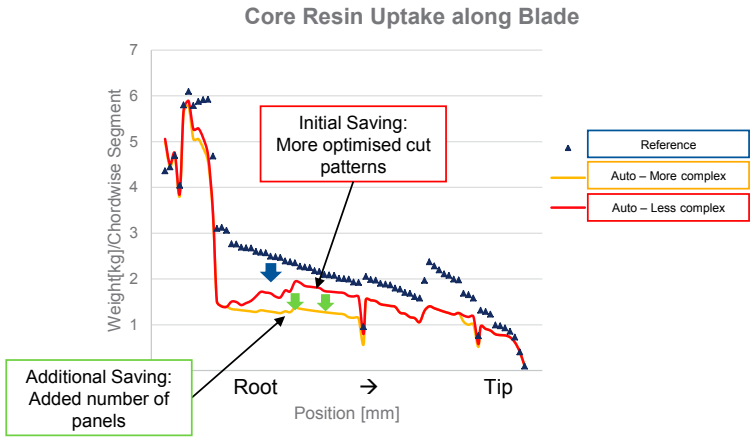
A large number of solutions are generated. The best solution will depend on the objective of the optimisation & any criteria that need to be respected. The figure above illustrates an optimisation for core resin uptake weight, but $ cost/time-cost can be other 'targets' on the y-axis.



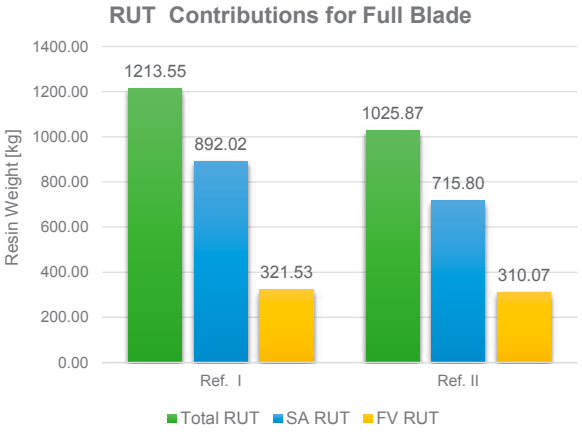
Final cut-spacing is optimised based on the local curvature and constrained by complexity & panel size limits.



Panel level properties can be compared against reference cases, e.g. cross-sectional openings.



1m segments can be compared along the length of the blade, identifying differences between 'cases'.



Final solutions can be compared based on processing cost, total resin uptake, etc.

Results

- A large number of solutions can be explored within minutes or hours.
- Performance of these solutions can be evaluated considering an array of design constraints, and with data levels that are much higher than before.
- Designs can to a larger extend be tailored to customer's specific design objectives and the impact on total cost-of ownership is clear.
- As an example, the numerical models for the geometrical fit of the core material in the wind turbine blade has shown a potential to reduce resin uptake reduction in the range of 0.4-1.3 kg/m^2.

Conclusion and Further Work

Digitalizing design process can create significant value. In this case study significant weight savings have been found by digitalizing core kit design processes. Ultimately though, greater benefits from digitalizing core material design process will emerge, as more design parameters are added, and the complexity increases and human capabilities meet its limit. For example, by knowing the properties and location of each panel and its features, the digital design process enables a data rich design approach. In the future this will enable considerations such as quantification of resin flow behaviour and infused mechanical properties.

However, challenges remain and they will be addressed in further work. As an example, today common ways of sharing design information is in 2D drawings or 3D models. The future digital design platforms will not need these visualizations, instead basic design data can be shared, but it will require that design platform interfaces are defined clearly. This linking across the supply chain will be essential for design changes to be fed-into or fed-back into the digital design platform. Long-term this will enable design platforms across the supply chain to connect and explore the solution space of the end-product, in this case the wind turbine blade, thereby, avoiding sub-optimization within the supply chain.

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India to have over 65% Power Generation Capacity from Non-Fossil Fuels By 2030: RK Singh

India will have more than 65 per cent of its power generation capacity from non-fossil fuels by 2030, Power and New & Renewable Energy Minister Mr. R.K. Singh said while addressing a CII conference on green energy. He stated that the country has already 170 GW of renewable energy (including large hydro), while another 80 GW is under construction. India has planned to hit 500 GW of renewable energy by 2030. Talking about the recent deliberations with industry players on green hydrogen, he also said the industry has evinced interest for 25 million tonnes of green hydrogen capacity. The green hydrogen manufacturing capacity could be 35-40 million tonnes, he noted.

Source: Press Trust of India, October 17, 2022

IEX Exploring Opportunity to Launch India's First Carbon Exchange

Indian Energy Exchange (IEX) is preparing to boost the share of renewable energy in its trading volumes and also diversifying into newer areas like the Carbon Markets and Coal trading, Chairman and MD S N Goel tells ET Energy World in an exclusive interview. We are encouraged with the Government's idea of establishing a Coal Exchange. Similarly, the provision of setting up a carbon market in the country as per the Energy Conservation Act 2022 provides us the opportunity to set up a Carbon Exchange in the country. IEX will continue to harness technology and innovation to facilitate the nation's energy transition towards carbon neutrality.

Source: ET Energy World, 12 October 2022

ReNew Power to invest Rs 30,000 cr to scale up green capacities: Chairman Sumant

ReNew Power plans to invest Rs 30,000 crore over the next two years to scale up its solar and wind energy capacities, its Chairman Mr. Sumant Sinha said. "We have 5,000 megawatts of projects that we are building right now. We have won various auctions... have PPAs," Sinha, told PTI. Sinha also said his company plans to produce green hydrogen in India.

Source: Press Trust of India, 17 October 2022

India to Export Green Energy to Singapore From 2025

India will for the first-time export green energy from 2025. The MoU to explore opportunities in green hydrogen potential in India will see Greenko group and Singapore's Keppel Infrastructure working towards a 250,000 tonne per annum contract to be supplied to Keppel's new 600Mw power plant in Singapore. Further, the contract for the export of green ammonia would also expand to cover bunker fuel through the Keppel network in Singapore's network of bunker fuel supplies to ships.

Source: Press Trust of India, 25 October 2022

NTPC to Award Contracts for 4.8 GW Coal Power Projects in Next Three Years

NTPC is now aggressively looking at expanding the capacities of its existing thermal power plants, apart from identifying a few brand new projects. After awarding the contract for a 1,320 MW thermal power project in Odisha's Talcher, NTPC has finalised awarding contracts for four more coal-fired power projects over the next three years to add 4.8 GW capacity to the country at Sipat (800 MW) in Chhattisgarh, Singrauli (2x800 MW) in Uttar Pradesh, Darlipali (800 MW) in Odisha, and Lara (2x800 MW), again in Chhattisgarh.

Source: Money Control.com, 1 November 2022

Global Open-Source Data Platform launched for Clean Energy Solutions

Prospect, an open-source data and transaction platform has been launched with support from the European Union, Germany, Sweden, the Netherlands and Austria. The platform automatically collects, aggregates, analyses and displays data across modern sustainable energy solutions. It was launched by the Access to Energy Institute (A2EI) and the European programme GET.invest. Prospect is hoped to optimise real-time data collection, analysis and visualisation to support sustainable energy stakeholders in providing affordable and clean energy access for all.

Source: Smart Energy, 31 October 2022

Jakson Green to Invest Rs 22,400 Cr to Setup Green Hydrogen, Green Ammonia Projects

Jakson Green has signed a MoU with the government of Rajasthan to invest Rs 22,400 crore to set up a green hydrogen and green ammonia project, in phases. Jakson Green will set up a 3,65,000 tons per annum Green Hydrogen & Green Ammonia plant along with an integrated hybrid renewable power complex in a phased manner which is expected to generate over 32,000 direct and indirect employment opportunities across various phases of the scale-up, planned between 2023 and 2028.

Source: PTI, 25 October 2022

$4 Trillion Needed by 2030 for Net Zero Goals – World Energy Outlook

IEA executive director Mr. Fatih Birol has stated in a press conference that Clean energy investments today is [total] $1.3 trillion and will, with current policies, reach $2 trillion…But if we want to reach our net zero [and 1.5°C] goals, our investment target needs to double and reach $4 trillion."

Source: Smart Energy, 27 October 2022

WTO Should Attack Trade Barriers to Low-Carbon Transition: Chief

The WTO should tackle trade barriers for low carbon industries among other measures aimed at addressing the role of global trade in driving climate change, WTO Director-General Mr. Ngozi Okonjo-Iweala said in a report published on 7th November 2022. The WTO World Trade Report 2022 launched at the COP27 climate summit in Egypt says the most realistic way to make deep emissions cuts without reducing living standards in richer countries and harming development prospects in poorer ones is through advancing low-carbon technologies.

Source: Reuters, 7 November 2022

Wind Power - A Sustainable Energy Resource for Transition to Net Zero

Prabhakar A.R. Bende
Former Managing Director
MP Power Transmission Company Limited and
MP Power Generating Company Limited

India's energy transition in the power and transport sector is going to play a key role to reach its national climate goals by the end of the current decade to avert further dangerous global warming. The electricity and transport sectors together account for about half of the global greenhouse gas emissions and that is why the main focus is on transiting these two economic sectors from fossil fuel to renewables to reach net zero. The solar and wind being abundant natural resources have gained significant importance in abatement of anthropogenic climate change.

The United Nations Framework Convention on Climate Change (UNFCCC), since its inception in 1992 is persistently working to bring all the nations together in global efforts to mitigate the adverse effects of climate change. The journey from Kyoto Protocol to the Paris Climate Agreement and finally COP26 Glasgow Climate Pact 2021, paved the way to combat the adverse effects of climate change by limiting greenhouse gas emissions to seize global warming. The 26th Glasgow conference of UNFCCC (COP26) brought together 120 world leaders which achieved significant success towards moving to net zero and the action plan for the decade ending 2030 was drawn up for a 45% reduction of greenhouse gases emissions to reach net-zero around mid-century. A revolutionary decision for provision calling for phase-down of coal power and phase-out of inefficient fossil fuel was taken in the conference. The ***'Global Coal to Clean Power Transition statement'*** was signed by 46 countries promising to accelerate a transition away from unabated coal power generation and to cease issuance of new permits for new coal-fired projects. This was a positive step towards accelerating the process of phase-down of coal power generating plants.

The electricity and transport sectors together account for about half of the global greenhouse gas emissions and that is why the main focus is on transiting these two economic sectors from fossil fuel to renewables to reach net zero.

India's first Nationally Determined Contributions (NDC) was submitted to the UNFCCC in October 2015, expressing the desire to reduce emissions intensity of its GDP by 33-35% and creating an additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent by 2030. The Prime Minister of India, at COP26 in October 2021, announced a pledge to achieve net-Zero emissions as Panchamrit, a fivefold strategy aimed at:

(i) raising the targeted non-fossil fuel based energy capacity to 500 gigawatts by 2030.

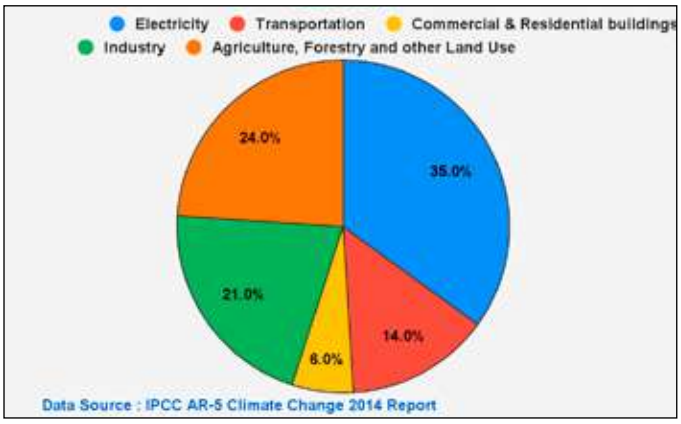
(ii) meeting 50% of energy requirements using renewable energy sources by 2030.

(iii) reducing total projected carbon emissions by one billion tons between 2021 & 2030.

(iv) reduction of the carbon intensity of the economy to less than 45% by 2030, and

(v) country to become carbon neutral and achieve net zero emissions by 2070.

As decided in COP26, India submitted the updated NDC to UNFCCC on 26th August 2022 reiterating earlier climate change pledges. The updated NDCs also committed to adopt a climate friendly and a cleaner path than the one followed by others at corresponding level of economic development, adapt to climate change by enhancing investments in development programmes



Global Greenhouse Gas Emission by Economic Sector

in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health and disaster management, mobilize domestic and new & additional funds from developed countries to implement the mitigation and adaptation actions in view of the resource required and the resource gap, and build capacities, create domestic framework and international architecture for quick diffusion of cutting edge climate technology in India and for joint collaborative R&D for such future technologies. The updated NDC reads "To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation, including through a mass movement for 'LIFE'– 'Lifestyle for Environment' as a key to combating climate change". It is beyond doubt that with these pledges, India is moving forward towards achieving the long-term goal of net zero by 2070.

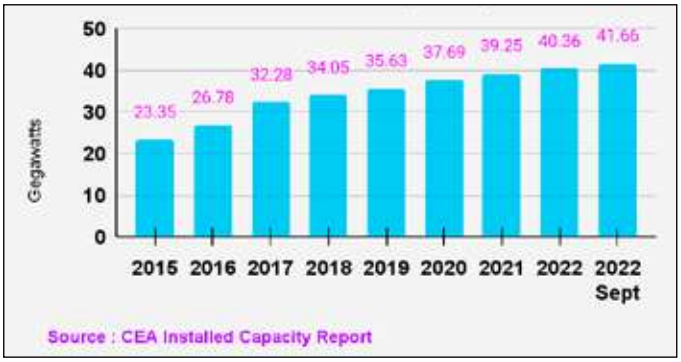
India, with 407.8 GW installed capacity with renewables contributing to 40% is the third largest producer of electricity next to China and the US. It is necessary to shift the country's power generation towards clean energy and distancing itself from fossil fuel-based transportation along with measures in other sectors to achieve the climate change goals. The last decade has seen tremendous impetus in renewable capacity additions and since last couple of years the Battery Energy Storage Systems (BESS) are receiving greater attention. As of September 2022, the country has achieved 171.71 gigawatts non-fossil capacity including 6.78 GW nuclear power, which is 42% of total installed capacity of 407.8 GW.

The worldwide electricity generation in 2021 from wind and solar recorded an all-time high growth of 10% with 38% of total power supply from clean energy sources. Renewable energy being an important step in mitigating climate change effects, goals have been formulated by the leading countries to enhance renewable capacities for achieving net zero. The International Renewable Energy Agency (IRENA) estimates that 90 percent of the world's electricity should come from clean energy by 2050 to achieve net zero goals.

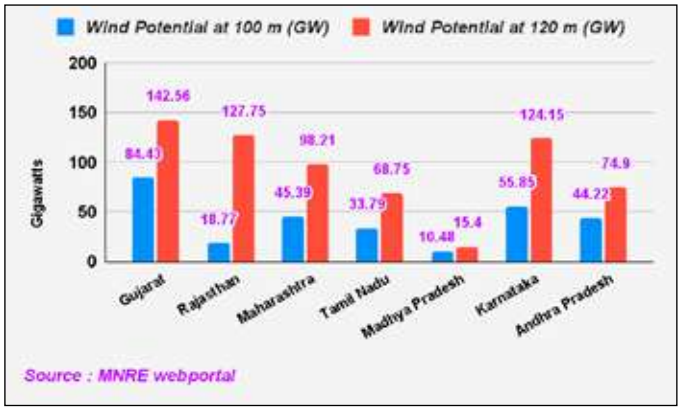
Wind energy is also one of the fastest growing energy sources offering tremendous potential. The onshore and offshore wind energy technologies have evolved over the past few decades to maximize the electricity produced with higher hub heights and larger rotor diameters. The global wind power installed capacity increased from 197.8 GW in 2010 to 743.1 GW in 2020, at a compound annual growth rate (CAGR) of 14.2% and is further expected to reach 1,839.5 GW by 2030. Globally, 108 GW of onshore wind was installed in 2020, doubling 2019 additions which is an unprecedented growth. This record level of installations resulted from Chinese and US developers which made up 79% of global deployment. The top five countries in the wind power installed capacity are China, United States, Germany, India and the United Kingdom. India, ranking fourth with installed capacity of 41.67 GW as of September 2022, has demonstrated installed capacity growth at a compounded annual growth rate (CAGR) of about 7.97% between 2010 and 2022. The generation of electricity from wind turbines increased proportionally as capacity increased. The total wind generation in India increased to 60.15 billion units during 2020-21, growing at a CAGR of 8.3% between 2017 and 2021, whereas the renewable energy sector has grown at a CAGR of over 15.50 per cent in the last five years.

India's pledge to reach 500 GW non fossil fuel power capacity by 2030 depends greatly on the success of implementing 140 GW onshore, 30 GW offshore wind power capacity and 280 GW solar power in addition to other cleaner sources. The National Institute of Wind Energy (NIWE) has installed 800+ wind monitoring stations all over country for Wind Resource Assessment for the selection of potential sites and evaluated wind potentials at different heights above ground level. The gross wind power potential at 100 meters is 302 GW and 695.50 GW at 120 meters. Out of the total estimated potential more than 95% of commercially exploitable wind resources are concentrated in seven states. The Capacity Utilisation Factor (CUF) of the order of over 30% and even more than 35% is achievable at some locations in Gujrat, Tamil Nadu, Karnataka, Maharashtra and Andhra Pradesh which would ensure affordable wind tariff.

Ministry of New and Renewable Energy had issued 'Policy for Repowering of the Wind Power Projects' on 5th August 2016 in order to create a facilitative framework for repowering. However, as there was no significant progress in repowering of majority of old Wind power projects with sub-MW scale wind turbines, MNRE has released a revised draft National policy on 17th October 2022, taking into account representations received from various stakeholders and subsequent deliberations. The objectives of the Repowering Policy are optimum utilization of wind energy resource by maximizing energy yield utilising the latest state-of-the-art onshore wind turbine technologies. This policy lays out conditions for developers to go for repowering of their old wind turbines. National Institute of Wind Energy (NIWE) has estimated repowering potential of the country to



Wind Power Installed Capacity in India



Wind Power Potential at different hub heights

SG 3.4-145, our next -generation turbine

Delivering India's positive energy with SG 3.4-145, our next -generation turbine. India's journey to become a sustainable nation is powered by a billion aspirations. We're proud to play a part in empowering India with clean and renewable energy, at affordable costs. Standing tall on a new 3MW platform, the SG 3.4-145 is a key milestone in India's clean energy story. This turbine delivers a remarkable 48% more

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annual generation than its predecessor, in Indian low-wind conditions. Backed by smart monitoring system and optimized for all-weather conditions, the SG 3.4-145 is the right fit for the Indian market, delivering high profitability and reduced LCoE. The perfect turbine made for India, made in India. The SG 3.4-145 is indeed geared up to deliver India's positive energy.

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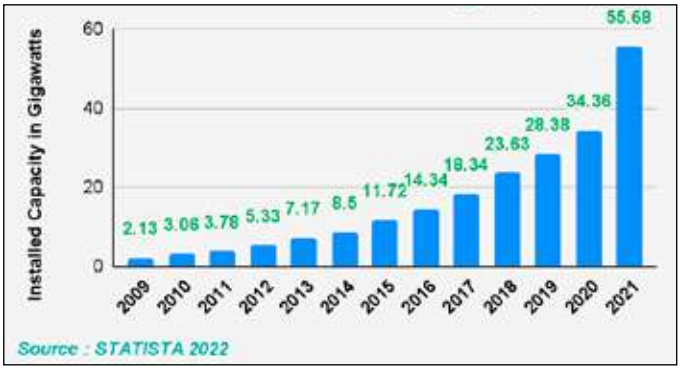
be 25.406 GW considering wind turbines below capacity 2 MW. The eligibility criteria, implementation framework, arrangement of power purchase and incentive have been proposed in the draft policy to facilitate repowering of old wind turbines below 2 MW capacity with higher capacity taller turbines to ensure higher power generation from the same site or area. The repowering of old wind turbines will be a boost to reach the prestigious target of 140 GW Wind power capacity by 2030.

Offshore wind power is also rapidly emerging as one of the world's future energy sources given its massive untapped potential. The land resources required for onshore wind projects are gradually becoming a major constraint. Offshore wind power offers a credible alternative in such a scenario. Increased clean energy could be possible from bigger and taller offshore wind turbines as absence of any obstruction in the sea offers much better quality of wind and its conversion to electrical energy. The first offshore wind turbine was installed in Denmark in 1991 which has been decommissioned in 2017. As of 2022, Hornsea 2, situated roughly 89 kilometres off the coast of Yorkshire, United Kingdom is the largest offshore wind farm in the world with over 1.3 GW installed capacity utilising 165 numbers Siemens Gamesa 8 MW turbines.

The International Renewable Energy Agency (IRENA) and the Global Wind Energy Council (GWEC) have signed the Global Offshore Wind Energy Compact, aimed to ensure sustainable energy for all in the global battle against climate change, setting a target of 380 GW of energy from offshore wind installed worldwide by 2030 and 2000 GW by 2050. The agenda is aimed at ensuring that no country or region is left behind by the sector to help the world reach its 2050 goals. Globally, about 6 GW offshore wind capacity was added in 2020 which is almost similar to annual capacity addition during 2016 to 2019. The significant progress is noticed in 2021 with addition up by about 62% (21.32 GW) over 2020 level reaching 55.68 GW.



Worldwide Offshore Wind Energy Capacity

There are good prospects for the country to harness offshore wind energy as India has about 7500 KMs of coastline surrounded on its three sides. While the onshore wind energy plants are driving the growth, the idea of offshore wind energy is novel to the country. The Government of India has already notified the "National Offshore Wind Policy" on 6th October 2015 setting the target of installing 5 GW offshore wind by 2022 and expand it to 30 GW by 2030. The country has an offshore wind energy potential of 140 GW by 2050, with Gujarat and Tamil Nadu being the leading states. The National Institute of Wind Energy (NIWE) has identified 16 potential offshore wind zones in Gujarat and Tamil Nadu for exploitation of offshore wind energy, with Gujarat having 36 GW and Tamil Nadu 35 GW potential.

India has signed a bilateral green strategic partnership with Denmark in 2019 as inter-governmental cooperation in order to develop a booming offshore wind market and related technical capabilities and also launched the 'Centre of Excellence on Offshore Wind and renewable Energy" for support in developing offshore wind energy sector. The initiative is a government-to-government initiative under the Indo-Danish Energy Partnership (INDEP) to bring together industry, public authorities and civil society in facilitating and accelerating the implementation of the Indian offshore wind strategy.

RPO trajectory upto 2029-30 (%)

Year	Wind	Hydro	Others	Total
2022-23	0.81	0.35	23.44	24.61
2023-24	1.60	0.66	24.81	27.08
2034-25	2.46	1.08	26.37	29.91
2025-26	3.36	1.48	28.17	33.01
2026-27	4.29	1.80	29.86	35.95
2027-28	5.23	2.15	31.43	38.82
2028-29	6.16	2.51	32.69	41.36
2029-30	6.94	2.82	33.57	43.33

Note: **Others include energy produced from any renewable energy power project other than wind and hydro.**

Source: Ministry of Power, India

Ministry of New and Renewable Energy (MNRE) is instrumental in providing adequate policy support and a conducive regulatory environment to ensure rapid and orderly development of the renewable sector. The country has taken several steps to encourage wind energy, including introduction of Generation based Incentives (GBI), Accelerated Depreciation (AD), Renewable Purchase Obligation (RPO), Electricity Act 2003 reform, tariff rules, competitive bidding, development of Green energy corridors, waiver of ISTS charges and losses, implementation of offshore wind energy policy, National Wind Solar Hybrid Policy, policy on repowering of wind power project and green energy open access. The RPO trajectory for the period till March 2022 was for solar and non-solar power, but separate Wind RPO and Hydro RPO including Pump Storage Plants (PSPs) is included in the new RPO trajectory for the projects commissioned after 31st March 2022 for Wind and 8th March 2019 for Hydro. These initiatives will have multilevel impacts on the development and growth of not only the wind energy but also the pumped storage facilities in the country.

India has achieved only 69.45% (41.67 GW) of Wind Power installed capacity till September 2022 against target of 60 GW falling short of 18 GW which is difficult to achieve in next six months. Government's initiatives like Implementation of Generation based Incentives (GBI), Accelerated Depreciation (AD), waiver of ISTS charges and losses, Renewable Purchase Obligation (RPO) and Green energy open access will prove to be critical steps to boost the wind power. The progress which was slow during the Covid pandemic is expected to accelerate. The only concern is the financial health of government owned distribution companies which are not showing any improvement in bringing down AT&C losses and the free electricity is turning out into a death trap for distribution sector. This sector being the buyer needs immediate redressal for the success of climate goals.

Green Hydrogen: Critical Enabler of Global Transition to Sustainable Energy and Net Zero

Dr. Sanjiv Kawishwar
Director, CORE
(Centre of Renewable Energy), India

Tejas Sole
Emerging Market Lead
POWERCON, India

> "Green hydrogen plays a vital role in the reduction of carbon emissions that are polluting the environment. Its production does not lead to the release of any carbon compounds, its burning results into the water."

Need of Green Hydrogen

The world is facing a major challenge of climate change. The global community is committed of taking action to keep global temperature rise of this century well below 2°C above pre-industrial levels. A growing number of countries are pledging to reach net-zero carbon dioxide (CO2) emissions by mid-century with the goal of limiting temperature rise to 1.5°C. Its necessities the full decarbonization of economies sectors.

Green hydrogen plays a vital role in the reduction of carbon emissions that are polluting the environment. Its production does not lead to the release of any carbon compounds, its burning results into the water.

In universe, there is more presence of hydrogen than any other element—it's been estimated that approximately 75%+ of all atoms are hydrogen. But hydrogen atoms do not exist in nature by themselves. To produce hydrogen, its atoms need to be decoupled from other elements with which they occur. Hydrogen is consisting of only one proton and one electron. Hydrogen can be decoupled from water, plants or fossil fuels. However, this decoupling determines the hydrogen energy's category.

Types of Hydrogen

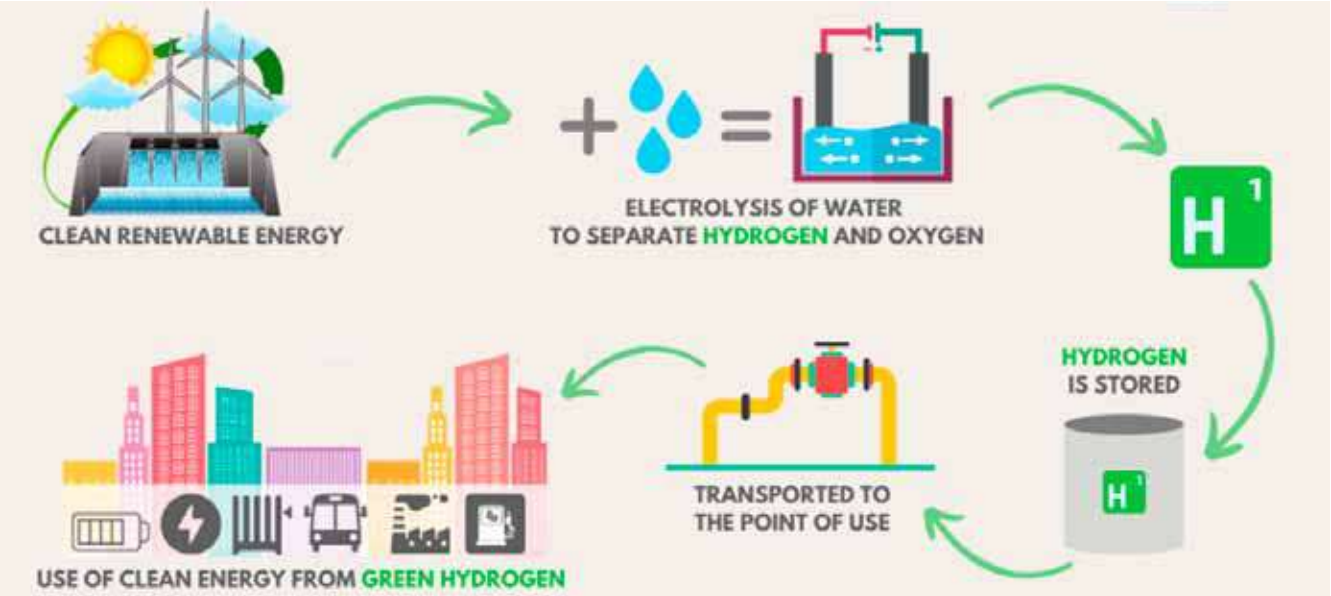
Depending on production methods, hydrogen can be Grey, Blue, Green – and sometimes even Turquoise.

As stated above, Green hydrogen could be a critical enabler of the global transition to sustainability energy & net zero emissions economics.

	Grey Hydrogen	Blue Hydrogen	Turquoise Hydrogen	Green Hydrogen
Source	Methane/Coal	Methane	Methane	Renewable Electricity
Process	*SMR/ Gasification	*SMR/ Gasification with Carbon capture	Pyrolysis	Electrolysis
Byproduct production	Caron dioxide	Caron dioxide	Caron dioxide	Water
	Polluting substances	Polluting substances	Polluting substances	Zero Carbon emission

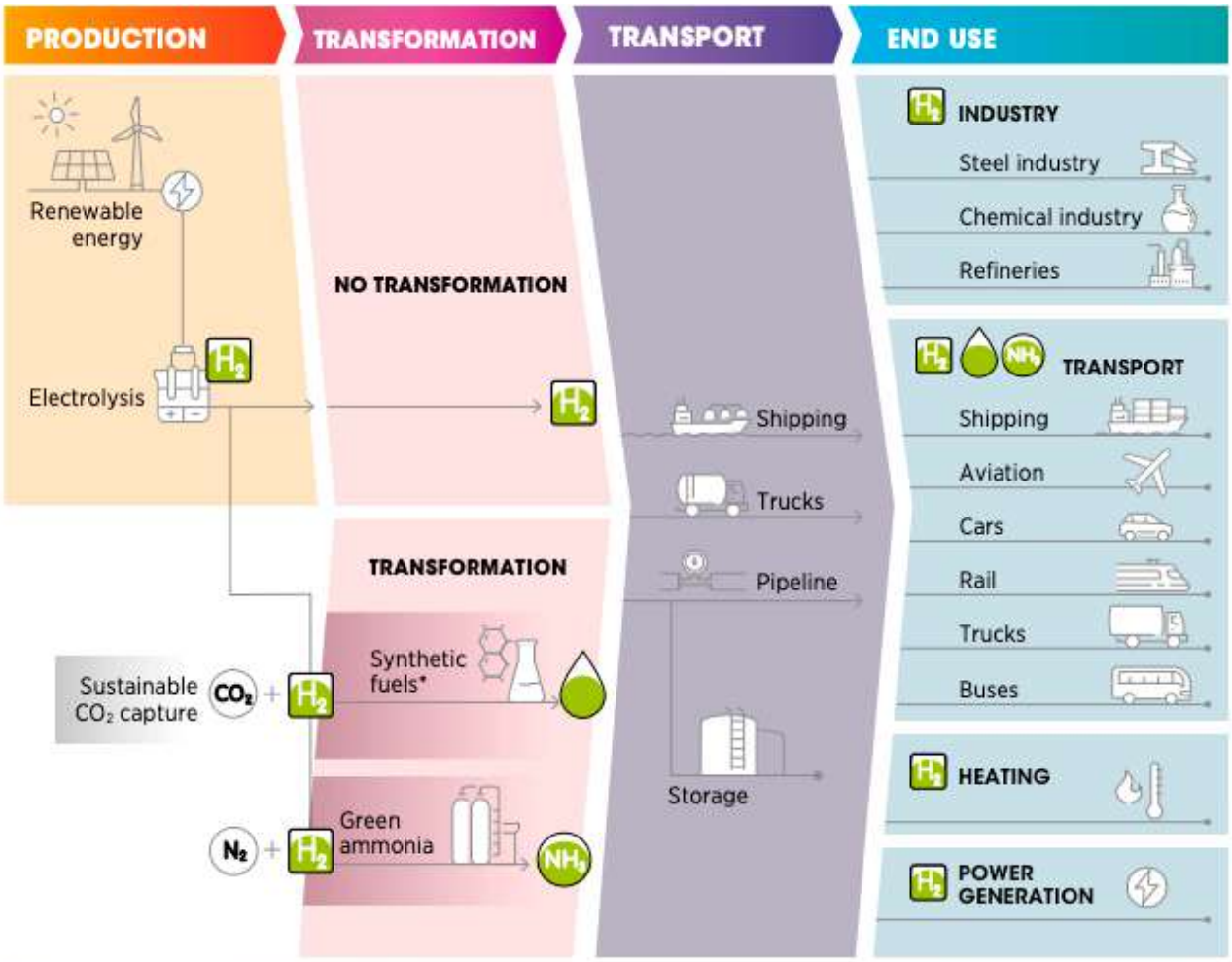
*SMR – Steam Methane reforming

Production of Green Hydrogen



Green Hydrogen Usages

Green hydrogen can be used for various purposes as follows.

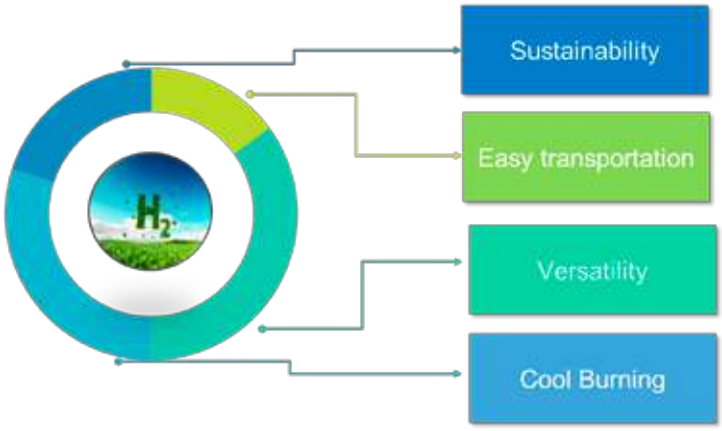


Source: IRENA

** The term synthetic fuels refers here to a range of hydrogen-based fuels produced through chemical processes with a carbon source (CO and CO_2 captured from emission streams, biogenic sources or directly from the air). They include methanol, jet fuels, methane and other hydrocarbons. The main advantage of these fuels is that they can be used to replace their fossil fuel-based counterparts and in many cases be used as direct replacements – that is, as drop-in fuels. Synthetic fuels produce carbon emissions when combusted, but if their production process consumes the same amount of CO_2, in principle it allows them to have net-zero carbon emissions.*

Advantages of Green Hydrogen

Green hydrogen has many advantages as follows.



Disadvantages of Green Hydrogen

Green hydrogen has some disadvantages also as follows:

1) ***High Cost:*** One of the main drawbacks of Green hydrogen is the high cost of production.
2) ***Explosive:*** Green hydrogen is a highly volatile and flammable element, so extensive safety measures are required to prevent leaks and explosions. Secondly it is colorless. It is dangerous as it cannot be detected when leaking. That is why there is a huge requirement for the installation of sensors.
3) ***Storage:*** Green hydrogen has to be compressed to liquid form and maintained at low temperatures. It makes it bit difficult to store.
4) ***Inefficient Energy Consumption:*** Green Hydrogen consumes more energy than other fuels. Producing green hydrogen, compressing it and then converting it into electricity requires more energy. When compared with Batteries, Green hydrogen results in only a 35-40% output.

Opportunity for Use of Renewable Energy

Renewables with green hydrogen solution will reduce renewable energy curtailment, allow maximum utilization of renewable energy sources, entrust and protect renewable energy investments against loss of revenue due to curtailment, provide power system operation more flexibility and allow additional capacity for more renewable plants in the electric grid. Thus green hydrogen could be a critical enabler of the global transition to sustainability energy & net zero emissions economics.

Snippets

India Can Accelerate Green Investments to USD 12.1 Trillion By 2050

With the ongoing rate, India's net Green House Gas (GHG) emissions will rise to 11.8 gigatons of CO2 equivalent by 2070 from the 2.9 gigatons in 2019, Mckinsey & Co said in a report. However, India has the potential to create 287 gigatons of carbon space for the world if it accelerates its efforts to fight climate change. This amounts to almost half of the global carbon budget for an even chance at limiting warming to 1.5 degree celsius. "India's decarbonisation will require an estimated USD 12.1 trillion (5.9 % of GDP) of green investments until 2050 for the 'accelerated' scenario.

Source: PTI October 28, 2022

China Plans to Build 43.3 GW Offshore Wind Farm Before 2025

Chaozhou in China's Guangdong Province is building an offshore wind farm that will provide more power than all the power plants of Norway. The city plans to begin work on the offshore wind farm of 43.3 GW before 2025. The wind farm will be built by Chaozhou between 75 to 185 km from the city's coast on the Taiwan Strait. The wind farm will be more than 10km long and run on the Taiwan Strait, where wind is strong enough to power turbines. China has added 17GW offshore wind generation capacity to its offshore wind generators in 2021, more than any country combined in the past five years.

Source: Wind Insider.com, 27 October 2022

India to Face Challenges in Phasing out Coal by 2030: IEA

India faces the primary challenge of meeting rising electricity demand with renewables and nuclear on a large enough scale to reduce the use of unabated coal-fired generation, according to the International Energy Agency (IEA). In its latest report, World Energy Outlook 2022, the IEA predicted India to see the largest increase in energy demand of any country with an increase in population due to urbanization and industrialisation. Renewables meet more than 60 per cent of the growth in demand for power, and account for 35% of the electricity mix by 2030: solar PV alone accounts for more than 15%. However, coal still meets a third of overall energy demand growth by 2030, and oil, mainly for transport, another quarter.

Source: Energy Economic Times, 27 October 2022

Siemens Gamesa Offshore Wind Turbine Prototype up to 15 MW

Siemens Gamesa has started the assembly process for the SG 14-236 DD prototype featuring a 236-metre diameter rotor, with a 43,500 m2 swept area and 115-metre blades.

Source: Siemens Gamesa, 25 October 2022

Adani Industries Installs 5.2 MW India's Largest Wind Turbine

Mundra Windtech Ltd (MWL), a wholly-owned subsidiary incorporated by Adani Enterprises Ltd (AEL) has installed country's largest Wind Turbine Generator (WTG) in Mundra, Gujarat. This 5.2 MW prototype WTG is the biggest wind turbine in terms of power standing 200 metres tall and has a rotor diameter of 160 metres and hub height of 120 metres.

Source: PTI, 4 November 2022

Developing Economies will need USD 1 Trillion a Year in Renewable Energy Sector to achieve Net-Zero Target: IMF

The International Monetary Fund has said on 7th October 2022 that developing economies needed an investment of USD 1 trillion a year by 2030 solely in the renewable energy sector to stay on track to achieve the net-zero greenhouse gas emissions target by 2050.

Observing that emerging markets and developing economies account for two-thirds of global greenhouse gas emissions and many are highly vulnerable to climate hazards, the International Monetary Fund said these developing economies would need significant climate financing in the coming years to reduce their emissions and to adapt to the physical effects of climate change.

"The investment needs of these economies solely in renewable energy could reach USD 1 trillion a year by 2030 if they are to stay on track to achieve net-zero greenhouse gas emissions by 2050," it said, adding that developing economies alone will require up to USD 300 billion a year by 2030 to adapt agriculture, infrastructure, water supply, and other parts of their economies to counterbalance the physical effects of climate change.

If efforts to reduce emissions fall short of global temperature objectives set by the Paris Agreement, the need for adaptation financing will rise sharply for emerging markets and developing economies. Estimates range from USD 520 billion to USD 1.75 trillion annually after 2050 depending on the emission pathway, it said.

"Emerging markets and developing economies will need significant climate financing in coming years to reduce greenhouse gas emissions (mitigation finance) and adapt to the current and predicted physical effects of climate change (adaptation finance)," the IMF said in a report released ahead of the annual meeting of the IMF and the World Bank here.

In a simultaneous blog post, three senior IMF officials Torsten Ehlers, Charlotte Gardes-Landolfini, Fabio Natalucci, and Ananthakrishnan Prasad said private climate financing must play a pivotal role as emerging markets and developing economies seek to curb greenhouse gas emissions and contain climate change while coping with its effects.

"Estimates vary, but these economies must collectively invest at least USD 1 trillion in energy infrastructure by 2030 and USD 3 trillion to USD 6 trillion across all sectors per year by 2050 to mitigate climate change by substantially reducing greenhouse gas emissions," they wrote.

'Emerging markets and developing economies will need significant climate financing in coming years to reduce greenhouse gas emissions (mitigation finance) and adapt to the current and predicted physical effects of climate change (adaptation finance)'

While private sustainable finance in emerging markets and developing economies rose to a record USD 250 billion last year, the blog post said that private finance must at least double by 2030, at a time when investable low-carbon infrastructure projects are often in short supply and funding of the fossil fuel industry has soared since the Paris Agreement.

The IMF in its report said that scaling up private climate finance in emerging markets and developing economies calls for a multi-pronged approach with improvements across various dimensions, including support from multilateral development banks (MDBs), the IMF, and the public sector.

"This reflects both the scale of financing needs and the variety of investments needed to achieve material climate change mitigation and adaptation. Innovative financing instruments can help overcome some of the challenges faced by the private sector in emerging markets and developing economies, such as credit and political risks and lack of scale," it said.

Courtesy: PTI, October 08, 2022

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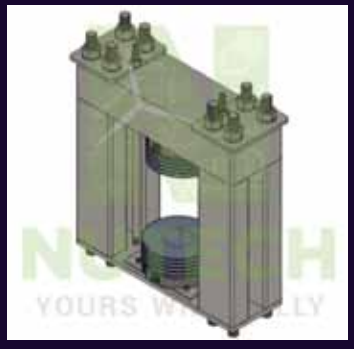

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Green House Gases (GHG): Accounting Importance for Wind & Solar Industry

NET ZERO THINK is providing innovative solutions in the areas of Climate Change Impact Assessment; Green House Gas Accounting; Scope 3 Emissions; Offshore/Onshore Wind Site & Technology Selection; Green Hydrogen & Storage Solutions; BRSR/GRI/ TCFD/CDP Reporting and Carbon Credit Advisory.

Manoj Kumar Singh
Founder & CEO

Dr. Pranamika Bhuyan
Lead GHG Accounting & Carbon Credit Solutions

Net Zero Think Private Limited

With climate disclosure mandated under CDP & BRSR (Business Responsible Sustainability Reporting), enterprises looking to understand more about their overall exposure to climate risk, they are embarking on GHG (Green House Gases) accounting reporting.

Recent development in COP27 climate conference calls the financial institutions to invest trillions of dollars in clean energy transition. The United Nations' High Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities said that companies and financial institutions must back up their climate commitments with actions and investments. Recommendations have been come up like "Net-Zero pledges should contain interim targets measuring progress along a 1.5°C pathway five years at a time, reaching net-zero by 2050 or sooner; targets should account for companies' complete Scope 1, 2 and 3 emissions."

General perception among renewable energy project developer is that their carbon footprint is low against the positive impact on environment which is coming from replacing fossil-based power generation.

But if we categories the emissions in scope 1, 2 and 3 then perception would change. The emissions which are generated

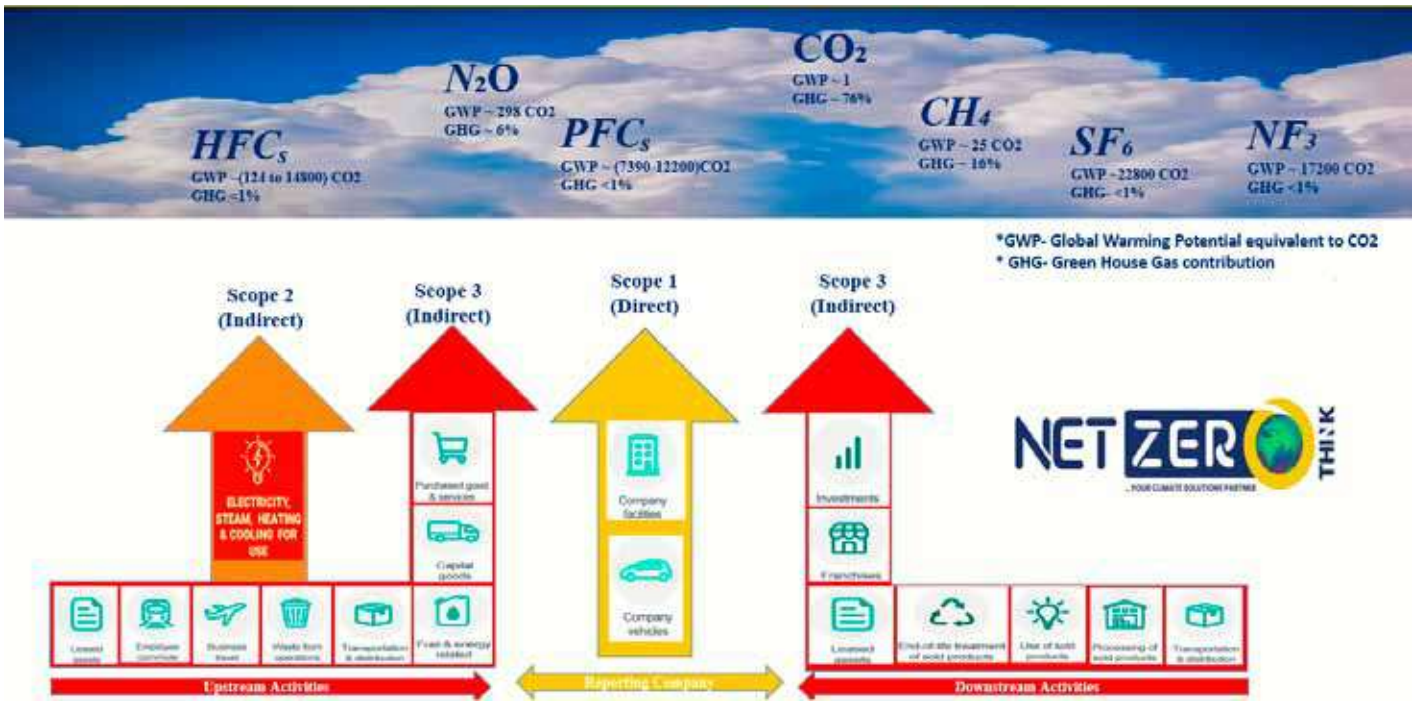

Figure 1: *Green House Gases Emissions Sources*

from upstream supply activities of equipment and goods during construction of projects are typically very high. For Independent Power Producer & Renewable Energy Asset Owner, typical Scope 3 emissions contribution is more than 90% of their overall GHG emissions.

Organisations are facing various challenges in measuring their Scope 3 emissions. They are short on resources to do so, and they have to deal with a lack of accurate data and the absence of a standardised methodology.

Nonetheless, an understanding of the importance of Scope 3 emissions and the challenges in measuring those emissions is required for organisations to start their journey in preparing for the **net zero transition**. Although Scope 3 emissions are indirect emissions, and are in fact the direct emissions of others, organisations do have significant influence on these emissions and their exposure to transition risks of climate change may be greater in these indirect areas.

What are GHG Emissions?

According to GHG Emissions Protocol, classification of emissions is listed below:

- **Scope 1 emissions** are direct emissions from owned or controlled sources. These emissions occur from the following activities: (1) generation of electricity, heat or steam including boilers, furnaces and turbines, (2) physical or chemical processing, (3) transportation of materials, products, waste and employees from company owned or controlled sources, (4) fugitive emissions (e.g. unintended leaks, or irregular emissions of gases). Emissions include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, and perfluorocarbons, sulfur hexafluoride.
- **Scope 2 emissions** are indirect emissions from the generation of purchased energy (i.e., electricity, heating, cooling). Emissions physically occur at the facility where electricity is generated. Not only can these emissions account for a big part of a corporation's environmental footprint, they are also typically necessary information for some GHG programs and calculation of emission costs.
- **Scope 3 emissions** are all other indirect emissions (not included in Scope 2) that occur in the value chain of the reporting organisation as a result of the organisation's operations, including both upstream and downstream emissions. Scope 3 emissions include a corporate's upstream and downstream value chain (e.g. suppliers and distributors), as well as business travel, leased assets, and even bank lending exposure.

In other words, Scope 3 emissions are all other indirect upstream and downstream greenhouse gas emissions that occur in the organisation's value chain.

In order to quantify overall impacts on GHG emissions in a holistic sense, an organisation should consider all emissions sources within its value chain (refer Figure 1). For example, upstream emissions attributable to purchased supplies and services, capital goods, fuel and energy related activities, waste generated in operations, transportation and distribution activities, as well as employee commuting and business travel.

Downstream emissions could include those from processing, transportation and distribution of products sold, use and end-of-life treatment of products sold, leased assets and franchises, and investments.

Why Scope 3 Emissions is Important?

1. They are a huge part of most organisation's emissions.

For industries utilising raw materials (e.g. real estate, construction, metals and mining, agriculture commodities), Scope 3 encompasses 90-95% of an organisation's value chain.

Take solar & wind project developer or asset owner for an example: only upto 6-8% of its emissions fall under Scope 1 and 2 given that the organisation relies on renewable energy for all its office facilities. The remaining 92 to 94% come from its Scope 3 emissions, with the majority coming from mining, manufacturing, transportation & construction of solar module, wind turbines, invertors, cables & structures.

2. They are a valuable risk-management tool.

Mapping GHG emissions allows organisations to understand their emission hotspots (i.e. carbon-intensive inputs/products), and which parts of their value chain are inherently more vulnerable to risk from increasing resource prices and a changing regulatory landscape, such as carbon taxes and the tightening of efficiency standards.

With respect to climate change risks more broadly - especially transition risks of climate change - GHG emissions are a critical consideration. Upstream Scope 3 emissions are exposed to policy risk while downstream Scope 3 emissions are exposed to market, technology, legal and social licence risk. In addition, the ability to access debt or equity funding in future is dependent on value chain emissions performance and a clear path to net-zero emissions across the value chain.

A robust risk management framework thus necessitates a solid understanding of your Organisation's value chain emissions and is critical to future business strategy.

3. They can help unlock business opportunities in a low-carbon economy.

As the world transitions to a low-carbon economy and countries commit to net-zero targets, governments and investors are increasingly focusing on value chain emissions. Successful businesses that are planning to last well into the future will be focusing their efforts on forecasting risks and opportunities in this rapidly changing landscape.

Taking GHG emissions into account enables organisations to identify areas for business innovation and industry and supplier collaboration, leading to transformative change and providing first-mover competitive advantages to the leaders of the future.

For instance, Renew power aims to reduce GHG emissions from supply chains and achieve Net Zero by 2040; this declaration may incentivising suppliers to access renewable energy sources for manufacturing wind & solar components and collaborate with various low carbon solution partners.

4. Their disclosure is being mandated.

Initially a voluntary set of recommendations, the Task Force on Climate-related Financial Disclosures (TCFD) has now become part of the regulatory framework in many jurisdictions, including

the European Union (EU), Singapore, Canada, Japan and South Africa. New Zealand and the United Kingdom are mandating climate risk disclosures in line with the TCFD by 2023 and 2025 respectively.

As part of the 2021 update to TCFD, it was also stated that all organisations should consider disclosing Scope 3 GHG emissions, on top of the mandated Scope 1 and 2 emissions disclosure. Where Scope 3 emissions are a material source of climate risk, they must be quantified and used to inform the calculation of financial impacts of climate change.

In India, SEBI (Security Exchange board of India) and RBI (Reserve Bank of India) have recommended to consider Scope 3 emissions disclosure along with physical risk assessment.

Although these disclosure frameworks do refer to disclosing Scope 3 emissions where they are material - and organisations themselves make the determination on whether they are material or not; given that Scope 3 emissions typically form the majority of an organisation's value chain emissions, it would be challenging to make a robust case that they are not material.

High-Level Expert Group on Net-Zero Commitments report published at COP27 is a guide to ensure credible, accountable net-zero pledges. It provides clarity in four key areas: environmental integrity, credibility, accountability and the role of governments. According to this commitment net zero pledges must cover all greenhouse gas emissions and all scopes of emissions. It includes all the financial institutions, businesses revealing all emissions-direct, indirect and those originating from supply chains and cities and regions must include territorial emissions. This report also emphasizes on publicly available, detailed, concrete net zero pledges by businesses, financial institutions and local authorities.

GHG Emissions Measurement Challenges

Despite the clear benefits and importance of GHG measurements, there are real challenges in measuring value chain emissions. Based on Net Zero Think's experience, recurring pain points typically include:

- Lack of reliable, accurate and specific data
- Lack of resources
- Lack of standardised methodology

Requiring GHG Emissions Reporting Would Better Inform Investors of Climate-Related Financial Risk

For over two decades, companies have been gaining GHG accounting experience and thousands of companies now estimate and publicly report GHG emissions each year. For the majority of companies, Scope 3 emissions represent a large source of transition risk.

Although Scope 3 emissions can require assumptions, rely on imperfect estimation methods and are uncertain, this is no different than many current financial accounting disclosures. Estimation is common and necessary in financial accounting, which is why the SEC requires disclosure of significant assumptions that go into accounting estimates. A high-quality audit that probes these estimates and assumptions for management bias is critical to reliable financial reporting. With similar process controls over estimation of Scope 3 emissions, checked by an independent auditor, companies should be able to provide investors informative data on how dependent their full value chains are on emissions and their progress toward addressing transition risks in their business models.

By requiring GHG emissions disclosure, the SEC would provide investors with more complete information about their exposure to climate-related financial risks.

Transparent estimation of Scope 3 emissions allows companies to move forward through knowledge sharing among the stakeholders and eventually builds better data for future improvements.

Way-forward: GHG Accounting is necessary

The pressure on businesses to act on BRSR/TCFD's recommendations to report on their climate strategy and disclose Scope 1-3 emissions will only increase with time. Despite the challenges around Scope 3 measurement, thousands of forward-looking organisations recognise the importance of such disclosure to their stakeholders. As data improves and methodologies are standardised over time, it is necessary to start early to prepare for the net zero transition we need for a liveable future.

FM Ms. Sitharaman Urges AIIB to Invest in RE in India

Finance Minister Ms. Nirmala Sitharaman has urged the Asian Infrastructure Investment Bank (AIIB) President Mr. Jin Liqun to scale up investments and mobilise private finance in India's key priority areas like renewable energy, energy efficiency and climate smart technologies.She also reiterated that AIIB should think of setting up a regional presence in India to facilitate dialogue and outreach to project authorities. In 7th annual meeting of the Board of Governors of the AIIB, it was decided that the bank will ramp up investments in priority areas for India like clean energy and infrastructure sector.

Source: IANS, 19 November, 2022

India's Airports Adopting Green Energy Fast

India is going big on its commitment regarding net zero emission and switching as fast as possible into green energy in every sphere of business. In tune with this mission, several Indian airports are switching to green energy and the Centre has kept a target of turning 90 airports into carbon neutral by 2024. Cochin International Airport became the first 'green airport' in the world. By 2024, more than 90 airports in the country will be carbon neutral.

Source: ET Energy Times, 18 October 2022

Renewable Energy Storage Expensive; Coal, Gas Power Forms Base Load at Present

Union minister Mr. R K Singh has said that electricity generated from coal and gas forms the base load as round-the-clock supply of renewable energy is not viable at present due to expensive storage. The power minister was addressing a seminar on National Bioenergy Programme at New Delhi also said that eventually coal and gas-based energy will be phased out.

Source: PTI, 18 November 2022

Hexagon puts data to work to overcome challenges in renewable energy technology manufacturing, such as cost, durability and efficiency.

Our solutions optimise processes from design to quality inspection, delivering efficiency gains at every step.

Hexagon offers an unrivalled portfolio of end-to-end solutions, each focused on automating processes for more efficient manufacturing and more reliable, high-performance systems. Our technology accelerates progress towards a sustainable future for all. Find out more at **https://hexagon.com/industries/energy-power-generation**

Or write to naveen.chakradhar@hexagon.com

HEXAGON

MNRE Issues Draft Tender to Lease Sea Bed for 4 GW of Offshore Wind Projects

Ministry of New and Renewable Energy (MNRE), Government of India has issued a draft Tender Document along with contractual agreements on 14th November 2022 for sea bed leasing for carrying out study/survey and subsequent development of offshore wind projects under Open Access/Captive/Third Party Sale for stakeholders' consultation. The comments were invited by 28.11.2022. This is for the selection of offshore wind power developers (OWPD) for leasing of sea-bed areas equivalent to 4000 MW of offshore wind power projects off the coast of Tamil Nadu, India through International Competitive Bidding.

Grid Connectivity and Long-Term Open Access/Access to grid under general network access (GNA) framework to grid shall be in the scope of the offshore wind power developer (OWPD).

The energy generated from offshore wind power projects to be consumed in captive mode or sold to third party under open access framework or sold through merchant sale/power exchange.

Non-refundable cost of RfS is Indian Rupees Five Lakh and Ninety Thousand only including GST (18%) to be submitted through NEFT/RTGS transfer in the account of NIWE along with the response to RfS.

EMD Amount is Indian Rupees one Crore per Project to be submitted in the form of Bank Guarantee along with the response to RfS.

The tentative Flow chart for the bidding process and scope of work are given in the diagrams.

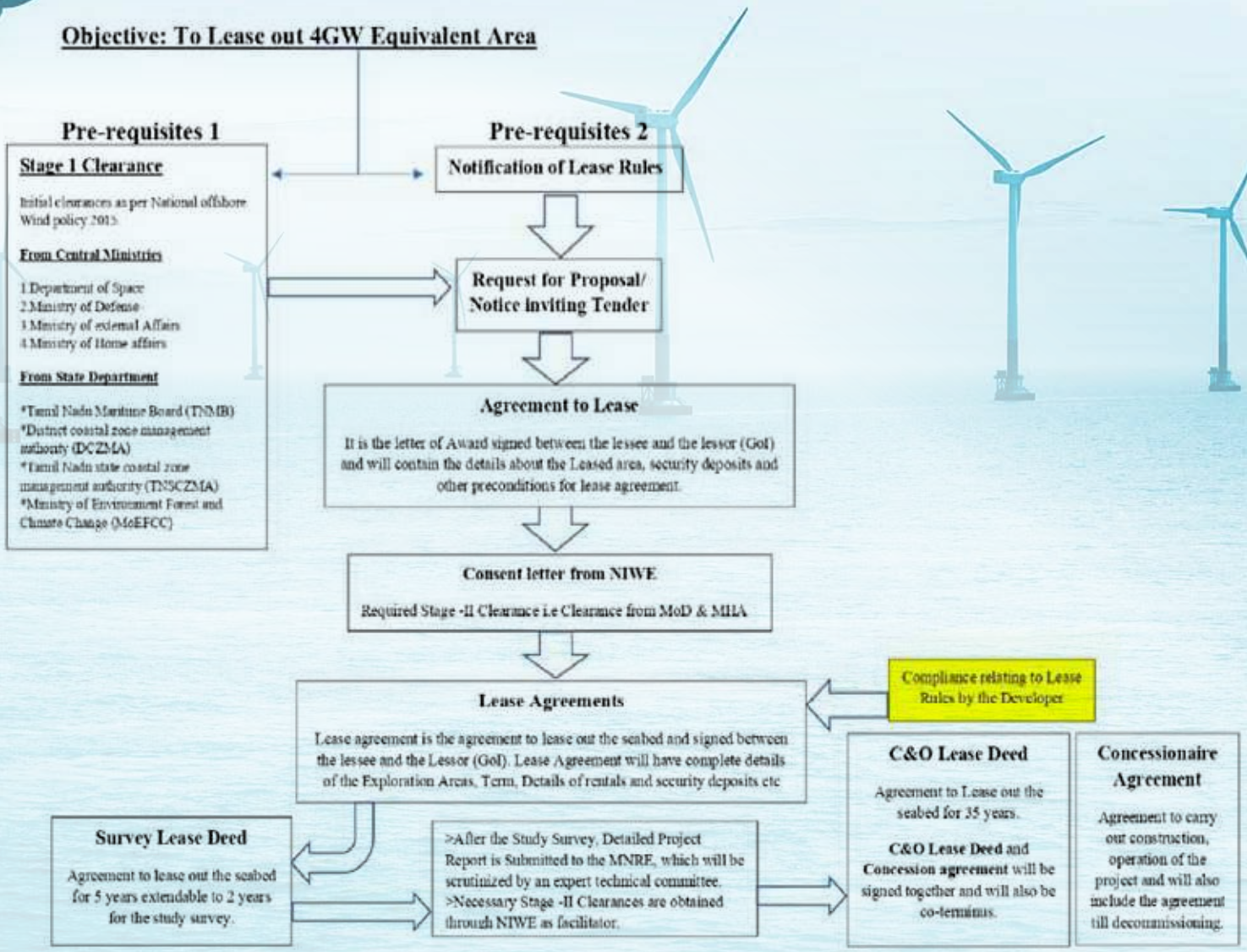

Figure 1: *Flow chart for leasing out 4 GW offshore wind equivalent sea-bed area*

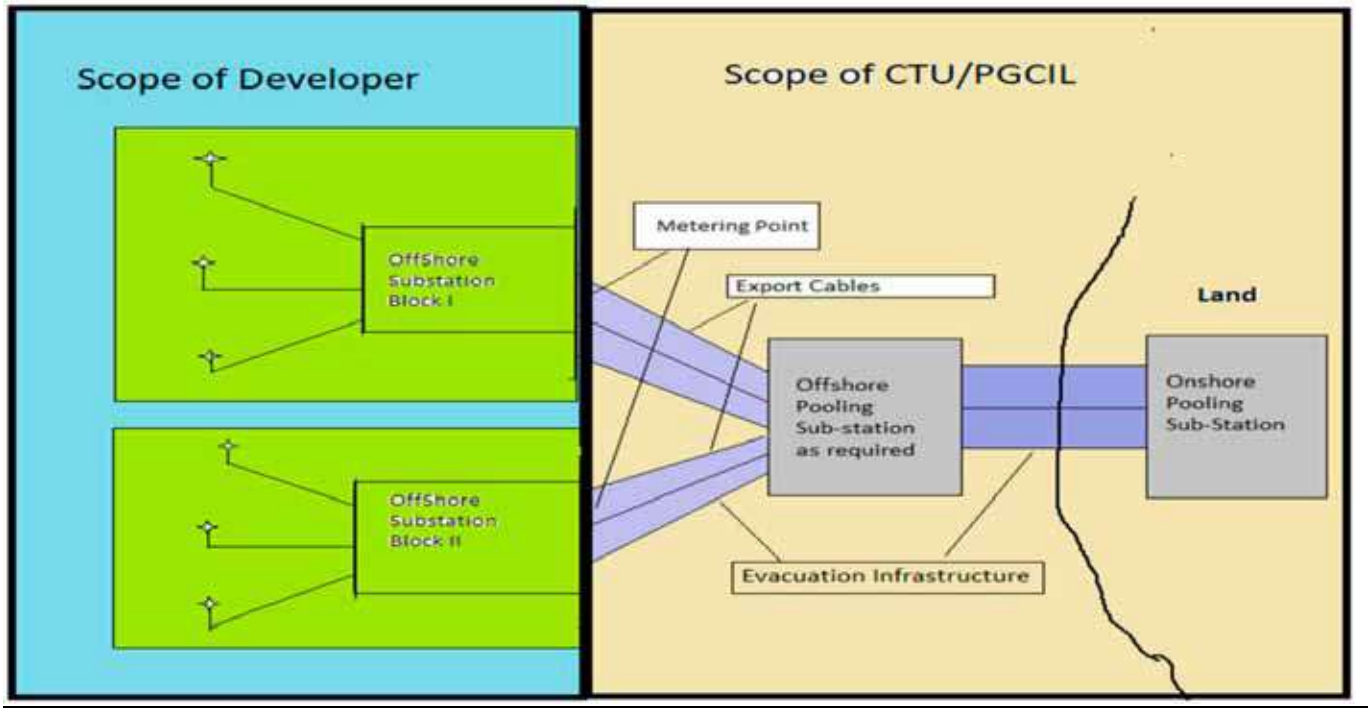

Figure 2: *Scope of work for developers and CTU/PGCIL for offshore wind project*

IWTMA Participation in Green Power 2022

Confederation of Indian Industry, Sohrabji Godrej Green Business Centre conducted Conference & Exposition on Renewable Energy - Green Power 2022 on 22 & 23 November 2022 at Taj Coromandel, Chennai. On 23rd November 2022 a session on "Onshore and Offshore Wind Energy" was conducted.

From left to right: ***Mr. Deepak Maloo****, Sales General Director, ONW APAC, GE Renewable Energy;* ***Mr. A.D. Thirumoorthy****, Chief Technical Advisor, Indian Wind Power Association (IWPA);* ***Mr. R. Ravi Chander****, Principal Counsellor, CII-Godrej GBC;* ***Mr. Ramesh Kymal****, Chairman, RE Council, CII-Godrej GBC;* ***Mr. R. Venkatesh****, CEO, Everrenew;* ***Mr. D.V. Giri****, Secretary General, Indian Wind Turbine Manufacturers Association (IWTMA) and* ***Dr. K. Balaraman****, Former Director General, National Institute of Wind Energy (NIWE)*

Regulatory Update on Wind Power

New RLMM List for Wind Turbines Issued on 19 October 2022

Ministry of New and Renewable Energy, Government of India, Wind Energy Division has issued Wind Turbine Models included as on 19th October 2022 in the RLMM after declaration of new procedure (i.e. 01 November 2018). The list contains 13 Original Equipment Manufacturers (OEMs) manufacturing 41 models ranging from 225 kW to 3660 kW with hub height up to 160 meters and rotor diameters156 meters.

https://mnre.gov.in/img/documents/uploads/file_f-1666175160889.xlsx

MNRE Issues Draft National Repowering Policy for Wind Power Projects 2022

Ministry of New and Renewable Energy (MNRE) has issued the revised draft of National Repowering Policy for Wind Power Projects on October 17, 2022 for feedback. The Repowering Policy aims to maximize the use of wind energy resources by maximising energy (kWh) yield per square kilometer of project area, and using the most up-to-date onshore wind turbine technologies. Repowering has been identified on 25 GW of wind capacity across 8 states. The following Wind turbines are eligible for repowering under the policy:

i. All Wind turbines as identified in accordance with the quality control order issued by this ministry under the relevant BIS Act ;
ii. The Wind turbines of rated capacity below 2 MW;
iii. Wind turbines which have completed their design life; and
iv. A set of existing Wind turbines over an area shall also be eligible for Repowering provided:
   - Project area is a geographically contiguous land area
   - All turbines considered for repowering are connected to a single Polling Sub Station (PSS)
     file:///E:/Downloads/file-Sat%20Nov%2005%202022%2000_05_28%20GMT+0530%20(India%20Standard%20Time).pdf
   - More than 90% of total capacity of the project should have completed its design life.

CERC Postpones Commencement of Certain Sections of GNA Regulations

Central Electricity Regulatory Commission (CERC) has postponed the commencement of various sub-rules of CERC (Connectivity and General Network Access) to the Inter-State Transmission System) Regulations, 2022. The new commencement dates will be notified later.

Source: Mercom India, 13 October 2022

Government of Gujarat Extend Wind Power Policy to March 2023

Government of Gujarat, Energy and Petrochemicals Department had announced the Wind Power Policy 2016 which was extended to further operative periods latest up to 31.07.2022. Government of Gujarat is pleased to extend the operative period of this policy further to March 2023 or till a new wind power policy is announced, whichever is earlier incorporating the amended GRs.

Source: Government of Gujarat, Energy and Petrochemicals Department, GR 21.10.2022

MNRE Issues Amendment to 'Guidelines for Tariff Based Competitive Bidding Process for Procurement of Power from Grid Connected Wind Solar Hybrid Projects"

Ministry of New & Renewable Energy (Wind Energy Division) Government of India has issued Amendment on 2nd November, 2022 in the 'Guidelines for Tariff Based Competitive Bidding Process for procurement of power from Grid Connected Wind Solar Hybrid Projects' issued dated 14.10.2020 and subsequently amended on 23.07.2021 and 09.03.2022.

file:///E:/Downloads/file-Sat%20Nov%2005%202022%2000_01_45%20GMT+0530%20(India%20Standard%20Time).pdf

CEA Designates Regulatory Affairs Division as Coordination Division for All Regulations

Central Electricity Authority (CEA), Ministry of Power, Government of India has informed that its Regulatory Affairs Division (RA) will henceforth be as Coordinating Division for all regulations of Central Electricity Authority. The Nodal Division will be responsible for preparation of draft ((for all stakeholders) including consideration of public comments for amendment, addendum, deletion etc. to the respective CEA regulations. All such drafts seeking the concurrence of the Authority, will be routed through the RA Division. RA Division will act as "Repository of all the Regulations issued by CEA and will ensure harmony and integrity among these Regulations". Regarding the matters related to Regulations of CERC/SERC, the RA Division will be the coordinating Division for furnishing comments on behalf of CEA. RA Division will be responsible for all correspondence with MoP, MNRE, CERC, SERCs, State Governments etc. as the case may be in respect of Regulations on above. Further detail is available in CEA ID Note dated 25 October 2022.

Central Electricity Regulatory Commission (CERC)

Draft Central Electricity Regulatory Commission (Terms and Conditions for Dealing in Energy Savings Certificates) (First Amendment) Regulations, 2022

1. Public Notice *(Last date:- 02.11.2022)* *https://cercind.gov.in/2022/draft_reg/PN-ESC-1stAmendment_121022.pdf*
2. Draft Amendment *https://cercind.gov.in/2022/draft_reg/DN-ESC-1stAmendment_121022.pdf*
3. Explanatory Memorandum *https://cercind.gov.in/2022/draft_reg/EM-ESC-1stAmendment_121022.pdf*

Staff Paper on 'Power Market Pricing'- reg.
(Last date of submission of comments and suggestions is extended untill 11.11.2022)

1. Public Notice(Extension) *https://cercind.gov.in/2022/staff_paper/Ext.pdf*
2. Public Notice *https://cercind.gov.in/2022/staff_paper/Public%20notice%2012.10.2022.pdf*
3. Staff Paper *https://cercind.gov.in/2022/staff_paper/SP_Power%20Market%20Pricing_111022.pdf*

Ministry of Power (MOP)

Directions to RLDCs under Section 37 of the Electricity Act, 2003 for Scheduling of power under the RE bundling scheme dated 12.04.2022

https://powermin.gov.in/sites/default/files/Directions_to_RLDCs_under_Section_37_of_the_Electricity_Act_2003_for_Scheduling_of_power_under_the_RE.pdf

Amendment to the Scheme for Flexibility in Generation and Scheduling of Thermal/Hydro Power Stations through bundling with Renewable Energy and Storage Power dated 12th April, 2022- Deletion of Paras 9.2 and 9.4.3

https://powermin.gov.in/sites/default/files/Amendment_to_the_Scheme_for_Flexibility_in_Generation_and_Scheduling_of_Thermal_Hydro_Power_Stations_through_bundling_with_Renewable_Energy_and_Storage_Power_dated.pdf

Green Energy Open Access: Procedure Advised by POSOCO and Portal Launched

Ministry of Power, Government of India had notified Power System Operation Corporation (POSOCO) as Central Nodal Agency to set up and operate a single window green energy open access system for renewable energy. Power System Operation Corporation Limited, National Load Despatch Centre (NLDC) has circulated the Procedure for Grant of Green Energy Open Access in Compliance to Ministry of Power Electricity (Promoting Renewable Energy through Green Energy Open Access) Rules, 2022. POSOCO has launched the green energy open access portal. Any consumer with a connected load of 100 kW or above can get renewable energy through open access from any renewable energy generating plant set up by himself or by any developer. The portal can be accessed at https://greenopenaccess.in/ for processing of applications by the stakeholders including open access participants, traders, power exchanges, national/ regional/state load despatch centres, central/state transmission utilities. The portal provides a transparent, simplified, uniform and streamlined procedure for granting open access to green energy that will be key to facilitating deepening of electricity markets and enabling integration of renewable energy resources into the grid. The approval for green energy open access will be granted in 15 days or else. The move is aimed at ensuring affordable, reliable, sustainable, and green energy for all.

Compiled by ***Om Taneja****, Renewable Energy Consultant*

Gautam Adani Announces Rs 65,000 Crore Investment in Rajasthan

Industrialist Mr. Gautam Adani has announced Rs 65,000-crore investment in Rajasthan over the next five to seven years, including present projects. The group just a week back achieved commercial operation of the world's largest wind-solar hybrid power plant in Rajasthan.

Source: PTI, 7 October 2022

US and India Launch Task Force on Energy Storage Technologies

The US Department of Energy (DOE) and India's Ministry of Power (MoP) launched the Energy Storage Task Force to facilitate on going and meaningful dialogue among government officials, industry representatives, and other stakeholders from both countries to help scale up and accelerate deployment of energy storage technologies to facilitate clean energy transition.

Source: Chemindigest, 10 October 2022

Siemens Gamesa 5.X Reaches 100 Turbines Installed Globally

The Siemens Gamesa 5.X onshore platform with a rated capacity of up to 7-MW and the largest rotor diameters, 155 and 170 meters, has reached a huge milestone, with the 100th wind turbine installed at the 372 MW Björnberget wind farm near Ange, Sweden.

Source: Wind Insider, 10 October 2022

A Turbine Prototype Just Broke a 24-Hour Wind Power World Record

Siemens Gamesa's 14-222 DD offshore wind turbine prototype has set a world record for the most power output by a single wind turbine in a 24-hour period: 359 megawatt-hours. The SG 14-222 DD is a 14 MW offshore wind turbine with a capacity of up to 15 MW with Power Boost. It features a 222-meter diameter rotor, 108-meter-long B108 blades that are cast in a single piece and can now be recycled, and a swept area of 39,000 square meters.

Source: Electrek, 10 October 2022

Taking Steps to Make India Market for Carbon Credits: MNRE Minister Mr. R K Singh

Union Minister for New and Renewable Energy Mr. R K Singh has said that the government is taking measures to make India a market for carbon credit which will be utilised to meet the country's NDC goals.

Source: PTI, 6 October 2022

World Must Triple Investment in Renewable Energy: UN Report

OPINION

Time is Not on Our Side: WMO Secretary-General

Global investments in renewable energy should be tripled by 2050, in order to put the world on the trajectory toward net zero emissions, according to the latest report released by the World Meteorological Organization (WMO).

The supply of electricity from clean energy sources must be doubled within the next eight years, or global energy security could be undermined, the report said.

According to the WMO's 2022 State of Climate Services report, climate change is putting global energy security at risk. The effects of climate change, including more frequent and intense extreme weather, are directly affecting fuel supply, energy production, and energy infrastructure.

Although water resources are scarce on a global scale, 87 percent of global electricity generated from thermal, nuclear and hydroelectric systems in 2020 directly depended on the availability of water.

Some 33 percent of the thermal power plants that rely on freshwater for cooling are in high water stress areas, as are 15 percent of existing nuclear power plants - a figure that could rise to 25 percent in the next 20 years.

"Net zero by 2050 is the aim. But we will only get there if we double the supply of low--emissions electricity within the next eight years," said WMO Secretary-General Petteri Taalas.

"The energy sector is the source of around three quarters of global greenhouse gas emissions. Switching to clean forms of energy generation, such as solar, wind and hydropower - and improving energy-efficiency - is vital if we are to thrive in the 21st century," he said.

"Time is not on our side, and our climate is changing before our eyes. We need a complete transformation of the global energy system," the WMO chief warned.

Africa could be a major renewables player in the future, the report says. Africa is already facing severe effects from climate change, including massive droughts. The declining cost of clean technology holds new promise for Africa's future, and there is a huge opportunity for Africa to help close the gap in the need for renewable energy.

Courtesy: IANS, 12 October 2022

IREDA Eyes DFI Status to Get Green Finance at Lower Rates

Indian Renewable Energy Development Agency Ltd (IREDA) is eyeing the status of a development financial institution (DFI) to access funds at lower rates to boost funding for India's ambitious climate goals. The plans come after state-run Power Finance Corp. and REC Ltd applied for the DFI status focusing on green finance.

It will increase their access to low-cost funds for green projects and will also help access foreign funding, grants and loans easily and in larger quantum compared to other public financial institutions. DFIs primarily cater to social and physical infrastructure projects with long gestation periods. According to estimates, there is a requirement of around $3.5 trillion by FY50 and around $10 trillion by 2070 for transitioning towards a net-zero economy.

Source: Mint, 9 November 2022

Inter-Ministerial Committee Proposes Setting up of a Non-Lapsable 'Green Energy Transition India Fund'

An inter-ministerial committee on just transition from coal has proposed setting up of a non-lapsable 'Green Energy Transition India Fund' to help coal bearing Regions to chart an alternative development plan after coal mines in the region are closed in a phased manner.

Resources for such fund may be raised from various sources such as international sources (climate finance), issuance of bonds, special levies or cesses, fines collected from polluters, existing resources such as clean energy cess and so on.

Source: ET Bureau, 10 November 2022

Greenfield Coal-Based Plants to Have Mandatory Renewable Power Generation Clause

To enhance renewable energy capacity in the country, the Power Ministry aims to make it compulsory for any thermal power producer aiming to set up a new generating capacity after April 1, 2024, to either set up or procure renewable energy capacity equivalent to it. To implement this, it plans to bring out an amendment in the Tariff Policy 2016 to include the provision of "renewable generation obligation (RGO)".

Source: IANS, 10 November 2022

HINE

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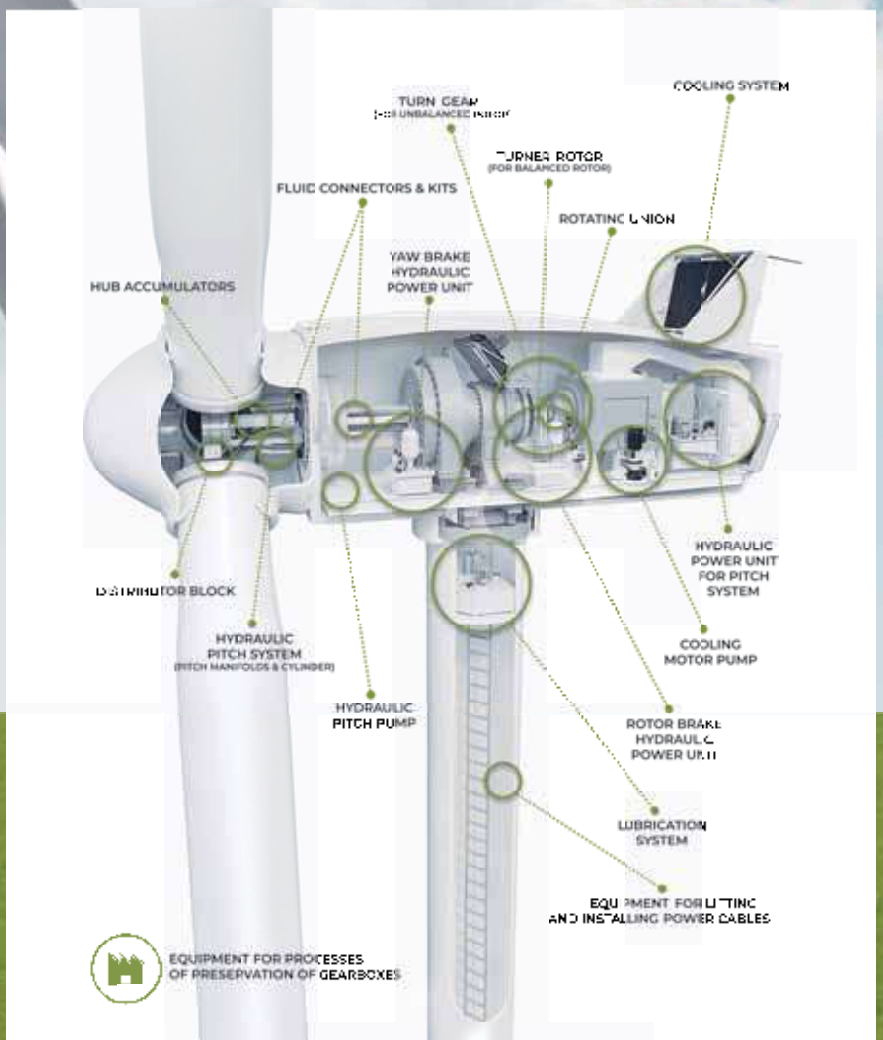

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Innovations in Wind Turbine Technology

Blades, Tower and System Optimization

Alok Kumar
Regional Renewables Sales Manager- Asia Pacific Region, DNV MES India Private Limited, Bangalore

Decarbonization and net-zero roadmaps for most countries have placed additional focus and importance on wind energy. Globally, wind power has been growing steadily since the early installations in the 1980s, and installed capacity reached 837 GW by the end of 2021. DNV's Energy Transition Outlook (ETO), an independent model of the world's energy system, forecasts installed capacity of 1 TW in 2023, 4 TW in 2040, and 6.8 TW in 2050, of which 2 TW will be offshore.

Wind energy is a mature, well-established, renewable power source, with early installations of wind turbines successfully completing their design life. Wind turbine technology has significantly evolved over three decades globally. In India, wind turbines were first installed in the 1980s with 40kW and 55kW capacities and up to 3.6 MW of wind turbine model is now listed in the Revised List of Models and Manufacturers of Wind Turbines (RLMM). Their average size has grown from a 15-metre hub height and a rotor diameter of less than 15 m in 1986 to 160 m and 156 m, respectively, now among models listed in RLMM.

The technology is constantly evolving towards enhanced reliability, increased capacity factors and minimum cost. This is made possible by optimizing control systems, pushing for more reliable drive trains, and incorporating longer, lighter blades and taller towers. With increasing hub height and turbine size, wind turbines can capture higher wind velocity at a larger span area. Challenges associated with transportation and installation are the limiting factors for wind power deployment. Hence, much recent research and innovation focuses on making wind turbine blades and towers larger, taller and more suitable for transportation and installation.

Wind Turbine Blades

Modern wind turbine blades have a maximum power coefficient of 45–50%, close to the theoretical design limit of 59% (the Betz limit). There is little potential left to improve the maximum aerodynamic efficiency; hence, the focus has been mainly on blade materials. With increasing rotor length, the weight of the blades increases, as do the gravitational loads. Efforts have therefore been made to build long but lighter blades. To do so, many new materials are being explored, and glass fibre is being replaced with lighter, composite materials.

As the industry is moving towards a circular economy, there is greater emphasis on the recyclability of materials. The other area of focus has been the design of fully recyclable blade materials. Traditionally, blades are manufactured using reinforced glass or carbon fibres along with a polymer adhesive, making recycling very difficult. New materials and special adhesives are being explored to improve the recyclability of the blade. Bio-based composites, including wood composites and laminates, are gaining importance again as blade materials to ensure they are carbon neutral and recyclable. There is also a focus on developing a process that would allow the recovery and recyclability of blade materials from decommissioned wind turbines.

'Smart' blades are another innovation and research path. These change shape depending on wind conditions, thereby managing loads without any active intervention of the controller.

The objective is to inherently limit the stresses through the change in local blade shape and reduce material fatigue. Similar efforts are being made toward developing a blade design that could be self-healing. Wind turbines are prone to delamination due to lightning, manufacturing defects, and extreme weather, and blade repairs are expensive and more rigorous from a safety perspective. A concept of self-healing design, similar to the human circulatory system, aims to ensure autonomous damage repair through including healing agents in the composite materials.

Robotic solutions for blade repairs are also being developed and improved. They aim to avoid the conventional repair method involving rope access by technicians, which is costly and less safe, with reliability issues. The robotic approach uses ultrasonic sensors and a high-end camera to detect micro-cracks and initiate early repair to avoid propagation and major failures. These solutions can also be used for timely inspection to deduce early micro-cracks and repairs.

There is an equally major focus on exploring possibilities for modifying blades of operational wind turbines to enhance performance. In most cases, there is an adequate margin between the site-specific and design loads of wind turbines. Hence, there is the possibility of increasing wind turbine production through extending blade length by attaching a piece at the tip or via various add-ons such as vortex generators, spoilers, or blade-tip improvers.

Wind Turbine Tower

Tubular steel tower has been the most popular choice for megawatt-capacity wind turbines. However, dependence on costly steel with volatile pricing has forced designers to look at concrete towers and other new materials. Design innovation is also targeting reduction in the amount of steel used and optimization of its use.

With the trend of increasing tower heights, challenges associated with transporting and installing larger towers are becoming limiting factors. Therefore, conventional tower designs are being modified to enable on-site manufacturing and assembly. Bolted steel towers are being considered for manufacturing for their easy transportation and assembly at the project site.

Lattice tower, which was discarded primarily due to aesthetics reasons, is attracting the attention of designers again, mainly for cost reduction and easy transportation and installation. A hybrid solution combining lattice and tubular tower has been designed to capture the benefits of both concepts, and such innovation will continue. There are also efforts to optimize the manufacturing process, especially welding, to make it more suitable for taller and bigger towers.

System Optimization

Levelized cost of energy (LCOE) has become a significant focus in strategic-decision making when designing a new wind turbine model. An iterative process for conceptual design, along with several alternative designs, is considered and evaluated at the system level. To achieve the same, DNV has developed 'Renewables.Architect', a powerful tool for LCOE reduction. This flexible software framework has been designed specifically for Multi-disciplinary Design, Analysis and Optimization (MDAO). At the heart of this framework is a cost-of-energy modelling and concept design tool that features a library of engineering models and numerical algorithms spanning the entire wind energy system – from blade tip to farm operations and maintenance. It considers the complete picture by bringing together cost modelling of not just the machines but the balance of plant, operations and maintenance, and economic aspects so that decisions can be made most objectively. It also contains a discounted cash flow model where estimated costs and yield are escalated to LCOE and Net Present Value (NPV). Renewables. Architect is being increasingly used by the industry for overall system optimization for component design, turbine design, and overall wind farm optimization.

Another area of innovation has been performance optimization at the wind farm level. Control algorithms are an essential part of today's renewable energy generation devices. They allow the device's energy output to be optimized for changing local conditions, making energy production much more cost-efficient. Instead of optimizing the generation at individual wind-turbine level, the main objective is to optimize the output at the wind-farm level by considering the spatial and temporal wind-field variations, wake effects, and detailed turbine dynamic responses. A controller at the wind-farm level has more significant potential for wind-farm performance enhancement while ensuring the reliability of turbines as well as compliance with grid management.

Conclusion

Over the last three decades, the nameplate capacity of wind turbines has significantly increased from a few hundred kW to above 5 MW for onshore wind and more than 15 MW for offshore wind. This trend of increasing size and capacity will continue together with the drive to further optimize LCOE while circumventing challenges of transportation and installation. Design for long and light blades is the focus along with efforts towards using recyclable materials. The design of tall towers will continue to focus mainly on reducing the risk of higher volatility of steel prices and issues around transportation and installation.

Digitalization has paved the way for control and performance optimization at the wind-farm level, thereby increasing the performance and improving the reliability of turbines. Other concepts like two-bladed wind turbines, the design of a drive train at the bottom of the turbine, and superconducting generators, will continue to be explored.

SnipPets

India Plans to Invest Rs 2.8 Lakh Crore in ISTS for RE Evacuation

Out of the total Rs 2.8 lakh crore investments in ISTS for green energy evacuation, PGCIL plans to invest 40-50 per cent. India is planning to invest Rs 1.4 lakh crore by 2026-27 in setting up interstate transmission network (ISTS) for evacuation of renewable energy and a similar number till 2030, said K Sreekant, chairman and managing director of Powergrid Corporation of India (PGCIL).

"Rs 1.4 lakh crore is by 2026-27, beyond that it is still to be developed. Our estimate is that we will have similar investment for up to 2030 generation. It is still under development, various schemes are under discussion to optimise the investment in transmission. Rs 1.4 lakh crore investment will not include battery storage projects and will be separate from the investment it is making in its green energy corridor project. There is a National Transmission Plan also in the works.

Source: ET Energy World, 16 November 2022

GOI includes Energy Storage Systems in Harmonized Master List of Infrastructure

Department of Economic Affairs, Ministry of Finance, Government of India has included Energy Storage Systems (ESS) as a new infrastructure sub-sector in the energy category. Other sub-sectors in the category include electricity generation, transmission, distribution, and oil/gas/LNG storage facility. Further, the announcement defines ESS as dense charging infrastructure and grid scale energy storage system with a minimum qualifying capacity of 200 MWh, given that the ESS is not being established on merchant basis.

Source: ETN News, 12 October 2022

Enerfra Projects (India) Private Limited

WELCOME

IWTMA New Member

About Enerfra

Enerfra is a professional renewable energy services and solutions provider addressing electricity and energy challenges by improving access to and promoting the adoption of clean and energy-efficient technologies.

Enerfra was incorporated in 2013 by a group of professionals with more than three decades of experience in renewable energy industry. The leadership team has experience working across all verticals in renewable energy sector prior to setting up Enerfra.

Enerfra is headquartered in Bengaluru and has offices in Hyderabad and Jamnagar.

Our Business Model

We have an integrated business model that ranges from renewable energy production to the commercialization of energy solutions.

We develop our activity by following business lines:

- Consulting solutions for C&I and grid-connected renewable energy projects
- Development of renewable energy projects for customers
- Provide storage solutions
- Explore and develop new clean energy business models

Enerfra had executed Engineering, Procurement and Construction (EPC) contracts for reputed firms.

Enerfra is currently developing 1 GW projects in the State of Karnataka and Gujarat. Further, Enerfra has a strong pipeline of projects.

Management Team

U. B. Reddy
Managing Director

Mr. Reddy is a seasoned and proven professional with hands-on exposure to all aspects of the wind farm development for more than 25 years. He holds a BE in Mechanical Engineering.

R. Srinivas
Director & CTO

Mr. Srinivas brings a rich and diverse know-how of 20 years in wind power in India. He has extensive knowledge of power system engineering and in all aspects of Wind Energy Projects. He has a BE in Electrical & Electronics Engineering.

Snippets

Vestas 15 MW Prototype Turbine Taking Shape

Vestas has manufactured and rolled out the first 115.5-metre blade built for the offshore wind turbine prototype at its production facility in Nakskov, Denmark. Stretching 280 metres into the air with a production output of 80 GWh/year, the prototype will be the tallest and most powerful wind turbine in the world once installed later this year, according to Vestas. With a swept area exceeding 43,000 m^2, one single V236-15.0 MW unit is capable of producing enough energy to power more than 20,000 households.

China Produces World's Largest 16 MW Wind Turbine

China's home-developed 16 MW offshore wind turbine rolled off the production line which boasts the world's largest single-unit capacity and biggest impeller. With a propeller diameter of 252 meters, it covers a swept area of 50,000 sqm. A single unit could produce clean electricity of 66 million kWh per year, meeting the annual electricity needs of more than 36,000 urban households. It's estimated that it will reduce the consumption of coal by 22,000 tons and reduce Co2 emissions by 54,000 tons every year.

Source: Global Times.cn, 23 November 2022

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Editor: Dr. Rishi Muni Dwivedi

Windergy India 2023
5th Edition to be held in Chennai

5th International Trade Fair & Conference
4-6 October 2023
Chennai Trade Centre, Chennai, India

India is one of the fastest growing wind energy markets in the world with an installed capacity of over 41 GW. With a rapidly growing population and increasing demand for cleaner sources of energy, India's wind energy market is set to continue its strong growth trajectory.

It may be recalled that in order to reduce dependence on fossil fuel and achieve the target of net-zero emission by 2070, Prime Minister Shri Narendra Modi at COP26 (November 2021) pledged five key targets towards fulfilment of this objective. These include: (i) Increasing country's non-fossil energy capacity to 500 GW by 2030 (ii) 50 percent of country's energy requirements to come from renewable energy by 2030 (iii) Reduction of total projected carbon emissions by one billion tons from now till 2030 (iv) By 2030, India will reduce the carbon intensity of its economy by more than 45 percent (v) By the year 2070, India will achieve the target of Net-Zero.

Wind energy will play a pivotal role in achieving the above objectives and has already made impressive progress in terms of capacity addition, manufacturing capabilities and other areas. Currently, 27% of the total installed power capacity in the country comes from renewable energy, of which 37.73% is contributed by wind energy (40.13 GW). The target for wind energy is 140 GW by 2030 ~ an annual capacity addition of around 10 GW year on year.

As India's only comprehensive International Tradefair and Conference for the Wind Energy Sector, Windergy India aims to once again bring together wind industry professionals from India and overseas to reiterate the pivotal role of wind energy in achieving the target of net-zero emission objectives and to accelerate progress in terms of capacity addition, manufacturing capabilities and other areas through its annual tradefair and conference. Indian Wind Turbine Manufacturers Association (IWTMA) and PDA Ventures have just announced the fifth edition of Windergy India 2023 to be held from 4 – 6 October 2023 at Chennai Trade Centre, Chennai. Tamil Nadu is in the forefront of the entire Eco Value Chain.

The last edition which took place from April 27–29, 2022, at Pragati Maidan in New Delhi, was a success in bringing together the top OEMs, component makers, and service providers from countries including China, Malaysia, Denmark, the UK, Italy, Germany, France, and India. Over 3000 wind industry professionals from India and overseas comprising of Academicians, Associations, Industry Leaders, International Organisations, Banks and Financial Institutions, Clean-Tech Specialists, Consultants, Corporates, DISCOMS, Environmental Groups, State/Central Governments, Green Power Providers, Independent Power Producers, Investors, Landscape architects, Energy Consultants, Lawyers, Surveyors & appraisers, Media, and trade press, Municipalities, Non-Governmental Organisations, Non-profit Organisations, Think Tanks, PSUs, Power Consultants, R&D Institutions, Technology Developers, Trading Company/ Distributing Agent, Utility Providers, Venture Capitalists, participated at the event in a span of three days.

The parallel conference themed 'Power of the Wind: India's Drive to Net-Zero" had deliberations by industry leaders and professionals with the presence of 300 plus delegates analysed and reflected on policies and regulatory challenges in India. Future electricity demands, efficient grid integration and offshore were all examined in-depth, in addition to technology and green finance methods.

The upcoming 5th edition will yet again be an exclusive blend of a 3-day tradefair alongside a 2-day power packed conference with key note speeches, thought-provoking panel discussions, special addresses and technology presentations by senior bureaucrats, industry leaders, academics and other subject matter experts, providing an exclusive platform to meet, interact and engage with policymakers, regulatory authorities, international / domestic technology, solutions and service providers from the Wind Energy Sector.

For more details: https://windergy.in/
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