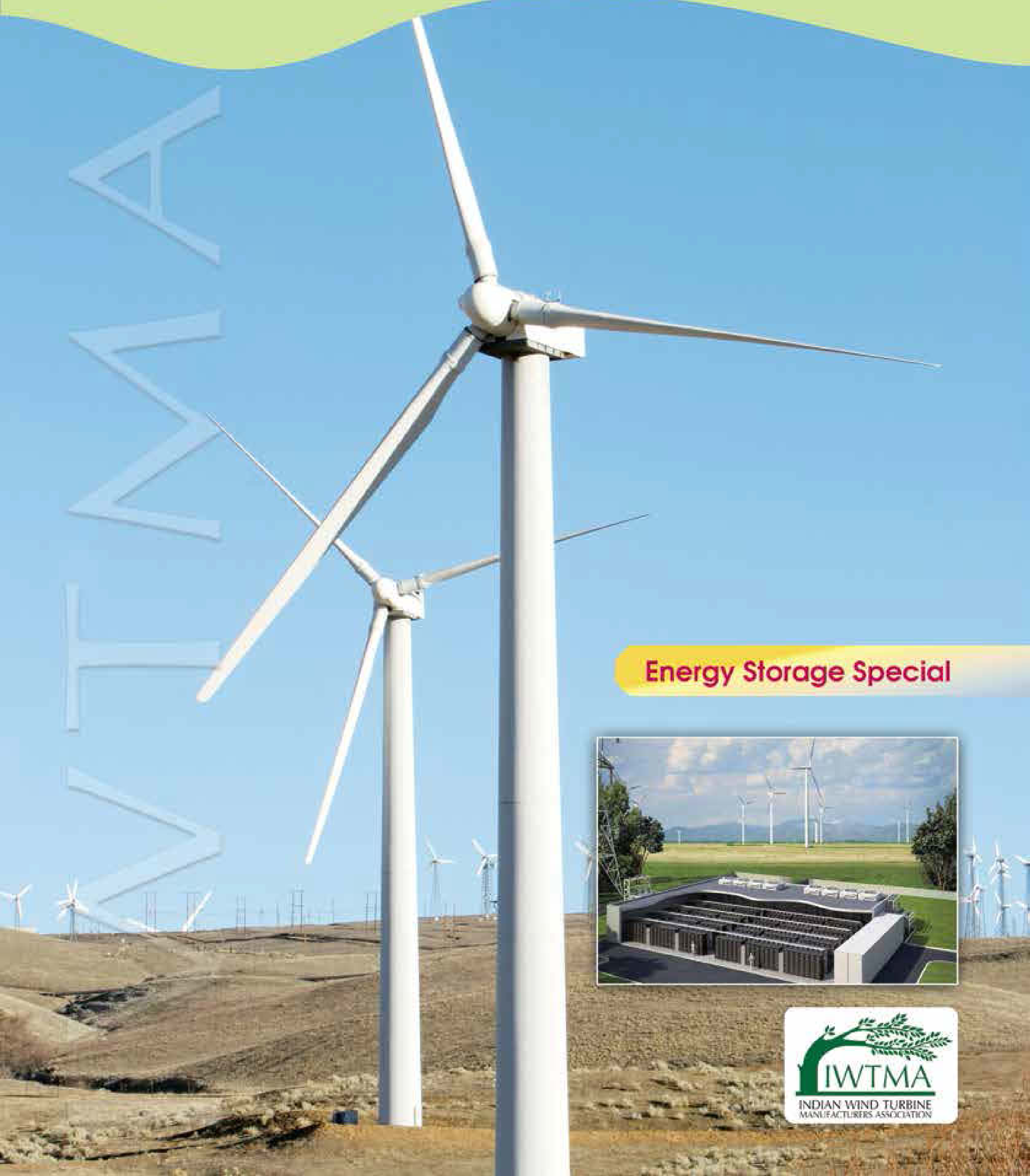
Indian Wind Power

Volume: 1 Issue: 1 October - November 2014 ₹ 25/-



Energy Storage Special

IWTMA
INDIAN WIND TURBINE MANUFACTURERS ASSOCIATION

Expertise offered to Wind & Solar Energy Stakeholders

Research & Development

- Supports multi institutional research on wind energy
- Performance testing of Small Wind Turbines / Aerogenerators
- Empanelment of Small Wind Turbine manufacturers
- Acoustic Noise measurement
- Study of wind-solar-diesel hybrid system

Wind Resource Assessment

- Site condition assessments for wind monitoring & wind farm development and field visits
- Procurement, installation and commissioning of met mast of 50m to 120 m height
- Providing measurement campaign management, assisting clients in the Installation and monitoring of meteorological masts, LIDAR and SODAR stations
- Data collection, management, quality control and wind energy resource reporting
- Analysis of Data with sophisticated software tools and techniques
- Long-Term Trend Data Analysis (NCEP/NCAR/MERRA)
- Turbine array layout design, optimization, field Micro siting and Produce bankable P50 P75, and P90 yield predictions.
- Investment Grade wind energy resource assessment reports (gross/net Predictions, uncertainty analyses, etc.)
- Analysis of existing wind farm operations
- Technical due diligence in complying with international standards.
- Power curve demonstration guarantee test
- Preparation of Tender document for development of wind farm
- Helping the evaluation of tender as one of the tender evaluation committee members.
- DPRs (Detailed Project Reports) preparation through State of art software tool for wind farm developers

Testing Services

- As per Internationally accepted procedures and stipulations for
- Power Performance measurements
- Load measurements
- Power Quality measurements
- Safety and function tests
- Yaw efficiency test
- User defined measurements
- The services are not limited by type or size of the Wind Turbines
- The services are certified as per the requirements of ISO 9001: 2008 and accredited as per the requirements of ISO/IEC 17025 : 2005

Certification Services

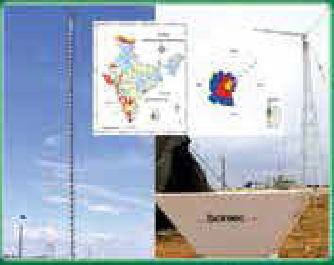
- Accord type approval / type certification to wind turbines in accordance with Indian Type Certification Scheme [TAPS - 2000 (amended)]. Type Certification Services are certified as per ISO 9001 : 2008
- Preparation of Indian standards on wind turbines
- Issue the Revised List of Models and Manufacturers (RLMM) of wind turbines periodically
- Issue the recommendation for grid synchronization to facilitate installation of prototype wind turbines

Training

- Capable of providing
- Wind / Solar Resource Measurement & Analysis
- Wind Resource Modelling Techniques
- Wind Speed Statistics / Solar irradiation and Energy Calculations
- Micro-siting and Layout of wind / solar farms
- Wind Turbine / Solar Technology
- Design and Safety requirements as per standards
- O & M practices

Solar Radiation Resource Assessment

- Direct Normal (DNI), Diffused Horizontal (DHI) & Global Horizontal (GHI) irradiation measurements
- Data quality checking
- Solar resource data delivery
- Calibration Laboratory for solar
- Solar Map preparation
- Preparation and vetting of feasibility, DPR of Solar projects



नीवे NIWE

NATIONAL INSTITUTE OF WIND ENERGY

Formerly "Centre for Wind Energy Technology"

An Autonomous Research & Development Institution, Ministry of New and Renewable Energy, Government of India

Velachery - Tambaram Main Road, Pallikaranai, Chennai - 600 100

Phone : +91-44-2246 3982 / 83 / 84 Fax : +91-44-2246 3980 http://cwet.res.in www.cwet.tn.nic.in E-mail : info@cwet.res.in

Indian Wind Power

A Bi-monthly Magazine of Indian Wind Turbine Manufacturers Association

Contents

Page No.

Indian Wind Turbine Manufacturers Association

4th Floor, Samson Tower, 403 L, Pantheon Road, Egmore
Chennai - 600 008. Tel : 044 43015773 Fax : 044 4301 6132
Email : secretarygeneral@indianwindpower.com
associatedirector@indianwindpower.com
Website : www.indianwindpower.com

(For Internal Circulation only)

From the Desk of the Chairman - IWTMA

Dear Readers,

We are pleased to reach you with our new issue of INDIAN WIND POWER magazine and share equal pleasure in greeting you all from IWTMA!

By the time this magazine reaches you, a new Association would have born as "INDIAN WIND ENERGY ALLIANCE (IWEA)" – joining together of Indian Wind Turbine Manufacturers Association (IWTMA) and Wind Independent Power Producers Association (WIPPA). Shri Piyush Goyal, Hon'ble Minister for Power, Coal and New and Renewable Energy (I/c) is launching the new Association.

The buzz word is to reach the capacity addition of 10,000 MW per annum on a year on year basis and the entire stakeholder community is gearing up to meet this challenge. Green Corridor planned by the Government through PGCL for grid integration and support of component manufacturers with a tag of "Make in India" coupled with land reforms for easy transaction are three major constituents towards this goal.

We are dedicating this issue to "Energy Storage" which is perhaps the most wanted link to be able to inject the power into the grid during peak demand thereby creating new energy storage solutions. This issue comes on the heels of the "Energy Storage India" – an International Conference & Exhibition being held from 3rd to 5th December 2014 at New Delhi.

Energy storage can be very useful solution for cold storage applications, electric vehicles, large hospitals, mini micro-grids, rural electrification etc. There are many solutions and technologies available for energy storage. While they were expensive in the past, the new technologies are competitive to store the energy. Energy storage plays an integral part for higher wind penetration and to maintain sudden large load/generation imbalance in the distribution grid by providing frequency support and preventing system collapse.

Finally, on behalf of IWTMA, I wish the readers and their families a "Merry Christmas and to usher in an eventful 2015 of prosperity and ring out 2014 with cherished memories.

We encourage you to enjoy reading and equally look forward to your valuable feedback.

Madhusudan Khemka
Chairman

Global Wind Energy Council's Long-term Outlook for Wind

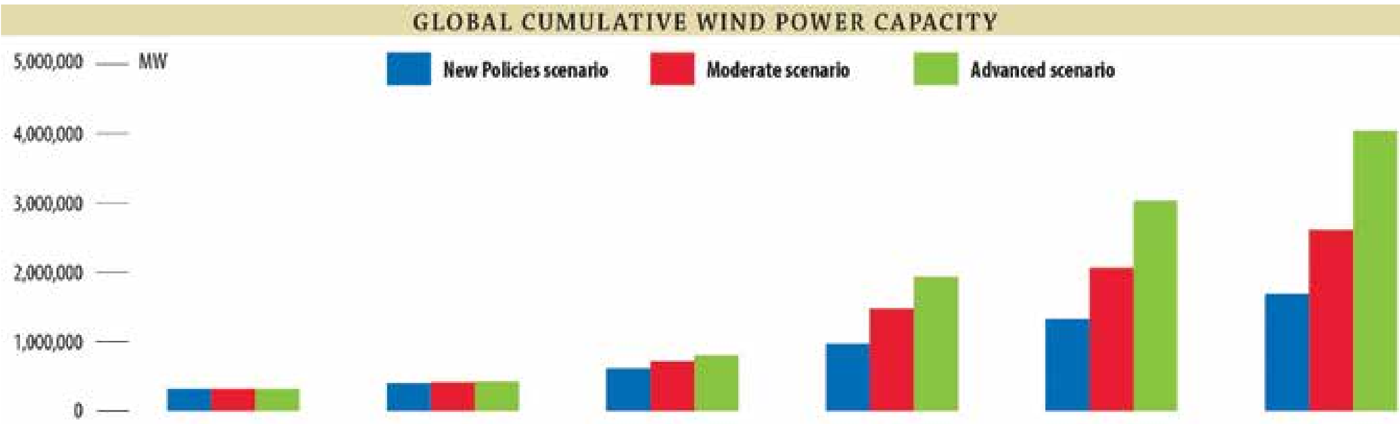
Shruti Shukla
Senior Policy Advisor, Global Wind Energy Council, Brussels

Wind power has now firmly established itself as a mainstream option for new electrical generation. The most remarkable recent development is that in an increasing number of markets, wind power is the least cost option when adding new generation capacity to the grid, and prices continue to fall. There are now commercial wind power installations in more than 90 countries with total installed capacity of 318 GW at the end of 2013, providing about 3% of global electricity supply, and the industry is set to grow by another 45 GW in 2014.

Global Wind Energy Council launched the fifth edition of the **Global Wind Energy Outlook[1] (GWEO)** on 21 October 2014 in Beijing. The GWEO is published every two years in collaboration with Greenpeace International. The Global Wind Energy Outlook isn't about the short-term or immediate projections. It's about what the industry will look like in 2020, 2030 and beyond.

As with past editions, the new GWEO presents three visions of the future of the global wind energy industry out to 2020, 2030 and up to 2050. The scenarios compare the International Energy Agency's central scenario from its World Energy Outlook with a 'Moderate' and 'Advanced' scenario developed especially for this report, detailing how the global wind industry could deliver in terms of global electricity supply, CO_2 emission savings, employment, cost reductions, and investment.

GLOBAL CUMULATIVE WIND POWER CAPACITY



	2013	2015	2020	2030	2040	2050
New Policies scenario						
MW	318,128	396,311	610,979	964,465	1,324,814	1,684,074
TWh/a	620	972	1,499	2,535	3,482	4,426
Moderate scenario						
MW	318,128	413,039	712,081	1,479,767	2,089,261	2,672,231
TWh/a	620	1,013	1,747	3,889	5,491	7,023
Advanced scenario						
MW	318,128	420,363	800,615	1,933,989	3,024,473	4,042,475
TWh/a	620	1,031	1,964	5,083	7,948	10,624

Source: GWEO (2014[2])

1 http://www.gwec.net/publications/global-wind-energy-outlook/global-wind-energy-outlook-2014/
2 http://www.gwec.net/wp-content/uploads/2014/10/1_Global-Cumulative-Wind-Power-Capacity.jpg

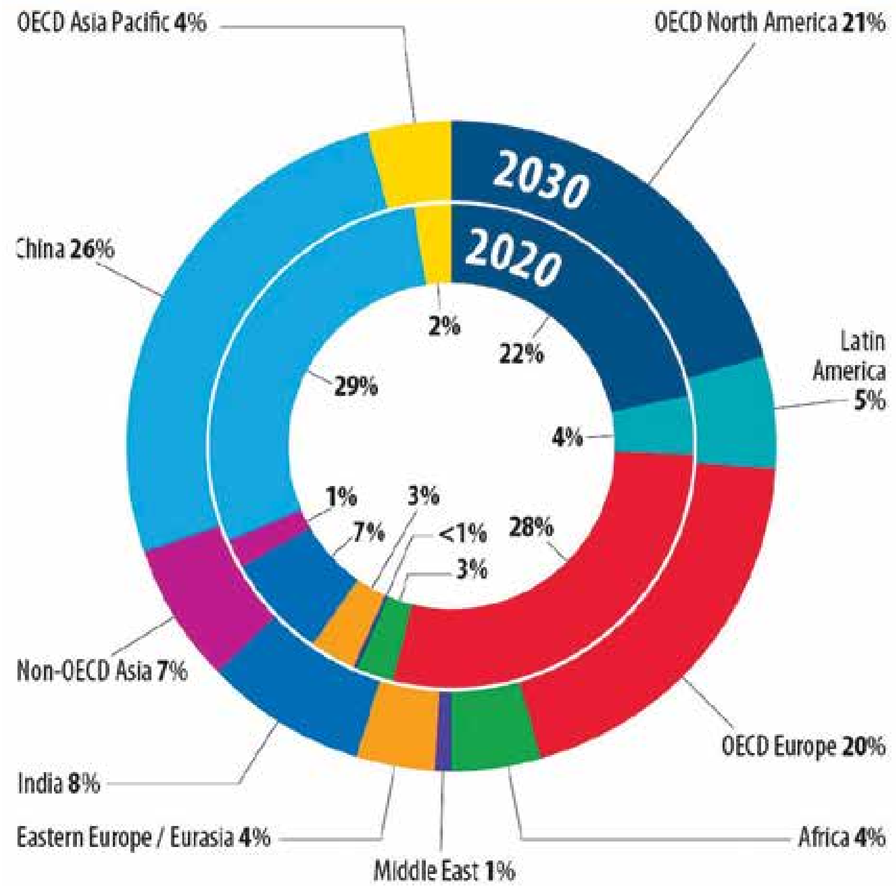
The upheaval in electricity markets around the globe, the wild swings in policy both in favour of and against renewable energy deployment and the uncertain future of the global climate regime make predictions about the future of this or any other industry even more difficult than usual. However, it is also the case that as wind power plays a more and more central role in our electricity system, that the various scenarios from industry, the IEA, NGOs and others all begin to converge.

While the three GWEO scenarios for the period out to 2020 have converged substantially in the past 2 years, the Advanced scenario, is the most ambitious, and outlines the extent to which the wind industry could grow in a best case 'wind energy vision', but still well within the capacity of the industry as it exists today and is likely to grow in the future. It assumes an unambiguous commitment to renewable energy in line with industry recommendations, the political will to commit to appropriate policies and the political stamina to stick with them.

It also assumes that governments enact clear and effective policies on carbon emission reductions in line with the now universally agreed objective of keeping global mean temperature rise below 2°C above preindustrial temperature levels. Wind power is an absolutely critical technology to meeting the first objective in that effort - which is getting global emissions to peak and begin to decline before the end of this decade.

The Advanced Scenario shows that wind power could reach 2,000 GW by 2030, and supply up to a fifth of global electricity, creating over 2 million new jobs and reducing CO_2 emissions by more than 3 billion tonnes per year. By 2050, wind power could provide 25-30% of global electricity supply.

REGIONAL BREAKDOWN: ADVANCED SCENARIO

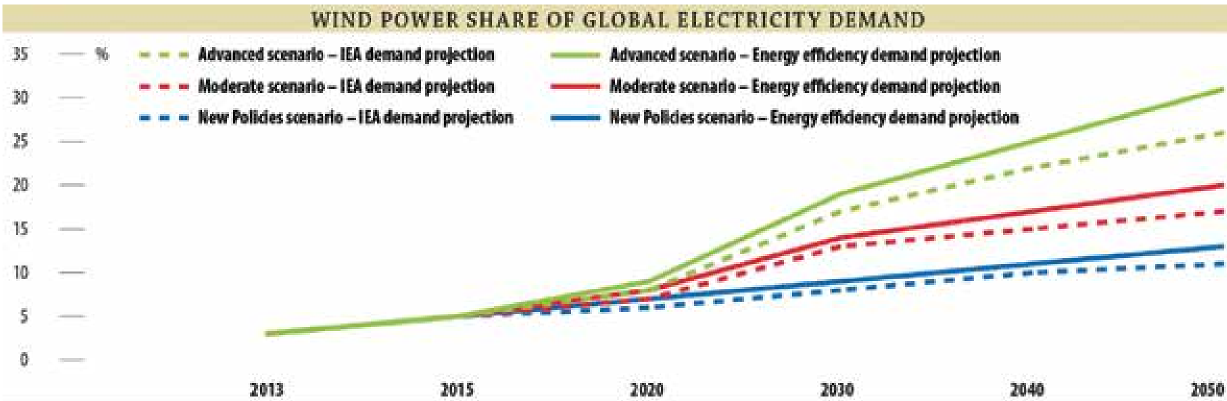


	2020	2030
OECD North America	173,684	399,912
Latin America	32,680	104,103
OECD Europe	225,577	386,017
Africa	20,955	86,012
Middle East	1,333	14,165
Eastern Europe / Eurasia	24,748	75,669
India	55,872	154,207
Non-OECD Asia	16,033	137,231
China	230,048	497,505
OECD Asia Pacific	19,686	79,169
Global Total / MW	**800,615**	**1,933,989**

Source: GWEO (2014[3])

The GWEO Advanced scenario shows that wind power could generate over 1950 TWh of electricity by 2020, meeting between 8.1% and 8.8% of global electricity demand, in line with the industry's long-term objectives and consistent with the idea of having global emissions peak before 2020. These numbers continue to rise steeply in the subsequent decade, with wind power contributing more than 5,000 TWh in 2030, meeting between 16.7% and 18.8% of total electricity demand.

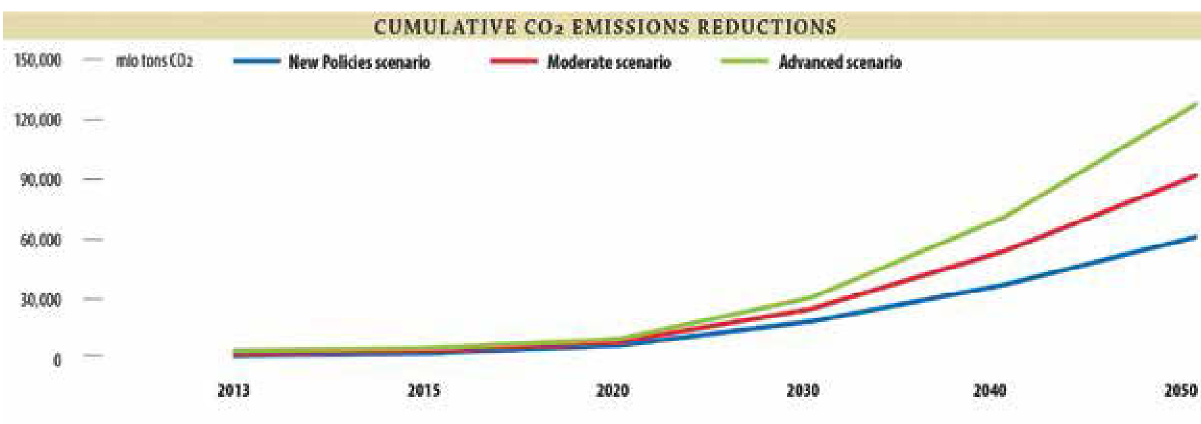
3 http://www.gwec.net/wp-content/uploads/2014/10/4_Regional-Breakdown-Advanced-scenario.jpg



	2013	2015	2020	2030	2040	2050
New Policies scenario						
IEA demand projection	3%	5%	6%	8%	10%	11%
Energy Efficiency demand projection	3%	5%	7%	9%	11%	13%
Moderate scenario						
IEA demand projection	3%	5%	7%	13%	15%	17%
Energy Efficiency demand projection	3%	5%	8%	15%	17%	20%
Advanced scenario						
IEA demand projection	3%	5%	8%	17%	22%	26%
Energy Efficiency demand projection	3%	5%	9%	19%	25%	31%

Source: GWEO (2014[4])

However, much would have to change in that period in order to reach these goals, including a global climate agreement which would establish a price on CO_2 emissions, policy stability especially in the US as well as other major markets, and some efforts to reduce the level of current massive subsidies for fossil fuels. Globally, the cost of government subsidies for fossil fuels increased from $311 billion in 2009 to $544 billion in 2012, according to IEA estimates. If lost tax revenues are also included, this figure rises to approximately $2 trillion[5].



Source: GWEO (2014[6])

The power sector is responsible for more than 40% of all CO_2 emissions from burning fossil fuels, and about 25% of our total greenhouse gas emissions. If global emissions are to peak and decline in this decade, as the science shows is necessary in order to meet climate protection goals, one focus has to be the power sector.

Wind power's scalability and its speed of deployment makes it an ideal technology to bring about the early emissions reductions which are required if we are to keep the window open for keeping global mean temperature rise to 2°C or less above pre-industrial levels.

4 http://www.gwec.net/wp-content/uploads/2014/10/5_Wind-Power-share-of-global-electricity-demand.jpg
5 http://www.economist.com/news/finance-and-economics/21593484-economic-case-scrapping-fossil-fuel-subsidies-getting-stronger-fuelling
6 http://www.gwec.net/wp-content/uploads/2014/10/9_Cumulative-CO_2-emissions-reductions.jpg

Energy Storage: Potential Enabler for Greater Wind Penetration in India

Dr. Rahul Walawalkar
Executive Director, IESA & VP, Emerging Tech & Markets, Customized Energy Solutions

Wind is becoming one of the major sources of power worldwide and India is at forefront of it. Among the various renewable energy sources available in India wind power generation is presently the largest renewable power source. Wind installed capacity of around 20 GW is nearly 15% of India's peak load during 2012-13. More than 95% of the sector's development is concentrated in the states of Tamil Nadu, Karnataka, Maharashtra, Andhra Pradesh and Gujarat, located in Southern and Western India.

Estimates of wind potential in India vary from conservative 50 GW to 2000 GW, so it is clear that availability of natural resources is not limiting factor for the continued growth of wind energy in India. The real challenge lays in the grid integration issues. Wind energy due to its variability is creating technical challenges for the grid operators for its integration. Grid operators need to balance generation and load on second by second basis. As wind output fluctuates operators must supply necessary generation from other sources in order to keep the balance between generation and load. In developed countries, presence of reserve generation capacity that includes flexible resources as well as established ancillary services helps in continuously balancing the grid. At lower wind penetration the conventional resources are capable of adjusting wind fluctuations. As the share of wind energy keeps increasing it will become challenging to manage grid stability. With increasing wind penetration, it becomes imperative to find new solutions to absorb wind variability and achieve grid stability. Advanced Energy Storage Systems provides one such solution!

Energy Storage is being considered globally to support wind integration and numerous demonstration as well as commercial projects have been operating for over 3-4 years around the globe. Energy storage technologies can be grouped as electrochemical and non-electrochemical technologies. The most common energy storage technologies are:

- **Electrochemical energy storage**
  - Lead Acid battery
  - Lithium Ion (Li-ion) battery
    - Lithium Iron Phosphate (LFP)
    - Lithium Cobalt (LCO)
    - Lithium Manganese Oxide (LMO)
    - Lithium Nickel Manganese Colbalt Oxide (NMC)
    - Lithium Titanate (LTO)
  - Sodium-Sulfur battery (NaS)
  - Sodium Ion batteries
  - Sodium Nickel Chloride (NaNiCl2) batteries
  - Flow Batteries
    - Vanadium Redox battery (VRB)
    - Zinc Bromine battery (ZnBr)
    - Iron Chrome battery
  - Nickel Cadmium (NiCd) battery
  - Nickel Metal Hydride (NiMh) battery
- **Non-Electrochemical energy storage**
  - Pumped Hydroelectric (PHS)
  - Compressed Air Energy Storage (CAES)
  - Flywheel
  - Ultra-Capacitor
  - Superconducting Magnetic Energy Storage (SMES)

The technology, size and duration of energy storage need to be carefully selected. Different applications require different kinds of energy storage technologies. Energy storage could also be optimized to take advantage of multiple revenue streams. For example, energy storage used to avoid revenue lost due to transmission curtailment can also be used to reduce forecast errors during low wind season.

Although costs of energy storage technologies are coming down there is lots of potential for further reduction of the levelized cost of energy delivered through energy storage. In next 12-18 months we are going to see introduction of range of new technologies that can operate for 10,000+ cycles as compared to 500-1000 cycles currently possible through lead acid batteries. This can result in dramatic reduction in the cost of ownership as well as open up new applications for use of storage.

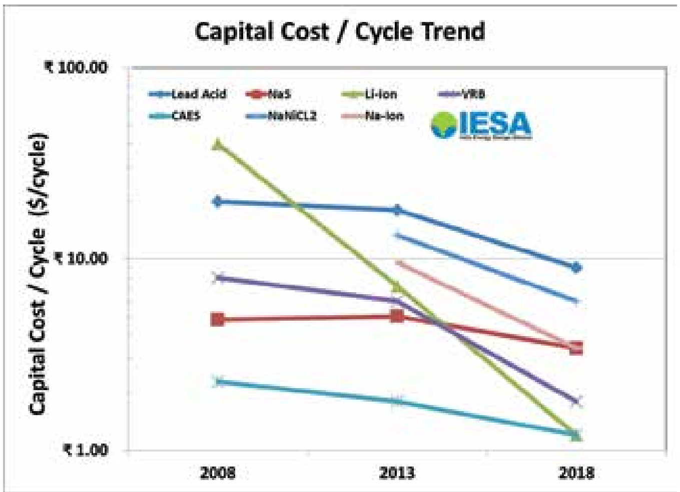


Figure: 1

Technology Suitability

Lead Acid Battery: It is one of the mature technologies in energy storage industry with proven commercial implementation. This is one of the most widely used electricity storage systems on the earth. The cost of Lead Acid technology is on lower side comparing to other technology in the industry. It varies from $120 to $150 ($/kWh) based on size and applications in which it is used. It uses lead, lead dioxide with sulfuric acid, which are readily available. It also has excellent recycling value. On the contrary it has low specific energy (kWh/kg) and specific power (kW/kg). Short Cycle life of this technology makes it mandatory replacement for long-term applications. On the operating scenario, it needs higher maintenance and has the risk of environmental hazards.

Lead-acid batteries are considered the default energy technology for short-duration energy storage systems.

Lithium Ion (Li-Ion) Battery: Lithium Ion technology is in nascent stage in commercialization with limited implemented projects. It includes different Lithium chemistries such as Lithium Iron Phosphate (LFP), Lithium Cobalt (LCO), Lithium Manganese Oxide (LMO), Lithium Nickel Manganese Cobalt Oxide (NMC), and Lithium-Titanate (LTO). The price is the only obstacle in its commercialization which ranges from $500 to $600 ($/kWh) depending upon manufacturers. There is potential for higher energy densities in these battery technologies. It has higher DOD cycle. Lithium-ion is a low maintenance battery. Manufacturers are constantly improving lithium-ion resulting in new and improved chemical combinations being introduced in market every year.

It has great potential to replace conventional lead acid batteries in the industry. It is suitable for ancillary services like frequency regulation and wind smoothing.

Sodium Sulfur Battery (NaS): Sodium-sulfur (NaS) batteries use molten sodium and sulfur separated by a ceramic electrolyte. It has higher energy and power density. It also has high efficiency. It is in nascent stage of commercialization. High temperature produces unique safety issues in the battery configuration.

Sodium Sulfur batteries are used for long duration applications. It is useful for applications like wind firming.

Flow Batteries: Flow batteries use liquid electrolytes with fixed cells to store and regenerate power. Energy and Power sizing is independent. So for higher energy or power only increase in electrolyte in the container is sufficient. It is easily scalable for large applications with lower increase in additional cost. It has higher energy and power density. But this is relatively immature technology with high maintenance cost.

Vanadium Redox Batteries (VRB): Electrolyte used in these batteries is ionic vanadium in sulfuric acid and charged electrolyte is stored in different tanks. It has very low maintenance cost. It operates at atmospheric pressure and temperature never exceeds 40°C.

Zinc Bromine (ZnBr) Batteries: This technology is relatively at early level of maturity. Currently, it is undergoing proof of concept testing of a 2 MW battery for distribution upgrade deferral. Round trip efficiency varies from 70% to 80%. As bromine is toxic in nature and zinc bromide is corrosive, this technology has some risk on safety hazard.

Pumped Hydro Energy Storage: Water is pumped from low elevations to higher elevations to store energy as gravitational energy, and run down through hydroelectric turbines to generate electricity. It has huge energy and power capacity. But it requires special locations and expensive to build. It is not suitable for wind integration.

Fly Wheel: Flywheels store energy in the form of momentum in a rotating wheel or cylinder. It has very high power density and high cycle life. It is independent of energy and power sizing. But it has low energy density. It is useful for quick recharge storage.

Compressed Air Energy Storage (CAES): Air is compressed and stored in large underground spaces, and is later used in gas turbine generators. It has huge energy and power capacity. It also requires special location and expensive to build and maintain.

Below, we provide examples of some of the energy storage projects deployed around the globe in recent years for different applications related to wind integration.

- **Utilizing energy storage integrated with wind farm for providing ancillary services:** AES Laurel Mountain facility is an example of integration of wind farm with energy storage for providing frequency regulation service. The energy storage portion of the project provides frequency regulation in the PJM market while also being available to help manage the rapid rate of change of output that can occur with fluctuations in wind conditions. The project achieved commercial operation in the third quarter of 2011 and is located in West Virginia. AES Laurel Mountain is among the first wind generators to supply critical operating reserve capacity to help maintain the reliability of the power grid.[1]

Figure 2: AES Laurel Mountain facility with 32 MW Li-Ion batteries @ 110 MW wind farm (Source: AES)

➢ **Wind firming:** Energy Storage can also be utilized for firming the wind farm output on a 5 minute / 15 minute / hourly basis if there is any added value that can be received through PPAs or to meet the IEGC scheduling requirements. The chart below shows such application utilizing Altairnano Lithium Titanate Oxide batteries where the blue curve of wind farm output (15 MW) was firmed up on a 5 minute block utilizing a 4 MW nLTO battery sized for 1 MWh (15 minute duration). The green curve shows the state of the charge variation for such wind firming algorithm.

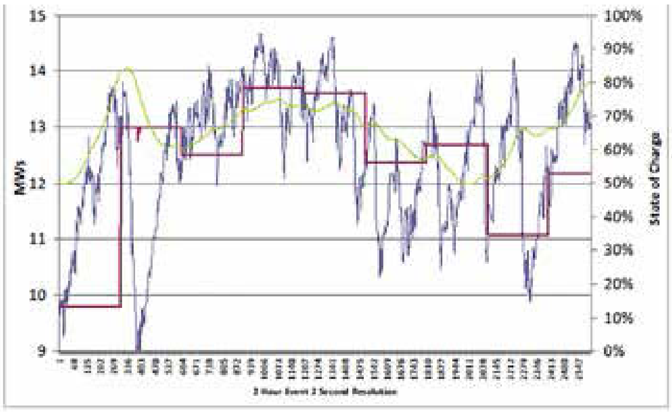


Figure 3: Example of wind firming algorithm using a 15 minute Li-Ion battery (Source: Altairnano)

1 http://www.aesenergystorage.com/news/aes-laurel-mountain-achieves-commercial-operation-energy-storage-and-wind-generation.html

➢ **Wind smoothing / ramp rate control:** Since larger system operators do have sufficient system resources, it may not be necessary to firm up the wind farm output. At the same time, various system operators are conducting studies to understand reliability impact of significant wind penetration which suggests that depending on the supply mix and reserves available some of the regions may require some limitations on ramp rate requirements due to wind variability. Following chart shows an example from eCoult (ultra battery) & DynaPower of a demonstration project for utilizing wind smoothing to meet ramp rate constraints in Australia.

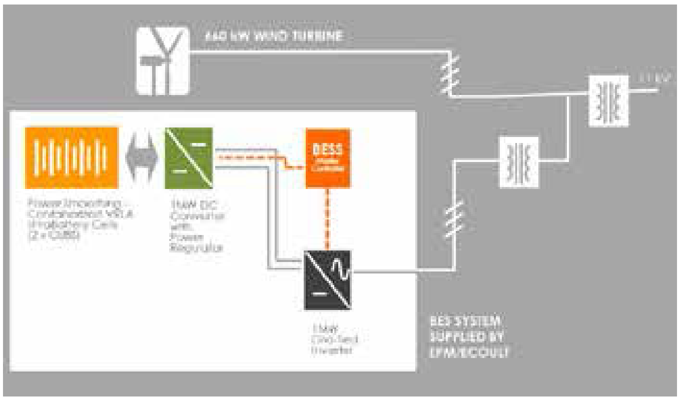


Figure 4: Schematic of the wind farm integration with eCoult energy storage system

Figure 5: Ecoult Battery at Hampton Wind Farm in NSW

There are number of technologies that could be suitable for the wind-storage integration depending on the application and sizing requirement. The technologies vary from advanced lead acid batteries such as Ultrabattery from Ecoult, to Li-Ion batteries for short duration applications, to flow batteries and Compressed Air Energy Storage (CAES) technologies for longer duration applications.

While deciding economics of energy storage with wind farms, number of key factors need to be considered. These include:

1. Energy and Power rating of energy storage vs wind farm size
2. Cycle life of energy storage
3. Anticipated duty cycle and Depth of Discharge during each cycle
4. Charge / Discharge rate for energy storage
5. Power Purchase Agreements
6. Grid interconnection costs (including substation and transmission costs)

Key applications of Energy Storage Systems for wind integration in India are:

- **Reduce Forecasting Errors:** Indian Electricity Grid Code (IEGC) mandates wind farms above 10 MW to schedule generation day-ahead. Unscheduled-interchange charges (charges for under-generation based on the frequency at the time) and penalties are prescribed in IEGC draft for output above +/- 30% of the scheduled.

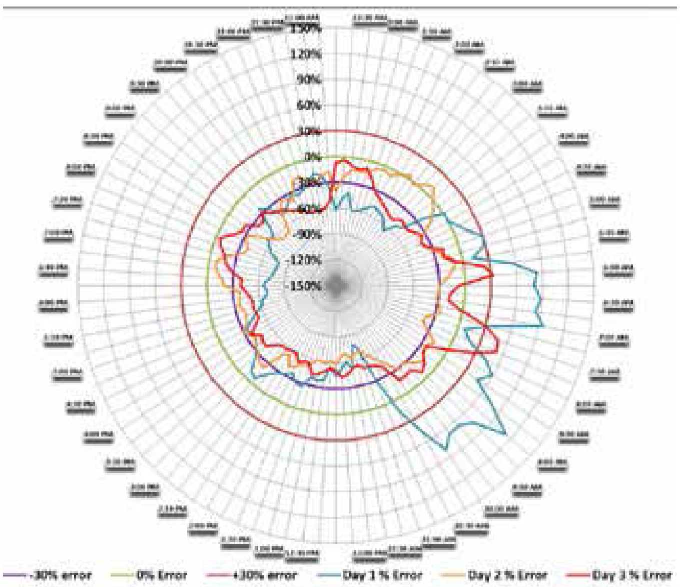


Figure 6: Forecasting errors from trials in Maharashtra

Following opposition from various wind power producers, Central Electricity Regulatory Commission (CERC) is reviewing this regulation on day-ahead forecast by wind power producers. Though wind forecasting is inherently unreliable, ESS can make wind power dispatchable and reduce the forecasting errors.

- **Transmission and Distribution Issues:** Several wind farms especially in Southern states face curtailment due to transmission congestion. These wind farms lose as much as 15% output due to curtailment. ESS can be charged to store the energy during curtailment and discharged when the transmission capacity is available. ESS can also be used to reduce transmission capex as well as charges. Wind power plant generates its full output only for few hours. ESS can be used such that the power supplied to the grid is always less than the capacity of wind farm for any given time. Thus it reduces the capacity of transmission needed and also reduces the transmission charges.

- **Captive Wind Plants:** Various commercial and industrial customers have captive wind farms due to RPO obligations and tax incentives. However, wind energy may become available when there is very little demand by the industry. Despite banking provisions, which captures some of the unconsumed energy, significant portion of wind energy may lapse and go unutilized by the industry thus causing significant loss. Commercial and industrial customers may pay as high as INR 8 (US $ 0.13) and 6 (US $ 0.10) per kWh respectively whereas wind energy's cost of production is INR 3 (US $ 0.05) per kWh. ESS can capture the unutilized wind energy and use it during peak periods.

- **Wind Energy Time Shifting and Arbitrage:** Many states have introduced time of day tariff. Wind farms in such states as well as wind farms selling energy through open access can take advantage of difference between peak and off-peak pricing. Many consumers suffering from power cuts pay as high as INR 18 to 20 (US $ 0.30 to 0.33) per kWh for diesel power. ESS can be used to charge through wind and discharge during peak price time zones or during power cuts.

- **Off-grid Applications:** Wind energy can also play a key role in off grid electrification, helping off grid systems to meet basic power needs for single households or small communities. Wind resources with ESS can provide power for regular daily periods when the wind energy source is unavailable and may also be used to ensure full autonomy for periods during bad weather conditions.

Energy Storage in India needs regulatory push for its wide-spread adoption. Currently no regulation specifically talks about storage integrated wind plant. Policies like accelerated depreciation, GBI or open access will help both the renewable and energy storage industry in general. Any fiscal incentives for energy storage will greatly help technology developers in terms of their first few deployments. It has been showed globally that such early demonstration can open up new markets and also help the early movers gain significant market share through adoptive learning.

Ministry of New and Renewable Energy has taken initial steps to fix this by creation of a Standing Committee on

Energy Storage and Hybrids. MNRE is also working on launching a pilot project for demonstrating energy storage technologies for the following 4 key applications:

- Large scale wind – solar integration
- Rural microgrid
- Commercial / Industrial / Residential/ defense microgrid
- Stand Alone Energy Storage system

It is anticipated that MNRE will release this RFP in November 2014 and potential projects will get selected by February 2015.

Market Potential of ESS for Wind Integration in India

Based on India Energy Storage Alliance's (IESA) analysis for applications of ESS for wind energy in India, we estimate a market potential of around 350 MW for a low growth case and a market potential of over 1 GW for a high growth case through 2020. Given the recent push for additional wind deployment by Indian Government and a target of reaching 100 GW of wind with in next decade, even the high case scenario may turn to be an under estimate. To achieve this potential, we need the wind industry to proactively evaluate energy storage as an enabler for greater wind penetration in India.

Renewable Energy Global Investment Meet (RE-INVEST) by MNRE

With the intent of providing a platform to the global investment community to connect with stakeholders in India, first Renewable Energy Global Investment Promotion Meet & Expo (RE-INVEST) is being conducted from 15th to 17th February, 2015 at Hotel Ashoka in New Delhi. The event is also a follow-up to the 'Make in India' initiative launched by the Prime Minister. The responsibility of organising the Meet has been given to the Indian Renewable Energy Development Agency (IREDA) jointly with CII and FICCI. The Central Theme of the Meet is further growth of renewable energy and energy efficiency in the country. IWTMA and its members are actively taking part in the conference and exhibition.

We need your Feedback

Dear Reader,

It is our endeavour to make IWTMA magazine Indian Wind Power, "THE MAGAZINE" for the Indian wind Industry. Your feedback on the general impression of the magazine, quality of articles, topics to be covered in future, etc. will be of immense value to us. We are thankful to your response. Kindly address your mail to "associatedirector@indianwindpower.com".

Thank You,

The Editor - "Indian Wind Power"

Indian Wind Turbine Manufacturers Association
4th Floor, Samson Tower, 403 L, Pantheon Road,
Egmore, Chennai - 600 008.
Tel : 44 43015773 Fax : 44 4301 6132
Email : associatedirector@indianwindpower.com

www.indianwindpower.com

Advertisements

Energy Storage and Micro-grids increasing the utilisation of Renewable Energy

Bridgit Hartland Johnson
GM, Active Power Systems S/SE Asia, Siemens Ltd., Mumbai

With the growing penetration of distributed generation plants, especially from renewable energy sources (RES) and their associated intermittent availability, new ways to manage the traditional electrical grid are arising, so that the grid is evolving towards a more sophisticated smarter grid.

One of the most interesting applications of the smart grid is the so-called micro-grids. A micro-grid is a geographically delimited aggregation of electrical and thermal production, storage and load, and it can work connected to the grid e.g. on-grid or off-grid in island mode. A micro-grid benefits from a smart centralized management system optimizing energy flows and the operations of the connected units. In this way more efficient operations can be achieved in terms of economical savings (or revenue, if there is participation to the electricity market or ecological benefits e.g. reduction in pollutant emissions).

Micro-grids are especially suitable for:

- Campuses including universities and governmental sites
- Industrial complexes or parks such as SEZs (Special Economic Zones)
- Critical infrastructure areas
- Commercial complexes such as shopping malls, stadiums or office buildings.
- Communities with weak network connections or constraints
- Remote locations
- Island networks

The main benefits of micro-grids are:

- Reduction of operational costs to supply the area/campus
- Reduction of the environmental footprint due to greater utilisation of renewable energy and more efficient consumption
- High power availability and good quality, continuous power supply even during utility outages as local power generation and storage allow independent operation
- Support to the utility grid when capacity availability exceeds demand and incentives are available.
- Allows consumers to receive real-time power at a much lower cost, by using local generation resources to offset peak power costs. In addition, the micro-grid model can include 3rd-party financing and long-term modernisation plans, which reduce infrastructure upgrade costs.
- Local power generation is typically more efficient and reduces the distance energy must travel and thus passes on fewer costs related to transmission, losses, congestion and operational overhead.

Micro-grids can meet the needs of the future. They allow local communities to increase electricity supply quickly and efficiently through relatively small local generator such as PV, wind turbines and other means.

Micro-grid components such as renewable or fossil-fueled generators, point-of-common-coupling breaker and its control, loads, energy storage systems, and others must meet several requirements to enable seam-less operation.

Lawrence Berkeley National Laboratory identified some important top-level micro-grid features:

- **Autonomy:** Micro-grids include generation, storage, and loads, and can operate autonomously in grid-connected and islanded mode. In the first case, a micro-grid can independently optimise its own power production and consumption under the consideration of system economics such as buy or sell decisions.

  In both operation modes, the system can minimize CO_2 emissions by maximising renewable energy consumption and minimising fossil-based generation. In islanded mode the system is capable of balancing generation and load and can keep system voltage and frequency in defined limits with adequate controls.
- **Stability:** Independent local control of generators, batteries, and loads of micro-grids are based on frequency droops and voltage levels at the terminal of each device. This means that a micro-grid can operate in a stable manner during nominal operating conditions and during transient events, no matter whether the larger grid is up or down.

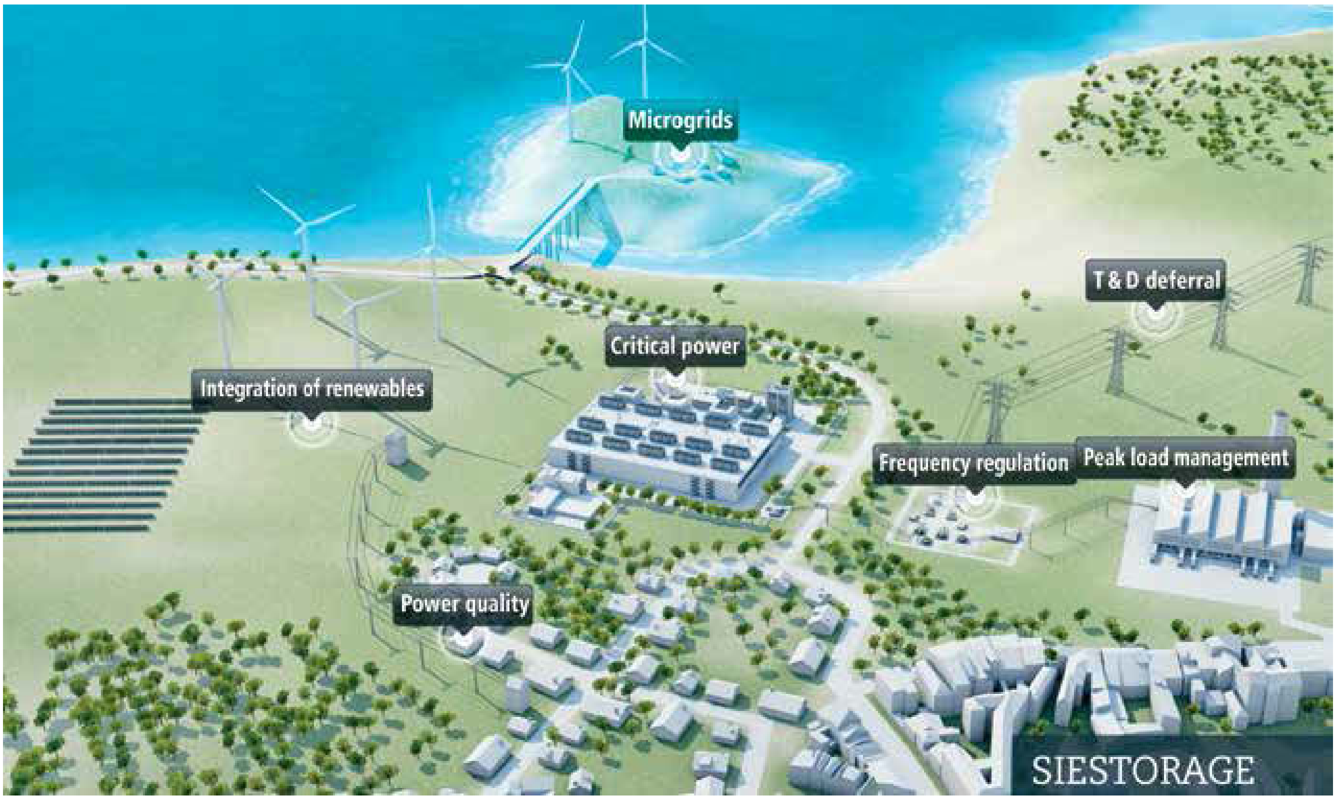
- **Compatibility:** Micro-grids are completely compatible with the existing utility grid. They may be considered as functional units that support the growth of the existing system in an economical and environmentally friendly way.
- **Flexibility:** The expansion and growth rate of micro-grids does not need to follow any precise forecasts. The lead times of corresponding components (fossil-fueled and renewable generators, storage systems, and others) are short, and a micro-grid can grow incrementally. Microgrids are also technology-neutral and able to cope with a diverse mixture of renewable and fossil-fueled generators.
- **Scalability:** Micro-grids can simply grow through the additional installation of generators, storage, and loads. Such an extension usually requires an incremental new planning of the micro-grid and can be performed in a parallel and modular manner in order to scale up to higher power production and consumption levels.
- **Efficiency:** Centralised as well as distributed micro-grid supervisory controller structures can optimise the utilisation of generators, manage charging and discharging energy storage units, and manage consumption. In this way energy management goals can be profoundly optimized, as in economic as well as environmental respects.
- **Peer-to-peer model:** Micro-grids can support a true peer-to-peer model for operation, control, and energy trade. In addition, interactive energy transactions with the centralised utility grid are also possible with this model. The proposed concept does not dictate the size, scale, and number of peers and the growth rate of the micro-grid. This means that no central entity, such as a central computer with appropriate software and communication capability to all micro-grid components, will be required.

Wind and solar power have already become key power sources in today's energy mix. Their heavy penetration and the growth of distributed generation have changed the structure of the power grid. Further, the unpredictable renewable generation capacity leads to fluctuations and imbalances between generation and load, influencing grid stability and power quality. Energy storage secures a stable and reliable power supply. It integrates renewable energy sources and optimises the usage of fossil generation to a modern eco-friendly grid and is a key enabler of micro-grids.

Siemens SIESTORAGE solution combines cutting-edge power electronics for grid applications and high-performance Li-ion batteries. The design of SIESTORAGE can be adapted to specific demands, and enables a large field of applications for utilities, industries, cities and infrastructure.

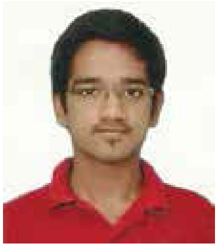
References:

Blueprint SICAM Microgrid Manager, RZ White Paper SGA eng K1 Ans

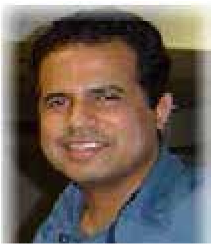


Energy Storage Techniques and It's Adaptability in Indian Market

Hari Manoharan
hari.m@ocespl.com



Praveen Palaniyappan V.R.
praveen.p@ocespl.com



Pramodh Panchanadam
pramodh@ocespl.com

Omkar Clean Energy Services, Chennai

Abstract

There is a growing need for energy storage systems, as the need for smoother power generation curve, which aid in peak shaving as well as grid stabilization, is increasing in India. This report discusses the various technologies used for energy storage such as Pumped Hydro, Compressed Air Energy Storage, Concentrated Solar Power (CSP), Battery storage, and how suitable they are for Indian conditions.

Key words***:*** **Solar PV, Wind Turbine, Pumped Hydro, CSP.**

I. Introduction

It has been estimated that to meet the growing energy requirements in India, the country will look to add between 250 and 400 GW of new capacity over the course of the next two decades. According to "Green Energy Corridor Report" published by Power Grid Corporation of India (PGCIL); it is estimated that about 5 GW of energy storage would be required by 2020[1]. If, the blueprints for the renewable energy capacity addition are to be followed through, then the country could witness addition of about 20 GW capacity from solar energy sources and about 35 GW capacity from wind energy sources.

The intermittent nature of renewable energy sources has pushed the need for energy storage systems to ensure a smoother power generation curve for grid stabilization and peak shifting.

Grid stability add is a major concern in India as it was seen in the case of the various blackouts that occurred in the country over the past years such as the 2012 blackouts, which spanned the northern and eastern parts of India. This could be overcome with strategic and efficient usage of energy storage systems at the grid interlocking point. The strategic positioning of Energy Storage Systems (ESS) units would greatly help in grid management by increasing response times between downtime and uptime.

II. Key Drivers for Energy Storage Market in India

1. Optimizing the supply and demand imbalance
2. Supporting the growth of intermittent renewable energy sources
3. Introduction of ancillary service markets such as frequency regulation markets
4. Transmission & Distribution (T&D) networking upgrade
5. Micro grid opportunities for Special Economic Zones (SEZs)
6. Rural Electrification
7. Telecom Sector application with micro Solar PV and mini Wind Technologies
8. Electrifying the transportation sector[2]

III. Technology Viability in India

Currently in the global market for energy storage devices, battery based, hydro based and thermal energy storage devices are primarily used due to their reliability and adaptability to the existing systems. Other systems such as Compressed Air Energy Storage, Flywheel storage devices are still nascent, with most of them still being under research stage.

A. Pumped Hydro

In India, pumped hydro systems are already in use in some states such as Andhra Pradesh, Maharashtra and Gujarat. The Srisailam Pumped Hydro Storage at Andhra Pradesh[3] is the biggest with rated power of 1670 MW, which also affords the ability for pump storage capacity. Though used in India, this technology is limited in use due to various reasons, the chief of which include geographic limitation – availability of land area, cross usage of water for irrigation, regulatory and political hurdles and environmental impacts such as loss of forest cover, habitat impact and displacement of people.

B. Battery Storage

Battery storage (primarily Li-ion) is another method commonly adopted for energy storage globally. One of the major installations is available in Hokkaido Island[3], Japan, with an energy storage capacity of 60 MW-h. There are multiple issues which prohibit the use of batteries with the primary reason being the prohibitive cost of employing these systems. In addition to this, Lithium (Li) - the widely used material for batteries, is not abundant in India and as such indigenous manufacturing of these batteries can prove to be cost inefficient.

C. Thermal Energy Storage

Thermal Energy Storage (TES) is a process by which the excess energy is stored in the form of heat using solid materials or liquid materials such as water, steam or molten salts for storage.

TABLE I: Technology Available in the Market[3][4]

Technology	Primary Application	Challenges
Compressed Air Energy Storage (CAES)	Energy management Backup and seasonal reserves Renewable integration	Geographically limited Lower efficiency due to roundtrip conversion Slower response time than flywheels or batteries Environmental impact
Pumped Hydro	Energy management Backup reserves Regulation service also available through variable speed pumps	Geographically limited Plant site Environmental impacts High overall project cost
Fly wheels	Load leveling Frequency regulation Peak shaving Transient stability	Rotor tensile strength limitations Limited energy storage time due to high frictional losses
Advanced Lead Acid	Load leveling and regulation Grid stabilization	Limited depth of discharge Low energy density Large footprint Electrode corrosion limits useful life Environmental Issues
Sodium Sulphur (NaS)	Power quality Congestion relief Renewable source integration	Operating Temperature required between 250° and 300° C Liquid containment issues (corrosion and brittle glass seals) Cost of Technology Issues with licensing the material/royalty
Li-ion	Power quality Frequency regulation	High production cost-scalability Extremely sensitive to over temperature, overcharge and internal pressure build-up Incorporating tolerance to deep discharge further increases cost Environmental concerns
Flow Batteries	Peak Shaving Time Shifting Frequency regulation Power quality	Developing technology, not mature for commercial scale development Complicated design Lower energy density
Superconducting Magnetic Energy Storage	Power quality Frequency regulation	Low energy density Material and manufacturing cost prohibitive Cost issues due to demand in parallel industries
Electrochemical Capacitors	Power quality Frequency regulation	Currently cost prohibitive Technology limitations Technology licensing issues
Thermo-chemical Energy Storage	Load leveling and regulation Grid stabilization	Currently cost prohibitive Technology limitations

1) Molten Salt-based TES

One such application of TES systems is in the segment of Concentrated Solar Power (CSP). The material used in this application is a combination of salts of sodium nitrate, potassium nitrate and calcium nitrate that acts as a conducting medium. This medium melts at 131 °C which is kept liquid at 288 °C in an insulated storage tank. The medium is pumped through panels in solar collectors where the focused heat reaches temperature up to 566 °C and is then sent to an insulated storage tank, where the thermal energy is preserved for up to a week. Currently, research is on for identifying replacements for molten salts that are being used in TES with alternatives such as heavy water being explored.

An example of this system is the solar power tower in Seville, Spain[3], which generates electricity up to 18 hours per day. Similarly, TES systems can be used for wind energy plants in India. This can be done through the use of dump loads which are basically arrays of resistors that are used to dump excessive power generation or acts as a buffer when the grid fails. It can be theorized that the heat generated from these dump loads can be used to heat thermal storage mediums much such as those used in solar CSP based systems effectively making them a TES based system. The high cost involved and the corrosive nature of the medium can be avoided using TES systems such as steam accumulators.

2) Steam Accumulators

Storage with Steam Accumulator is another type of TES, which stores energy in the form of steam. With water as working medium, the heat generated is converted into saturated steam, subsequently into superheated steam. With a combination of accumulators, this steam is stored which when fed into the turbine, generates electricity. Using a closed loop system would help in minimizing water wastage.

Though this technique is environment friendly, the design of accumulators and the availability of water make it unsuitable.

3) Cryogenic Energy Storage Systems

Cryogenic energy storage systems use electricity to cool air from the atmosphere to -195 °C using the Claude Cycle to the point where it liquefies and is stored in a large vacuum flask at atmospheric pressure. To generate electricity, the liquid air is pumped at high pressure into a heat exchanger where air at ambient temperature is used to convert the liquid to gaseous state. This phase change results in a massive increase in volume and pressure which then drives a turbine. This process has a system efficiency of about 25%. This process has been adopted in combined cycle thermal power plants. At present, there is a pilot 300 kW 2.5 MWh cryogenic energy storage facility in Slough, London.

Other TES based systems such as heat storage in rock beds and pumped heat storage systems are being researched as TES alternatives. However the viability of these systems in India is questionable as these systems have geographical requirements which limit their adoptability.

D. Batteries

Batteries are devices which are used to store excess electrical energy generated as chemical energy. One of the key factors which determine the performance of batteries is their discharge cycle. Batteries are classified based on the type of material used in their construction and their principle of operation.

1) Lead Acid

Lead acid batteries have the deepest charge/discharge cycle compared to other variants. They have an advantage of low-upfront costs. However, these batteries have relatively short lifetimes, high temperature sensitivity, significant maintenance requirements and waste-handling challenges.

2) Lithium Ion (Li-ion)

The transfer of Li-ions between the electrodes during the charge and discharge reactions characterizes the storage mechanism in these cells. Li-ion batteries have been employed in a wide range of applications with varied storage requirements.

3) Flow Batteries

Red-ox flow batteries (RFB) such as Vanadium red-ox flow batteries and hybrid red-ox flow batteries such as Zinc Bromine flow batteries are commonly used due to their high power and energy density compared to other RFBs. RFBs contain a proton exchange membrane which separates two electrolytes. This membrane is expensive to manufacture and maintain which limits the adoption rate of these batteries. In addition to this, RFBs require special control units, sensors and pumps to ensure optimal operation which introduces complications to the system. One other drawback is that, the energy density of these batteries, which varies considerably, is usually lower than that of other batteries such as Li-ion.

4) Electrochemical Capacitors (ECs)

Electrochemical capacitors physically store electric charge at the interface between the electrolyte and the high surface area carbon electrodes. Unlike traditional capacitors, ECs do not have a solid dielectric medium. ECs are classified as symmetric and non symmetric where the former is suited for short duration high power applications while the latter is preferred for long cycle life with good efficiency. The energy density of ECs is about one tenth that of traditional batteries.

These devices are used for more specialised applications where a large amount of power is required for a short duration. For example, ECs are used in the pitch control systems employed in wind turbine generators. ECs provide burst power for electric blade pitch control systems to ensure rotor speed remains within the operational limits.

E. Fly Wheels

Flywheels use a mechanical rotating device to store excess energy in the form of rotational energy which can then be called up instantaneously. It uses a motor to charge the device initially and when energy is needed, the spinning force stored in the fly wheel drives a turbine to produce electricity, slowing the rate of rotation. One advantage of these devices is that they capture intermittent energy and deliver a continuous supply of uninterrupted power. There are significant risks associated with these systems due to the high speeds involved in the storage mechanism. As opposed to batteries, flywheels have a wider operational temperature range and are usually made of inert materials which don't cause environmental concerns.

Flywheels are usually limited to small scale energy storage; for instance in automobiles. Large scale application is currently being evaluated with a 5 MWh flywheel based grid energy storage system, currently under operation in Stephentown, New York. Flywheel storage devices specifically tailored for wind turbines – where excess energy generated during high wind speed regimes is stored in flywheels are presently in the prototype phase.

F. Compressed Air Energy Storage (CAES)

In CAES systems, excess energy is stored by compressing and storing ambient air under pressure. The compressed air is heated and expanded to drive turbines to generate energy when necessary. Due to their low storage density, very large storage facilities are required which limits their application spectrum.

G. Superconducting Magnetic Energy Storage (SMES)

SMES systems store energy in the magnetic field created by flow of direct current in a superconducting coil, which has been cryogenically cooled to a temperature below its superconducting critical temperature. The stored energy is released by discharging the coil. Due to high energy requirements for refrigeration and high cost of superconducting wires, SMES is currently used for short duration energy storage and improving power quality. Viability of the technology for large scale energy storage applications is subject to discovery of high temperature superconductors which can be manufactured cheaply.

IV. CONCLUSION

Pumped hydro based storage is already proven with multiple installations across the country. However, as mentioned previously, pumped hydro based systems have multiple drawbacks. With incentives and technology breakthroughs, TES may be an ideal alternative especially for a country like India where solar radiation is available in plenty.

REFERENCES

1. Power Grid Corporation of India Ltd. "Green Energy Corridor Report". Volume 1. July 2012.
2. Walawalkar, Rahul. "India Poised for Rapid growth in Energy Storage"energystoragejournal.com. 31 Oct. 2013. Web. 30 July. 2014.
3. US Department of Energy, Global Energy Storage Database.
4. US Department of Energy. "Grid Energy Storage", Dec. 2013.

Wind Industry in India

The Way Forward - Part II

A brief note on the wind industry highlighting the issues and key support required to go to the next level.

Continued from the last issue....

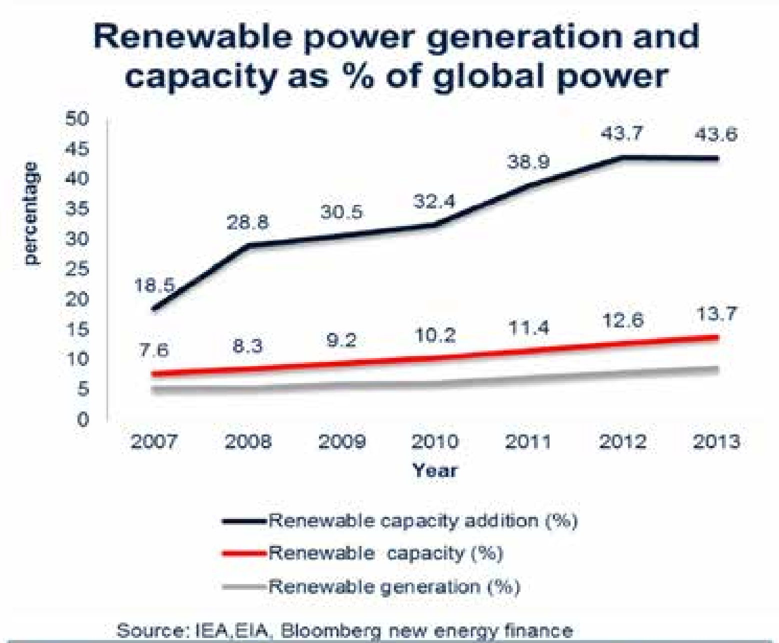
Indian Wind Energy Alliance
(An alliance of IWTMA and WIPPA)

Suggested Approach for Future

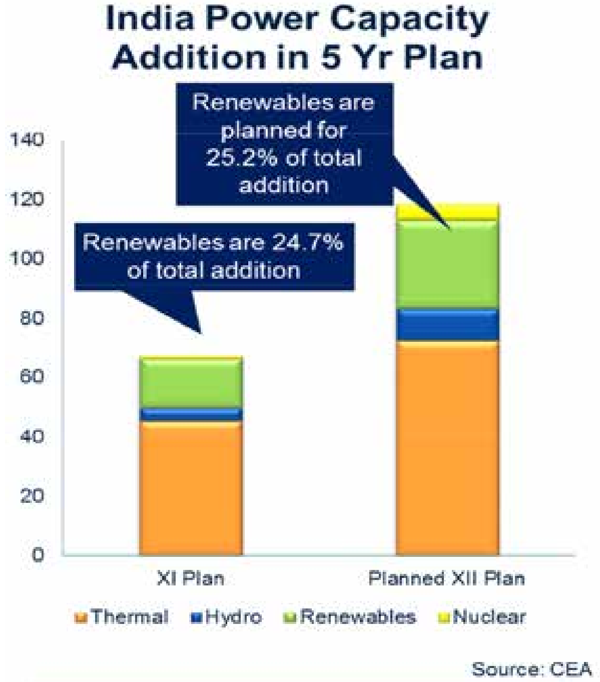
In order to leapfrog to next level we need to change our approach towards development of wind power. States are now finding it difficult to accommodate more wind power and not coming out with supportive policies. Presently, wind is not being treated as national resource unlike fossil fuels (coal, gas, etc.) and is almost entirely dependent on states for development and exploitation of wind potential.

We lost over 2200 Million Units in just four months (June - Sept. 2013) in Tamil Nadu due to lack of evacuation infrastructure and low priority to wind power by state. This is an example of national loss of resources, which cannot be taken back. In a country with huge power deficit, such wastage should be completely unacceptable.

We need a more enlarged role of center in the development of wind sector in India covering all the aspects. Wind resource should be treated as national resource and all efforts should be directed towards maximization of utilization of this unending natural resource and the development of wind sector should not be constrained by absorption capacity of states.



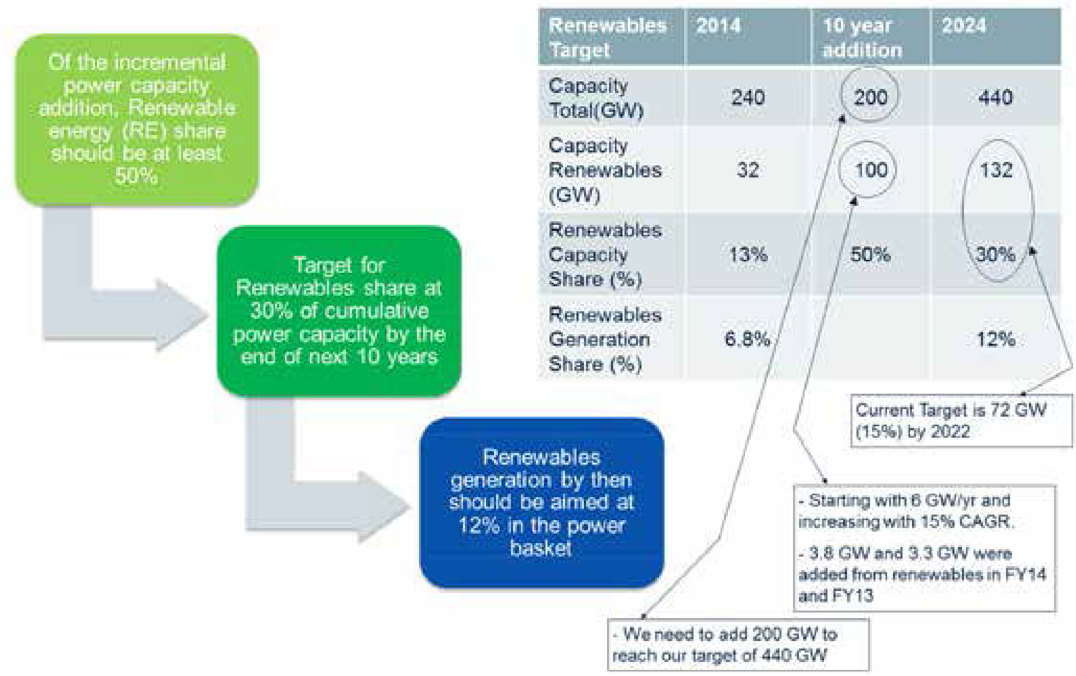
- Last year, 43% of the total electricity capacity addition globally was through renewables
- In the last quarter, 100% of the capacity addition in US was through renewables



In comparison, India plans to add only 25.4% capacity through renewables in XII 5 yr plan

Setting new targets for India for the next 10 Years

Country should start looking at capacity addition as a percentage of total future capacity addition. We need to have at least 50% of the future total capacity addition under renewable energy. This may lead us to reach 30% of the total installed capacity and 12% of the generation from renewables by 2024. Following could be a possible mix of capacity by 2024:



Renewables Target	2014	10 year addition	2024
Capacity Total(GW)	240	200	440
Capacity Renewables (GW)	32	100	132
Renewables Capacity Share (%)	13%	50%	30%
Renewables Generation Share (%)	6.8%		12%

We should target to start with 6 GW per year with a CAGR of 15%. This would require a capacity addition of around 50 GW in next 10 years from wind assuming wind will contribute half of the incremental RE capacity. However, in order to reach to these targets, we need to identify the bottlenecks and enablers and take immediate corrective steps with a long term view.

Enablers

We have again categorized the enablers in the following broad categories, which are explained in detail subsequently:

1. Policy & Regulatory Enablers
2. Fiscal & Financing Enablers
3. Infrastructural Enablers

Policy & Regulatory Enablers

1. Amendment of the Electricity Act

There is an urgent need to address some issues which requires amendment in the Electricity Act 2003 and Tariff Policy. These changes should be taken on priority to cover the following:

a. Bringing uniformity in regulations across states:

Uniformity is needed in policy and regulatory framework across the state to attract investments to the required level. Any deviation from central regulations in state regulations should be within the permissible limits and should be require proper justification.

b. Long term RPO trajectory and enforcement

RPO targets should be made uniform for all states and should be linked to NAPCC targets. Further, it should be mandatory for obligated entities to fulfill obligations and there should be suitable provisions to ensure compliance. Suitable incentive scheme should also be worked out to encourage state participation.

The definition of obligated entities for RPO compliance also needs to be elaborated so as to include open access users and captive consumers.

c. Concessional Open access charges for renewable

Open access charges and losses for solar energy are already waived off for CTU. Similarly, exemption should be extended to wind energy also. Further, in any case the charges should be levied on per unit basis factoring in the lower

PLFs of wind power and thereby providing a level playing field to wind generators.

d. **Exemption of cross subsidy surcharge in case of wheeling of renewable energy**

Cross subsidy surcharge should be exempted for renewables for at least 10 years enabling wind power to expand the open access sale option.

e. **Provision of banking for infirm renewable energy sources (wind, solar & mini hydel)**

Banking facility is a mandatory requirement for infirm power such as wind in order to be able to supply to consumers directly under open access. This needs to be recognized in the Act itself so that the state regulators will be required to incorporate banking provisions in the state regulations.

f. **Institutionalizing centralized forecasting for wind power generation**

There is a need to have a forecasting and scheduling framework addressing the variable nature of wind energy. In this regard, support can be provided in the form of a forecasting related scheme i.e. by institutionalizing centralized forecasting (in key 5-6 wind resource rich states) by setting up dedicated agency / organization for the same. Such centralized forecasting agency should be made responsible for accurately forecast and schedule wind power generation based on inputs received from individual / mandated wind farms.

This would provide the much needed support to wind sector and open up the interstate transfer of wind power, by insulating generators from the risk of forecasting accuracy.

2. **A comprehensive RE Policy covering the following**

   a. **MYT Feed in Tariff framework**
   b. **Framework for repowering**
   c. **Off Shore & Hybrid wind power development**
   d. **Exemption from pollution control check**
   e. **Guidance to state for RE policies**

3. **REC Market Revival**

There could be several support schemes/arrangements to increase the demand of RECs in the market. These are mentioned below:

a. **Facilitating centralized purchase of RECs:** Govt. of India should earmark a fund to be utilized to purchase RECs on behalf of States/discoms that are not complying with RPO. The purchase of RECs can be done for the States in proportion of their shortfall in meeting RPO. Subsequently, the amount equivalent to such purchase of RECs can be deducted from the fund allocated by the Central Govt. to the State Governments. Such arrangement could either be akin to or under the ambit of incentive structure proposed in the 13th Finance Commission report, to supplement the resources of different states by augmenting the consolidated funds of the individual states in order to facilitate incremental RPO fulfillment.

b. **REC Market Assurance Fund:** Govt. of India should earmark a fund that would act as market assurance for purchase of unsold inventory of RECs at the floor price, at the end of a financial year. Subsequently, these RECs could be resold (to discoms or obligated entities) as and when the natural demand for RECs improves due to RPO enforcement. An option in this regard could be to earmark this fund out of National Clean Energy Fund (NCEF) which has been set up to provide support on the matters pertaining to renewables.

c. **Incentivizing REC purchase through tax credits:** In order to revive the demand side in the REC market, Govt. of India should consider incentivizing REC purchase by providing tax credits for such purchases. This would surely act as a strong stimulus for open access based obligated entities which has the potential to take up a significant share of REC demand. Further, such incentive through tax credit would also help in development of voluntary purchase of RECs.

Fiscal and Financing Enablers

1. **Low cost of funding**

   a. Issuance of special instruments, e.g. Tax-free renewable energy bonds i.e. bonds on which the interest is tax-free
   b. Special Renewable Bonds on the lines of infrastructure bonds that provides income tax benefits through deduction in taxable income up to the extent of Rs. 20,000
   c. Capital Gains Bonds in which capital gains are exempt from capital-gains tax within a period of six months from the transfer of assets
   d. Providing debt at a subsidized rate for a part of the total debt and thereby reducing the total cost of funding

2. **Increasing the availability of funds for renewables**

   a. Carving out renewable energy projects out of power sector projects will enable banks to have exclusive limits

b. Further, categorization of Renewable Energy Projects under Priority Sector will encourage Banks to lend to such projects

c. Pension funds, provident funds, insurance funds and other overseas sources should be enabled to channelize long term funds

d. Pension and provident funds could be mandated to invest a specific portion of their controlled fund in renewable development projects

e. Creation of a debt fund to raise low-cost long-term resources for re-financing renewable projects that are past the construction stage

f. Renewable Energy projects should be included in the gamut of Infra Debt Funds (IDFs) because of similarity to annuity based road projects in cash flows and repayment profiles

g. IREDA has lower single borrower limits because of low capitalization and therefore, Government should arrange to infuse equity in IREDA through IPO route to consolidate the role of IREDA in RE development

h. The plea from the industry is to include lending for wind energy projects under the priority lending category for fast implementation of projects.

3. Longer tenor of debt

Lending entities (including banks) should advised to offer long term loans (20 years plus) to renewable energy projects matching the life of the project.

4. Reduction in MAT rate

Most of the 80-IA benefits have been lost over past few years due to high rates of Minimum Alternate Tax and the small difference between Corporate Tax Rates. Minimum Alternate Tax Rate should be lowered to NIL or at most to 10% similar to the IT sector.

5. Scheme for lower currency hedging cost

Support could be provided by offsetting/ subsidizing the high hedging cost through a scheme, so that RE project developer could get access to cheaper debts. Needless to say, this would be a big support to the investors and at the same time it would have lower burden on the Govt. as such hedging would be part of bigger portfolio of Govt. level forex transactions. RBI or IREDA may provide low cost foreign exchange hedges at 3-4%.

a. Hedging can be part of bigger portfolio of Govt. level forex transactions. RBI may provide low cost of foreign exchange hedges at 3% – 4% to access to cheaper debt from outside country

b. RBI can open a forex swap window for Wind Power Producers on similar lines as was done for OMCs

6. Changes in National Clean Energy Fund (NCEF)

a. Cess on other polluting industries (akin to Coal Cess):

NCEF has been formed through the levy of a Clean Energy Cess of Rs. 50 per tonne on coal produced domestically and imported to India. However, we understand that growth of RE sector in India, along with coming out with any/more of above mentioned support schemes, might require a bigger fund. Accordingly, the size of fund/ NCEF can be increased by imposing cess on other polluting industries, akin to existing cess on coal.

In our view, such cess could be increased as well as extended to industries such as power plants operating on furnace oil, aviation industry, railways etc. which are big consumers of fossil fuels, etc.

b. Increase Cess on Coal from INR 50 to INR 100 per tonne (Rs. 50 cess increases coal generation price by Rs. 0.02-0.03/kWh). This will grow fund from Rs. 3,500 Cr to Rs. 7,000 Cr.

7. Changes in GBI framework

a. MOF should pay IREDA in a timely manner and ensure that IREDA makes the payments monthly. Further in case of delays, provision of interest should also be implemented.

b. Presently, the GBI is payable @INR 0.50 per kWh with a limit of INR 10 Million per MW over 10 years. As it is well known fact that the new wind projects are only coming up in low PLF areas as high PLF sites have already been exploited, it may be difficult for several generators to avail the entire limit available under the scheme. In view of this, it is suggested to have a provision of higher per unit subsidy (INR 0.80 per kWh) for initial four years and INR 0.50 per kWh for remaining period without changing the overall limit of INR 10 Million per MW.

8. Extension of 80IA benefit up to 2020

The renewable industry is requesting for an extension of sunset clause for setting up of the project up to March 31, 2020 under section 80 IA. The existing incentive under this clause is coming to an end in the current financial year.

9. Renewable Energy Investment Trusts

Presently, there is no policy in place for creation of Renewable Energy Investment Trusts. Government should incentivise creation of Renewable Energy Investment Trusts which will provide long term capital at competitive rates. These investment vehicles will also lower tax burden on investors.

10. Development of Bond Market

a. Credit enhancements should be promoted and more institutions should be equipped to give such products so that infrastructure bonds can become better rated and larger set of investors can invest.

b. Banks should be mandated to invest into infra bonds, which are relatively better.

11. GST

Power is proposed to be exempted from GST. The entire chain of manufacturing, sales, purchases, service provisions etc. cannot take advantage of credits, if power is exempted from the purview of GST. Power sector should be covered under GST and taxed at zero percent to claim credit for the GST applicable on capital goods, raw materials, feed stock, and other inputs acquired for production and distribution of its outputs.

Infrastructural Enablers

1. Land related

As explained there are different problems faced regarding land procurement in different states. The possible solutions are:

a. Uniform policy guideline for allocation of land for wind power projects

A uniform policy for allocation of revenue land for wind power projects may be useful for states when the state come out with respective wind/ land policies. The example of Gujarat may be replicated where the district collector has been given powers to provide revenue land for wind power projects.

b. Amendments in the Act

i. Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013

It is essential to exempt land procurement for wind power projects from the ambit of the Act or have a different and higher ceiling limit for wind power projects over which the provisions of the Act becomes applicable to wind power projects.

ii. Electricity Act 2003

The licences or generators are dependent on the Indian Telegraph Act 1885 for laying electrical lines. An amendment in the Electricity Act (or in Indian Telegraph Act) is needed to give power to competent authority for providing Right of Way for evacuation lines for power projects in general which would also help wind power projects

c. Modifications in procedure for forest land

i. Fast tracking land for wind projects

The leasing of forest land for wind power projects needs to be modified/ fast tracked. At present, the process takes about 2 years, the same may be reduced to less than a year at least for erection of wind masts in the forest areas. This would speed up the development of wind power projects.

ii. Accepting non-contiguous land as compensatory land

It is essential, amongst other requirements, that equal amount of non-forest land is procured and given to forest department as compensatory land. It is now becoming difficult to get such contiguous land and thus the procedural requirement may be modified that non-contiguous land is also accepted as compensatory land.

2. Power evacuation related

a. Strengthening / extending the intra state transmission network

The intra state transmission bottlenecks may also be addressed through the green corridor project which is presently focusing on the interstate transmission. The priority states from wind power perspective are Tamil Nadu, Rajasthan and Andhra Pradesh.

b. Inclusion of wind potential area in transmission planning at state and central level

At present, the wind or renewable potential areas and possible capacity additions are not taken in to consideration when the transmission systems expansion or strengthening. This leads to development of grid bottlenecks with wind power projects getting connected to the grid. The planning of transmission thus should include possible wind and RE capacities in the state in next 5 years.

Complete Solutions for Yaw & Pitch Control

Bonfiglioli is a leading provider of complete packages for the wind industry that seamlessly control energy generation, from rotor blade positioning with a pitch drive to nacelle orientation with a yaw drive. Working closely with customers, Bonfiglioli designs and manufactures a series of specialized wind turbine gearboxes and inverters that deliver reliable, superior performance.

Bonfiglioli Transmissions (Pvt.) Ltd.
PLOT AC7-AC11, SIDCO Industrial Estate
Thirumudivakkam, Chennai - 600 044, INDIA
Ph: +91(044) 24781035 - 24781036 – 24781037
salesindia.mws@bonfiglioli.com • www.bonfiglioli.com

Bonfiglioli
power, control and green solutions

c. **Uniformity in connectivity and metering standards in different state as per CEA regulations**

The CEA has, in January 2013, issued Transmission Planning Criteria which has special section on wind power. This provides certain technical standards and allowances, e.g. relaxing the N-1 criteria for wind power, for evacuation line for wind power projects which would optimise the use evacuation costs as well as provide optimum evacuation. This should be implemented uniformly by all the states.

3. **Safety of wind projects**

In some of the states like Rajasthan and Maharashtra the thefts from wind projects are reaching to worrying proportion and through organized gangs. Providing adequate security and maintaining Law & order issue needs to be addressed immediately by the state administration, and create conducive environment for investments in wind energy projects.

As the losses to the generators are increasing due to thefts and overall security, such projects may be considered as "critical assets or prohibited area" so that stricter action against the thefts can be taken.

4. **Environment clearances (pollution control boards)**

The present listing of renewable power projects, under green category needs to be modified with excluding wind from green list as there is no air or water pollution as a result of wind power generation. Further, the process for obtaining consent to establish, which varies from state to state, needs documents and involves procedures which would delay the wind projects almost to double in addition to cost increase. Exemption for wind power projects from SPCB lists and requirement of consent to establish or modifications in the procedures is urgently required.

Conclusion

The sector is going through a tough time and facing issues on several fronts starting from land acquisition to sale of power. The entire project cycle needs urgent attention. The state of affairs is also clearly visible from the reducing pace of capacity addition in wind power. It is about time that we take a holistic view of the sector and set new goals and work hard on the means to achieve these goals.

India as a country is endowed with huge potential for wind power and wind industry has reached a stage where an enabling framework can take the country to the leading position in the world in terms of renewable energy installation and penetration levels. This will also help significantly towards country's energy security and energy access requirements and meeting sustainability targets.

i. Global Status Report 2013, REN 21

ii. World Market Report 2013, A BTM Wind Report

Design Aspects of Wind Turbine Blades

R. Kumaravel, BE, MBA, Ph.D
General Manager and Head
Turbine Testing Group

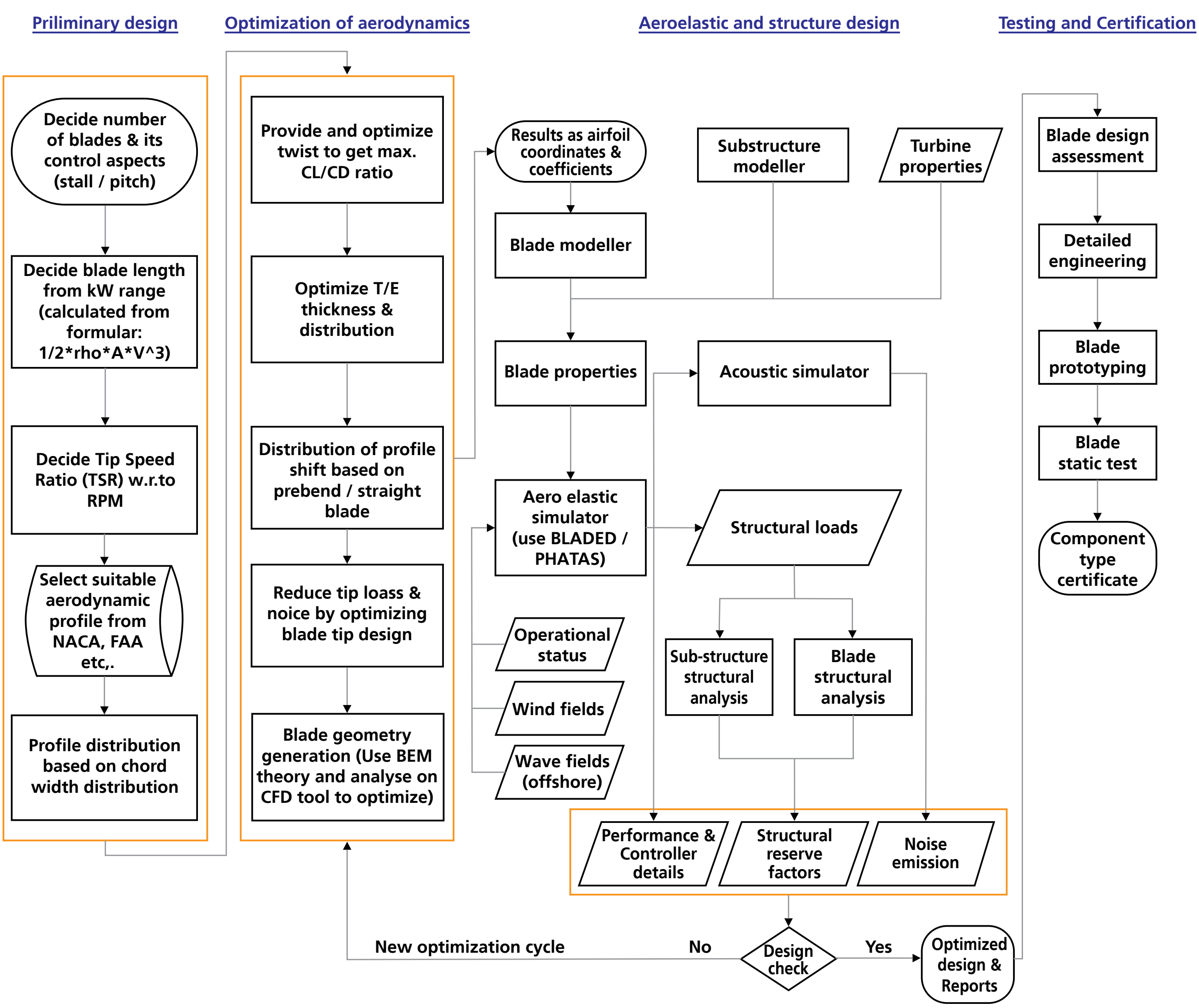
K. Bharathiraja, B. Tech
Deputy Manager
Blade Technology Group

ReGen Powertech, India

Abstract

A competitive wind turbine blade design requires a balanced contribution of all areas of engineering. Blade design process starts with a "best guess" compromise between aerodynamic and structural efficiency. As a wind field man says "blade is like a heart for the turbine" which pumps the energy from wind to turbine. Wind turbine blade design is the process of defining the shape (aerodynamic), structures (loads), efficiency (Cp) and specifications (controls) to extract energy from the wind. This paper describes about the design aspects and the various processes involved in design of a wind turbine blade.

Flow Chart 1: Design Aspects of Wind Turbine Blades



Introduction

Power has been extracted from the wind over hundreds of years with historic designs, known as windmills, constructed from wood, cloth/stone for the purpose of pumping water or grinding corn. A greater understanding of aerodynamics and advances in materials, particularly polymers, has led to the growth of wind energy extraction in the latter half of the 20th century.

In the last 20 years, wind turbines have increased in size by a factor of 100 (from 25 kW to 2500 kW and beyond) so as the blade size increased by 20 times (3m to 60m), the cost of energy has reduced considerably and the engineering base and computational tools have been developed to match the blade design and optimization.

Focus is now being made on the Horizontal Axis Wind Turbine (HAWT) due to its dominance in the wind turbine industry. HAWTs are very sensitive to changes in blade profile and design. The engineering challenge for the wind industry is to design an efficient blade to harness maximum wind energy. The Flow Chart 1 describes the various process and stages involved in the design.

Preliminary design

Preliminary design is a process of deciding the blade shape parameters and rough calculations about the efficiency of the blade. Nowadays all the HAWTs are having 3 blades, which is more optimal and proven. Pitch control turbines are efficient and reliable, so here the design process is to be discussed for 3 bladed pitch controlled HWATs.

The power output of an ideal rotor is given by P = ½ ρ A Cp, from this equation the swept area (A) can be calculated and thus radius and length of the blade. Choosing the TSR, tip speed ratio is much important for design process. The modern turbines have the TSR in the range of 8 to 10, which suites the generator RPM. The blade's whole design calculations are performed using TSR.

The plan form is a basic shape chosen to give the blade an approximately constant slowing effect on the wind over the whole blade length, this ensures that none of the air leaves the turbine too slowly, yet none is allowed to pass through too fast. Remembering Betz's limit, this results in the maximum power extraction.

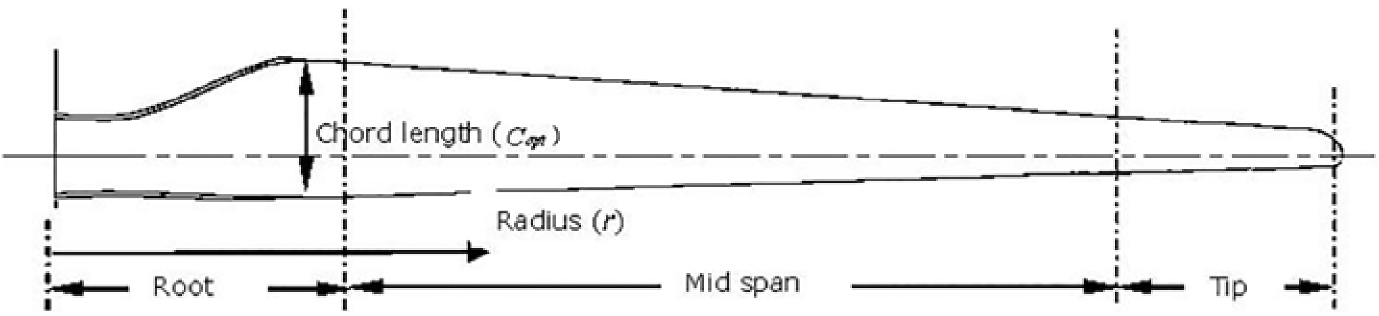


Figure 1: Typical Blade plan and region classifications

Selection of airfoils is most important aspect in the blade design, the airfoils were derived from the aeroplane industry, the blades are similar to the wings of the aeroplane. There are many families of airfoils available in the industry among which NACA, DU, Riso, FFA are most widely used and also many blade designers are now developing their own airfoils.

ECN's blade optimization tool (BOT) can be used for initial calculations of the blade shape. For the chosen blade plan shape, selected airfoils, profile distribution and coefficients of lift (Cl) and drag (Cd) are given as input along with turbine and wind parameters to perform the initial validation. Based on the output of annual yield, maximum electrical power, rated power, TSR and torque exerted, the blade plan form is fixed.

Optimization of Blade Aerodynamics

Blade optimization for aerodynamic efficiency is the next process in the designing of the blade, the shape and performance is optimized in this step. In the optimization procedure, Blade Element Momentum Method (BEM) is the industrial standard for the aerodynamic calculations. It is a linear iterative approach for the estimation of auxiliary aerodynamic parameters like the angle of attack and axial and tangential induction factors and most importantly and interestingly the aerodynamic blade efficiency. The essence of the Blade Element Momentum Method is to divide the blade into a finite number of cross-sections; the finite blade length between the two nearest cross-sections is called the blade element. The relative angles of attack, induction factors and incidences are found for each blade cross-section and averaged for the elements. The found measures allow the calculation of the aerodynamic efficiency, lift & drag forces and coefficients.

Airfoil shape optimization and the related results of coefficients of lift (Cl) and drag (Cd) are arrived in the X-Foil/R-Foil software for each blade cross-sections; these are input to optimize the twist in the profile distribution.

The distribution of Trailing edge (TE) and Leading Edge (LE) fixing and profile, Blade thickness, twist, profile shift, tip corrections are optimized using BEM/polynomial equations and are performed in AeroDyn or CFD tools like ANSYS. Finally, the contours, coordinates and coefficients are generated. The results illustration is given in figures 2-5.

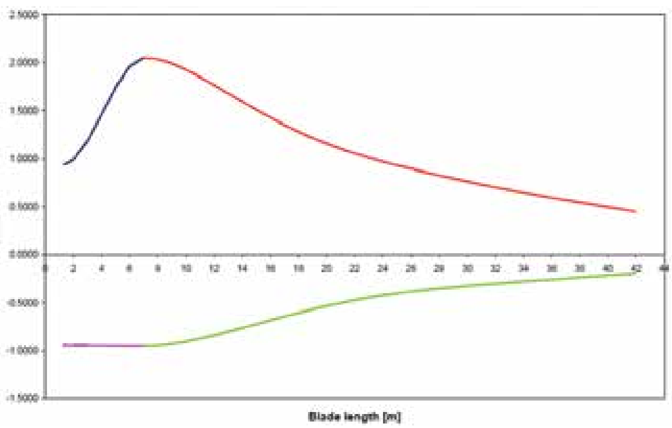


Figure 2: Blade LE/TE fixing and Profile distribution

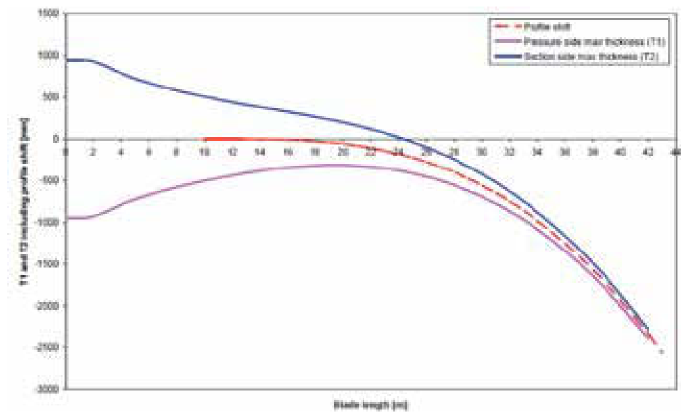


Figure 3: Profile shift & Thickness

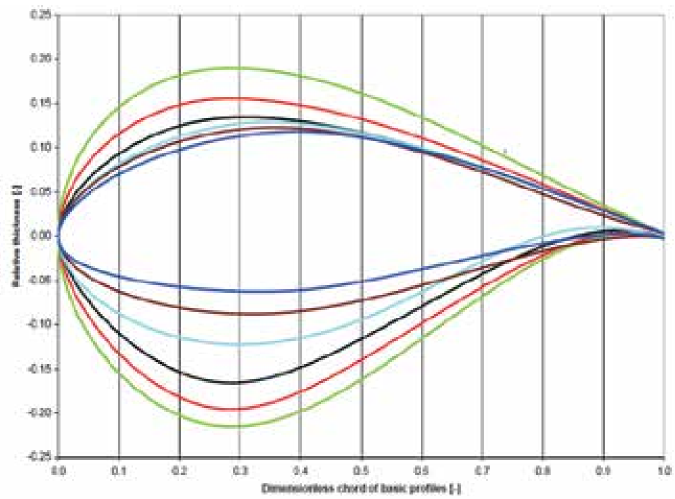


Figure 4: Blade Contour & Coefficients

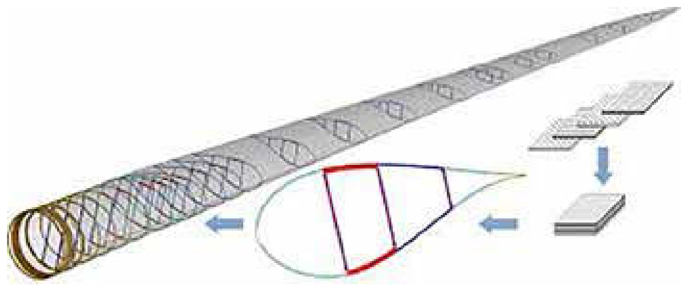


Figure 5: Profile and Structure generation

Aeroelastic and structure design

The next design stage is designing and optimizing the blade with respect to wind turbine performance and controls, loads, noise emission. Aeroelastic simulation is a numerical based calculation for the performance of blade with wind turbine's output with respect to the turbine properties and controls (pitch, yaw, etc.) optimization. The inputs are given to the aeroelastic simulating software like BLADED, PHATAS, FLEX, etc. and results are obtained as described in the flow chart.

Blade is modelled using FOCUS software with other sub-structures modelling, output from the modeller is given to aeroelastic simulator. FOCUS is used to design the blade structural design (polymer composites) layer sequence, root bolt connections and weight distribution. ANSYS, ABAQUS are the other tools for structural designing. Acoustic simulation is done in FOCUS or BLADEMODE for the noise controls.

The results (a) Performance/controller data (b) Structural reserve factors and (c) Noise emission are checked for the design completion and if the results are found OK the design reports are generated and the design cycle completed otherwise, the new optimization cycle begins from the aerodynamic optimization stage. Blade design is now completed and the next stage is certification. Based on the real field applications few parameters may be optimized if required.

Design Assessment

From the stages of numerical modelling to blade designing, the documents and mathematical models are provided to a third party certification body for evaluation. The comments from the certification body and its implementation in to the design, goes hand in hand as an iterative process in the design process. This improves and brings out a perfect design. The standards IEC or GL guidelines are followed by the certification which is also used for designing.

Detailed Engineering, Prototyping, Testing and Certification

On the completion of design assessment, the detailed engineering of the blade and sub-components are made, 2D drawings and CAD models are generated for manufacturing.

In Prototyping, to produce a blade two stages are there (1) Plug and mould manufacturing and (2) Blade manufacturing. The necessary drawings and CAD models are provided to the mould manufacturer. Test blade is manufactured after optimizing the manufacturing process and the blade is tested in a laboratory for static loads to validate the structural loads according to GL and if IEC is followed then dynamic testing is also mandatory. After successful completion of the testing, the measured loads are compared with the theoretical loads from the modelling. If the measured loads are found to be within the design loads, a type certificate is obtained for the blade. This completes the design of wind turbine Blade.

Andhra Pradesh Mulls Policy for Wind Power

With the AP government focusing on renewable sources of energy and planning massive increase in wind power capacity, the latest APERC order has not allowed a tariff hike as contested by developers. The wind power generation has been riddled with issues like developers not maintaining separate accounts and showing very little plant load factor (PLF). To deal with such issues, the government is working out a separate wind power policy.

U.S.-India Joint Statement 30th Sept. 2014 on Energy and Climate Change

The Prime Minister of India Narendra Modi and the President of the United States of America Barack Obama met on 30th September, 2014. We are giving below the extract of the Joint Statement issued by the Office of the Press Secretary, The White House relating to energy and climate change.

Recognizing the critical importance of increasing energy access, reducing greenhouse gas emissions, and improving resilience in the face of climate change, President Obama and Prime Minister Modi agreed to a new and enhanced strategic partnership on energy security, clean energy, and climate change. They agreed to strengthen and expand the highly successful U.S.-India Partnership to Advance Clean Energy (PACE) through a series of priority initiatives, including a new Energy Smart Cities Partnership to promote efficient urban energy infrastructure; a new program to scale-up renewable energy integration into India's power grid; cooperation to support India's efforts to upgrade its alternative energy institutes and to develop new innovation centres; an expansion of the Promoting Energy Access through Clean Energy (PEACE) program to unlock additional private sector investment and accelerate the deployment of cost-effective, super-efficient appliances; and the formation of a new Clean Energy Finance Forum to promote investment and trade in clean energy projects. They launched a new U.S.-India Partnership for Climate Resilience to advance capacity for climate adaptation planning, and a new program of work on air quality aimed at delivering benefits for climate change and human health.

They also launched a new U.S.-India Climate Fellowship Program to build long-term capacity to address climate change-related issues in both countries. The President and Prime Minister instructed their senior officials to work through the U.S.-India Energy Dialogue, U.S.-India Joint Working Group on Combating Climate Change, and other relevant fora to advance these and other initiatives.

The leaders welcomed the conclusion of a MoU between the Export-Import Bank and the Indian Renewable Energy Development Agency, which would make up to $1 billion in financing available to bolster India's efforts to transition to a low-carbon and climate-resilient energy economy, while boosting U.S. renewable energy exports to India.

Notification for Accelerated Depreciation

The Notification on Accelerated Depreciation has been issued by the Income Tax Department on 16th September 2014 making it applicable from 1st April 2014.


www.windworldindia.com
WIND WORLD
Clean Energy Forever
Our groundwork enables our clean energy contribution to touch the sky
Our groundwork is what earns us the wings:
▪ Robust operations - from concept to commissioning and lifetime care thereafter
▪ Comprehensive in-house manufacturing facilities – including complete turbines and towers
▪ Turbine technology - reliable and proven gearless technology
▪ Holistic solutions – to all wind energy related financial / regulatory / CDM aspects
▪ Proven track record - 18 years of operation; capacities exceeding 4200MW

Total Quality Management

G. Ramachandra Moorthy
DGM-TQM, Regen Powertech Pvt. Ltd., Chennai

Total Quality management is the integration of all functions and processes within an organization in order to achieve continuous improvement of the quality of goods and services. The goal is customer satisfaction.

The Three Quality Gurus

1. **Deming:** the best known of the "early" pioneers, is credited with popularizing quality control in Japan in early 1950s. Today, he is regarded as a national hero in that country and is the father of the world famous Deming prize for quality.
2. **Juran,** like Deming was invited to Japan in 1954 by the union of Japanese Scientists and engineers. Juran defines quality as fitness for use in terms of design, conformance, availability, safety and field use. He focuses on top-down management and technical methods rather than worker pride and satisfaction.
3. **Philip Crosby:** author of popular book *Quality is Free.* His absolutes of quality are:
    - Quality is defined as conformance to requirements, not "goodness"
    - The system for achieving quality is prevention, not appraisal.
    - The performance standard is zero defects, not "that's close enough"
    - The measurement of quality is the price of non-conformance, not indexes.

Commonality of Themes of Quality Gurus

- Inspection is never the answer to quality improvement, nor is "policing".
- Involvement of leadership and top management is essential to the necessary culture of commitment to quality.
- A program for quality requires organization-wide efforts and long-term commitment, accompanied by the necessary investment in training.
- Quality is first and schedules are second.

Definition of Quality

The concept and vocabulary of quality are elusive. Different people interpret quality differently. Few can define quality in measurable terms that can be proved operationalized. When asked what differentiates their product or service;

- The banker will answer "service"
- The healthcare worker will answer "quality health care"
- The hotel employee will answer "customer satisfaction"
- The manufacturer will simply answer "quality product"

Approaches of Defining Quality

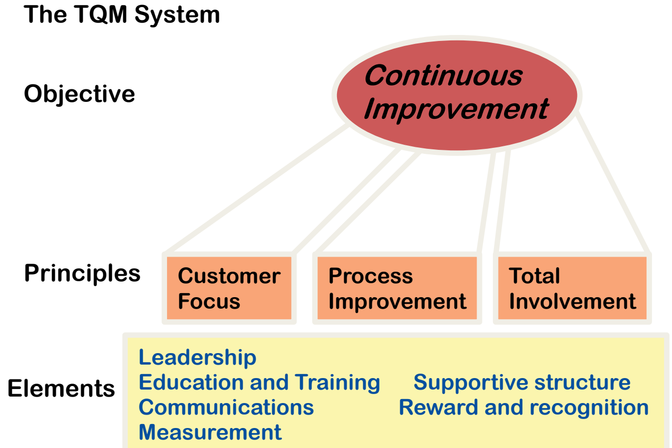
- Product based - Quality is viewed as a quantifiable or measurable characteristic or attribute.
- Quality is determined objectively. All the Product Characteristics are measured at the appropriate stages during Manufacturing, Erection, O & M. The results of the measurement are recorded in the Protocols.
- User based - It is based on idea that quality is an individual matter and products that best satisfy the preferences of Customer are those with the highest quality. All the Customer Specific Requirements & Preferences are reviewed thoroughly to ensure the compliance.
- Manufacturing based - definitions are concerned primarily with engineering and manufacturing practices and use the universal definition of "conformance to requirements". Requirements or specifications are established by design and any deviation implies a reduction in quality. The concept applies to services as well as product. Excellence in quality is not necessarily in the eye of the beholder but rather in the standards set by the organization. Hence conformance to requirements is ensured by aligning the manufacturing practices to design requirements.
- Value based - It is defined in term of costs and prices as well as number of other attributes. Thus, the consumer's purchased decision is based on quality at

an acceptable price. This approach is reflected in the popular Consumer Reports magazine, which ranks products and services based on two criteria: Quality and Value. Hence, it is essential that a High Quality Product must be cost competitive in order to gain Customer confidence & Satisfaction.

Characteristics of TQM Leader

- Visible, Committed and Knowledgeable
- A Missionary Zeal
- Aggressive Targets
- Strong Drivers
- Communication of Values
- Organization
- Customers Contact

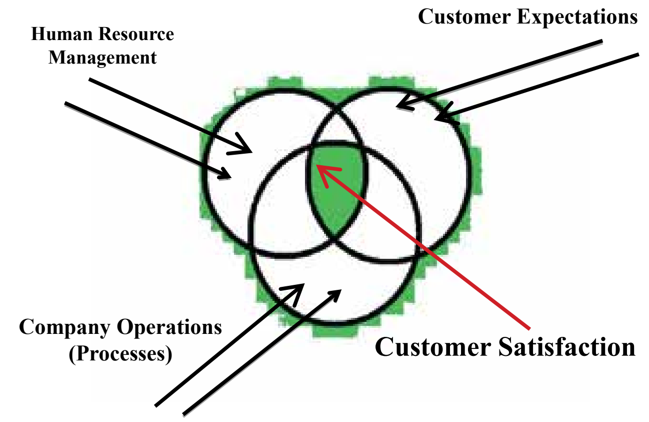
The TQM System



Indicators for Customer Satisfaction

- Frontline empowerment
- Excellent hiring, training, attitude and morale for front line employees
- Proactive customer service system
- Proactive management of relationship with customers
- Use of all listening posts
- Quality requirements of market segment
- Commitment to customers
- Understanding customer requirements
- Service standards meeting customers' requirements

Customer Satisfaction - Three Part System



Customer Satisfaction - Three Part System

Cost of Quality

Three Views of quality Costs

a. **Higher quality means higher cost.**
   - Quality attributes such as performance and features cost more in terms of labor, material, design and other costly resources.
   - The additional benefits from improved quality do not compensate for additional expense.

b. **The cost of improving quality is less than the resulting savings.**
   - The saving result from less rework, scrap and other direct expenses related defects.
   - This is said to account for the focus on continuous improvement of processes in Japanese firms.

c. **Quality costs are those incurred in excess of those that would have been incurred if the product were built or the service performed exactly right the first time.**

This view is held by adherents of TQM philosophy.

Costs include not only those that are direct, but also those resulting from lost customers, lost market share and the many hidden costs and foregone opportunities not identified by modern cost accounting systems.

Quality Costs

COST OF QUALITY IS THE COST OF NON QUALITY

1: 10:100 Rule - "A stitch in time saves nine"

Types of Quality Costs

The cost of quality is generally classified into four categories

1. Cost of Prevention
2. Cost of Appraisal
3. Cost of Internal Failure
4. Cost of External Failure

Cost of Prevention

- Prevention costs include those activities which remove and prevent defects from occurring in the production process.
- Included are such activities as quality planning, production reviews, training, and engineering analysis, which are incurred to ensure that poor quality is not produced.

Cost of Appraisal

- Those costs incurred to identify poor quality products after they occur but before shipment to customers e.g. Inspection activity.

Internal Failure

- Those incurred during the production process.
- Include such items as machine downtime, poor quality materials, scrap, and rework.

External Failure

- Those incurred after the product is shipped.
- External failure costs include returns and allowances, warranty costs, and hidden costs of customer dissatisfaction and lost market share.

Benefits of TQM

- Greater customer loyalty
- Market share improvement
- Higher stock prices
- Reduced service calls
- Higher prices
- Greater productivity

Conclusion

Remember the earth revolves around the CUSTOMER. Quality begets customers and customers beget quality. Let us all have action plans to support quality.

Protecting Western Ghats: Environment Ministry Gets Green Signal for Final Draft

The principal bench of National Green Tribunal (NGT), New Delhi, in an order on 25th September 2014 finally decided in favour of the Kasturirangan Committee report on environmental protection of the Western Ghats as opposed to the far more rigorous Madhav Gadgil report. The NGT passed the order in the wake of a petition filed by two NGOs — Goa Foundation and Peaceful Society — in 2012 for implementation of the Gadgil report.

Referring to an office memorandum and draft notification issued by Ministry of Environment and Forests (MoEF) which rejected the Gadgil report, NGT directed MoEF to issue the final notification based on the Kasturirangan Committee report but also consider eco-fragile areas which may have been left out in the draft notification. NGT, quoting an affidavit by MoEF, said the government was considering "excluding or including certain areas from the ecological sensitive areas, as per the draft notification issued on March 3 this year".

MOU Signed for First Demonstration Offshore Wind Power Project in India

The Ministry of New and Renewable Energy, Government of India, National Institute of Wind Energy (NIWE), and a consortium of six government entities have signed a memorandum of understanding (MoU) on 1st October, 2014 in the presence of Shri Piyush Goyal, Union Minister of State (I/C), Power, Coal and New & Renewable Energy to set up a joint venture company that will carry out an demonstration offshore wind power project in India.

The consortium consists of the National Thermal Power Corporation (NTPC), Power Grid Corporation of India Ltd (PGCIL), Indian Renewable Energy Development Agency (IREDA), Power Finance Corporation (PFC), Power Trading Corporation (PTC), and Gujarat Power Corporation Ltd (GPCL). The joint venture company would set up a 100 megawatt (MW) project along the Gujarat coast.

Ms. Varsha Joshi joined as Joint Secretary, MNRE

Ms. Varsha Joshi, IAS of UT Cadre has joined as Joint Secretary, Ministry of New and Renewable Energy, Government of India for Wind Sector succeeding Dr. Alok Srivastava who is transferred to Ministry of Shipping.

Know Your Wind Energy State - Andhra Pradesh - A Snapshot

Compiled by **Mr. Nitin Raikar,** Suzlon, Mumbai
(rnitin@suzlon.com)

Topography & Climate

State brief :

Andhra Pradesh lies between 12°41′ and 22°N latitude and 77° and 84°40′E longitude. The state borders Telangana in the northwest, Chhattisgarh in the north, Odisha in the northeast, Karnataka in the west, Tamil Nadu in the south and the water body of Bay of Bengal in the east. Geographically, Andhra Pradesh is bestowed with two mighty river systems of Krishna and Godavari. It has a varied topography ranging from the hills of Eastern Ghats and Nallamallas to the shores of Bay of Bengal. The state has two regions Coastal Andhra and Rayalaseema. The climate of Andhra Pradesh varies considerably, depending on the geographical region. In the coastal plain, the summer temperatures are generally higher than the rest of the state, with temperature ranging between 20 °C and 41 °C

Overall Power scenario

(Data as of 31 Mar 2014 & figures in MW)

Total installed capacity (all energy sources)	17731.07
Thermal (Coal+Gas+Diesel)	12190.28
Nuclear	275.78
Hydro	3734.53
RE (Grid connected)	1530.48
Peak Demand (MW)	14072
Peak Met (MW)	13162
Deficit (%)	-6.5

Wind Resource

(Data as of 31 Mar 2014)

Installable Potential as per CWET Wind Atlas	14497 MW @ 80m Hub Height & 5394 MW @ 50m Hub Height
Wind Monitoring stations est. by CWET	88
Operational wind monitoring stations	24
Stations with Annual Average WPD > 200 W/sq m extrapolated at 50 m height	41
Windy Districts (having installation track record)	Anantapur, Kurnool, Cuddapah, Nellore, Chitoor

Wind Statistics

(Data as of 31 March 2014)

Total Cumulative installed capacity (MW)	746.20
Govt Demonstration Projects (MW)	7.80
Private sector Projects	738.40
State Ranking in Wind Installation	# 6th
% of Wind Installations w.r.t all energy sources	4.21%
% of Wind Installations w.r.t all RE sources (Grid connected)	48.76%

Green Statistics

(Data as of 31 Mar 2014)

Million tones of CO_2 emissions offset by Wind powered projects in the state (p.a)	1.51 million tonnes
Million tones of Coal savings by Wind powered projects in the state (p.a)	1.17 million tonnes
Number of homes powered	0.46 million homes

Wind Policy - Salient features

Feed in Tariff (Sale to EB)	Rs 4.70 (Tariff validity from 15 Nov 2012 - 31 March 2015)
PPA Tenure	25 years
Banking	Allowed
Reactive Power Charges	25 paise/KVARh of reactive energy drawn from grid upto 10% of net active energy 50 paise/KVARh of reactive energy drawn from grid above 10% of net active energy

HT Tariffs:

Category	Voltage level	Fixed charge	Energy Charge
		Rs/Month	Rs/Unit
HT -IA (General)	11 kV	350/kVA	5.73
	33 kV	350/kVA	5.3
	>132 kV	350/kVA	4.9
ToD (6-10 pm)	11 kV		6.73
	33 kV		6.3
	>132 kV		5.9
HT - IB (Ferro Alloys)	11 kV	350/kVA	5.41
	33 kV	350/kVA	4.98
	>132 kV	350/kVA	4.58

Open Access Charges:

AGENCY	DESCRIPTION	2014-15
EPDCL	Wheeling Charges - 33 kV (Rs./kVA/Month)	13.46
SPDCL	Wheeling Charges - 33 kV (Rs./kVA/Month)	7.66
EPDCL	Wheeling losses - 33kV	3.39%
SPDCL	Wheeling losses - 33kV	4%
TRANSCO	Transmission charges (Rs /kW/Month)	65.3
TRANSCO	Transmission losses	4.02%
SLDC	Annual Fee (Rs. /MW/Year)	2535.65
SLDC	Operating Charge (Rs/MW/Month)	2378.11

Wheeling Charges - SPDCL (2014-15)	33 kV (Rs/kVA/Month) - Rs 7.66 & 11 kV (Rs/kVA/Month) - Rs 164.61
Wheeling Charges - EPDCL (2014-15)	33 kV (Rs/kVA/Month) - Rs 13.46 & 11 kV (Rs/kVA/Month) - Rs 240.15
Additional Note	As per the APERC Order wind energy is exempt from wheeling and Tx charges however Govt Order is still awaited.
SLDC Charges (FY 2014-15)	Annual Fees (Rs/MW/Year) - 2535.65
	Operating Charges (Rs/MW/ Month) - 2378.11
RPO - Non Solar (FY 2014-15)	4.75%
Prevailing APPC rate	Rs. 3.38/kWh

Regulatory Agencies & State Utilities

Govt Regulatory & Nodal Agencies	Andhra Pradesh Electricity Regulatory Commission (APERC) Non-conventional Energy Development Corporation of Andhra Pradesh Limited [NEDCAP]
State Utilities	Andhra Pradesh Power Generation Corporation Limited (APGENCO) Transmission Corporation of Andhra Pradesh Limited (AP TRANSCO) Northern Power Distribution Company of AP Ltd (APNPDCL) Southern Power Distribution Company of AP Ltd (APSPDCL)

Miscellaneous Factoids

Project Commencement Year	Andhra Pradesh's first demonstration Wind Power Project was commissioned at Tirumala in the Jun 1989. The Project comprised of 5 X 110 kW m/cs of JK-Wincon W110 XT make. The total Project capacity of this Demonstration Project amounted to 550 kW (0.55 MW).

* References : CERC, CEA, MNRE, NEDCAP, GoAP, APERC, Internal Records

Snippets on Wind Power

$100 Billion Investment Likely in RE in 5 Years: Piyush Goyal, Power and Coal Minister

Power, Coal and Renewable Energy Minister Shri Piyush Goyal has said that India will get $100-billion investment in renewable energy in the next five years and become a world leader in the sector. With billions of dollars worth of capital, and enforcement of the mandate for utilities to buy clean energy, called Renewable Purchase Obligation (RPO), the Modi government is keen on making electricity from clean sources like sun, wind, water and biomass a substantial part of the country's energy mix in five years.

India, China Business Delegates Sign Deals worth $3.4 Billion

Indian businessmen on 17th Sep 2014 signed deals worth $3.43 billion with their Chinese counterparts who are part of a delegation accompanying President XI Jinping. Several MoUs were signed in sectors such as wind energy, seafood, chemicals, cotton and pharmaceuticals.

NALCO to add 100 MW Wind Energy

National Aluminium Company Limited (NALCO), a public sector company one of the largest aluminium production companies in the world, has announced new plans to install a 100 MW wind energy project after cancellation of its coal mines. The company has also announced installation of a 14 MW wind energy project in the mined-out area of its bauxite mines in the western state of Odisha. The company already has two wind energy projects with aggregate capacity of 98 MW.

Gujarat may get India's first offshore wind power project

The first ever offshore wind power project in India is set to come up in Gujarat. The Central government is roping in public sector undertakings for the purpose and Suzlon is conducting a techno-commercial feasibility study for offshore wind power project in Gujarat.

Regulations, Energy Scarcity Holding up Growth: CEA

The new Chief Economic Adviser Mr. Arvind Subramanian in a podcast interview to the International Monetary Fund said that the Indian economy needs a couple of big things, better governance, a stronger state delivering security of contract, protecting property rights, and providing infrastructure. He added that you need a bigger role for the private sector, which means getting rid of the lots of regulations that stifled the private sector that stifled employment creation that stifled the ability of the private sector to grow, to become big. These are the kind of broad twin challenges that India faces.

Mr. Subramanian told that the bureaucrats were not taking some crucial decisions fearing that they would be sued. He added that a five per cent growth rate was "remotely not enough" for India to grow and provide the jobs for the expanding labour force. Growth would have to be brought back to 7.5 and 8 per cent consistently for about 10, 15, 20 years, if India is to really address all these challenges.

Fresh Surge of Wind Power

The restoration of benefits such as accelerated depreciation (AD) and generation-based incentive (GBI) is expected to invigorate the domestic wind power sector. CRISIL Research estimates that 10,000 MW of capacity will be added during 2015-18, entailing investments of Rs. 65,000 crores compared with 7,000 MW over the previous three years.

It is estimated that during 2015-18, capacity additions will be driven by Maharashtra, Madhya Pradesh and Andhra Pradesh, which offer attractive preferential tariffs that are determined by the respective State electricity regulatory commissions based on capital costs and PLF. Moreover, the power distribution companies (discoms) in these States are relatively stronger financially, which ensures timely payments. Due to considerable evacuation issues and a poor track record of timely payments, the capacity additions in Tamil Nadu are expected to decline.

Ban Again on Power Sale in Tamil Nadu

In an October 10, 2014 notification, the Tamil Nadu State Government has reintroduced the ban on inter-State sale of power invoking Section 11 of the Electricity Act, 2003. The government said that all the generating stations should supply surplus electricity either to the Tamil Nadu Generation and Distribution

Corporation (TANGEDCO) or any other open access consumer within the State, as per the regulations of the Tamil Nadu Electricity Regulatory Commission. In May 2014, the government had lifted the five-year ban as it was confident of the availability of electricity. But the frequency of interruptions in supply had gone up since then, forcing the authorities to impose a 20 per cent power cut on high-tension industrial units and commercial establishments.

Wind Could Supply Nearly 20% of Global Power by 2030

The installed wind power capacity could swell by 530 percent to 2,000 gigawatts (GW) by 2030, supplying up to 19 percent of global electricity, a report from a trade association and Greenpeace said. The installed wind energy capacity totalled 318 GW at the end of last year worldwide and provided around 3 percent of global electricity supply. Capacity is set to grow by another 45 GW to 363 GW this year. The GWEC, which represents 1,500 wind power producers, looked at the future of the wind energy industry to 2020, 2030 and 2050 under three scenarios based on existing and future emissions reduction and renewable energy policies. Based on International Energy Agency forecasts, it said cumulative installed wind energy capacity could reach 611 GW by 2020 and 964 GW by 2030.

Power Ministry for Changes in Renewable Energy Obligations

Union Minister Shri Piyush Goyal said on Tuesday, 11/26/2014 that the Power Ministry will soon approach the Cabinet with a proposal to introduce stringent rules for buyers and sellers of renewable energy, besides making amendments to the provisions in the overall tariff policy, He added "We have a particular focus on renewable energy and are looking at renewable power purchase obligation (RPO) for both the purchaser and generator and will be enforcing this more strictly," he said. At present, under the RPO (Renewable Purchase Obligation) mechanism, the state power distribution companies have to mandatorily purchase electricity generated through renewable energy sources during the year. On similar lines, the government is contemplating the RGO (Renewable Generation Obligation), which will make it compulsory for thermal power producers to also generate electricity through renewables.

The changes in the tariff policy are also being looked at in order to provide for long term power purchase agreements (PPAs), trying to provide intermediary companies to make such PPAs more bankable considering the poor health of several discoms. The government may even bring in an entity which provides bankability, confidence to financers that their money is secure through the intermediary who purchases the power that is generated and puts it into the grid. The move will bring down the interest cost and lead to certainty in the system.

UK Rolls out Bus that Runs on Poo Power

The Poo Bus the first UK bus that is powered entirely by human and food waste has begun its service between Bristol and Bath. This 40-seater bus runs on biomethane gas generated from sewage and food waste. The engine is similar to a conventional diesel engine. The bus operated by Bath Bus Company ferries people between Bristol Airport and Bath city. An average of 10,000 passengers travel from the airport to Bath each month. The eco-friendly bus, on a full tank of bio-methane gas, has a range of 300 km. A full tank of this gas takes the annual waste of about five people to produce. The carbon discharged by the bus into the atmosphere is 30 percent less compared to a regular diesel powered vehicle.

MNRE Notification for SAD Exemption on Additional WOEGs Parts

MNRE vide its office memorandum dated 24th November 2014 has issued notification and formats for availing Special Additional Duty Exemption Certificates for Wind Operated Electricity Generators (WOEGs). As per the notification dated 24/11/2014, in addition to the critical parts required for use in the Wind Operated Electricity Generators (WOEGs) being imported as per the Department of Revenue, Ministry of Finance notification no. 12/2012 dated 17.03.2012 as amended with notification no. 12/2014 – Customs dated 11th July 2014, generator, pitch system, hub, main/hollow shaft, brake system, converter, main / base frame and tower flanges are eligible for SAD exemption.

Gamesa Launches New Production Line:

Gamesa India strengthened its operations in the country by announcing the launch of its new production line in its Nacelles plant in Mamandur, near Chennai on November 20th, 2014. Ignacio Martín, Executive Chairman, Gamesa Group & Mr. Xabier Etxeberria, Business CEO, Gamesa Group, inaugurated the new production line in the plant for manufacturing 2.0 MW machines to be launched in 2015.

Know Your Member

Bonfiglioli Transmissions Private Limited

Mr. Kennady V. Kaipally
Country Manager, Mobile & Wind Solutions
Bonfiglioli Transmissions Pvt. Ltd.

Bonfiglioli Transmissions Private Limited (BTPL), Chennai is a 100% subsidiary of the Bonfiglioli Riduttori S.p.A. The company started its operations in 1999 and inaugurated state-of-the-art facility in the year 2000. We manufacture products for Mobile & Wind Solutions and the Industrial Solutions Business Units. This was the first facility outside the European boundaries with indigenous production that caters to domestic as well as export markets. Forty to fifty percent of the Indian production is consistently exported worldwide. Bonfiglioli India is accredited with ISO 9001:2000 (Vision 2000) Quality Certification by TÜV.

Bonfiglioli specialized in manufacturing integrated inverter solution for yaw drives, pitch drive control system as well as re-generator inverters to direct the electricity created by the wind turbine into the power grid. One in four Wind Turbines in Europe uses Bonfiglioli Drive. BTPL works closely with customers to develop tailor-made applications and deliver reliable, superior performance products, which comply with any worldwide standard.

Bonfiglioli manufacturing plant at Chennai

The state-of-the-art facility at Chennai manufactures Wind turbine gearboxes (700T series) namely Yaw Drive and Pitch Drive. The gearboxes has been designed, engineered and is manufactured by Bonfiglioli India. Bonfiglioli drives deliver high efficiency with customized reduction ratios and compact dimensions. The 700T series planetary speed reducers are highly shock resistant and designed for heavy duty purpose. BTPL is the market leader for supply of yaw and pitch drives to the Indian Market.

Printed by R.R. Bharath, published by Dr. Rishi Muni Dwivedi on behalf of Indian Wind Turbine Manufacturers Association and printed at Ace Data Prinexcel Private Limited, 3/304 F, (SF No. 676/4B), Kulathur Road, Off NH 47 Bye Pass Road, Neelambur, Coimbatore 641062 and published from of Indian Wind Turbine Manufacturers Association, Fourth Floor, Samson Towers, No. 403 L, Pantheon Road, Egmore, Chennai 600 008.

Editor: Dr. Rishi Muni Dwivedi


RRB ENERGY
25 years
SILVER JUBILEE
The latest from the Grand Master to make you a sure winner!
RRB Energy, a pioneer in the Wind Energy Sector, takes immense pride in introducing one of the World's finest and highly efficient 1.8 MW Wind Electric Generator (PS 1800 kW). Built with global technology with decades of expertise and precision.
Incidentally, RRB Energy christened the term WEG - Wind Electric Generator to India and India's oldest functional Wind Electric Generator is also from RRB Energy.
Now, make the move with the stalwart and watch the way your game changes!
RRB ENERGY
Let us tell you how PS 1800 kW is the best for India.
Made with Global Technology, Perfected for India.
RRB ENERGY LIMITED
Reliability Driven By Technology
182/2,Bypass Road, Poonamallee, Chennai- 600 056 Tamil Nadu, India. + 91-44-26271111 E-mail: marketing-pnml@rrbenergy.com www.rrbenergy.com