



Mr. Duncan Koerbel
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Energetica India catches up with Mr. Duncan Koerbel, Chief Technology Officer (CTO), Suzlon Energy to talk on Suzlon's technology development.

ENERGETICA INDIA: Suzlon's first wind farm site in Gujarat completes 20 years of operational milestone recently. How has wind technology evolved since then?

DUNCAN KOERBEL: Wind is the most untapped potential source of energy especially in India. It can help generate sustainable and viable alternative to the expensive imported fossil fuel. Two decades ago, when Suzlon started, the wind energy industry was at its nascent stage, in fact it was almost non-existent. Suzlon pioneered the 'concept to commissioning' model in the wind energy industry then offering complete

end-to-end solutions to harness wind for energy generation.

Wind technology has witnessed a sea change over the past two decades focused on improving the energy yield and bringing down the cost of energy. The technological innovations led by Suzlon have been in many areas- the size and weight of rotor blades, to increasing the height and type of towers (75 meter lattice towers, tubular towers to 120 meter hybrid towers combining both lattice and tubular which is the latest tower technology introduced by Suzlon and currently installed across sites in India). Further, majority of the turbines in India installed up to the year 2000 are

below 500 kW capacity and today we have machines of upto 2.1 MW and above capacity.

Also, the advancing technology has given a fillip to improving the operations and maintenance services (OMS) of wind turbines. It was not long ago that every turbine took many sheets of paper in the form of checklists, work instructions, technical documents and all necessary to maintain the turbines. This documentation over the years all being stored in file cabinets at our field service offices forms the DNA of Suzlon's technology.

Suzlon's proprietary SCADA system enables the information from millions of



sheets of paper and spreadsheets, to be available 24 hours a day, 7 days a week anywhere in the world. The SCADA system (Supervisory Control And Data Acquisition) is used today for remote supervision and control of wind turbines and wind parks. SCADA is further leveraged to offer transparency and increase generation through remotely applied algorithms

With improved reliability of wind energy, scheduling and forecasting, better energy yield all enabled by technology advancements, today, we are moving towards fossil fuel competitive Plant Load Factors which will add grid stability.

Since inception, technology has been the cornerstone at Suzlon. Over the years, Suzlon has been leveraging technology to consistently increase the plant load factor (PLF). The S97 120 m (2.1MW) turbine with hybrid tower

which enables viability of low wind sites and has achieved 35% PLF and the prototype of the S111 120 m hybrid tower turbine installed at Bhuj, Gujarat is expected to deliver 40% PLF

Wind-Solar hybrid is another concept that is gaining momentum in the industry and Suzlon is focusing on it, as this option optimizes land usage, grid infrastructure and offers energy reliability through complementary forms of energy generation

Suzlon product evolution led by technology advancements:

- Larger Rotor and taller tower turbine configurations with an improved Levelized Cost of Energy (LCoE) were designed and installed using new wave of innovation and leverage technology to optimize and harness wind resources at higher altitudes and unlock low wind sites which

were earlier unviable. We started off first with the S52 which had the hub height of 75m today we have our tallest turbine S111 which is 120m hub height.

- The nascent lattice turbine, S52 which generates 600 KW which were lattice towers at a low height designed for generating the optimal power output even at sites with a modest wind speed regime
- Then came a series of tubular tower wind turbines, S66-1.25 MW, S82-1.5 MW which are equipped with a dual speed, dual rating asynchronous generator; it can operate within a limited speed range
- With the S88-2.1 MW, Suzlon installed this turbine based on market requirement for bigger rotor diameter and in line with competitor products at Sangneri, Tamil Nadu in 2004. This was the first multi MW

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product introduced by Suzlon, which was the basis for various important variants later of the same rating.

- In 2011, Suzlon introduced the S97 90m 2.1 MW which ensured maximum energy output and improved return on investment under low wind regime. The key advancement was introduction of doubly-fed induction generator (DFIG) Technology and improved Pitch system in this product development. The S97 has a bigger rotor which has 21% larger swept area and 125% increased hub height. The S97 provided 25% more annual energy production, with resounding global speed.
- As we progressed, in 2014, the S97 120m was inducted that was ideal for IEC Wind Class III- but to harness the high wind speed at a height. The S97 120m enhanced the annual energy production to 10-15% compared to the S97 90m. This hybrid turbine has one unique transitional element that holds together the lattice and tubular portions.
- In 2015, introduced the world class S111 with improved DFIG that was further enhanced to achieve the variable speed capability upto 30%. The 6 yaw drivers ensures improved balancing and load sharing. The generator & gearbox combination design was optimised for taking the loads of bigger rotors.

- Both the S97 and S111 series is best suited for low wind application that have aerodynamic blades which is slender, lighter and more efficient. These are designed for profitable wind energy investment under low wind conditions. Suzlon also provides advanced wind resource assessment and life cycle management.

ENERGETICA INDIA: What kind of research & development is Suzlon working on? What new areas of improvement will we see in the near future?

DUNCAN KOERBEL: Suzlon is a pioneer in innovation, product and technology not only in India but globally. We are ahead of technological features particularly aero dynamic technology which is our biggest USP. We have our R & D centres in Germany, Netherlands, Denmark, China and India. This year, we established the Blade Science Centre at Vejle, Denmark with a view to capitalise on the technology expertise of the region. The centre will work on the development of aerodynamics, pitch control systems, smart controls and new structures. This way we are leveraging international expertise and capabilities to develop next generation high reliability products and at the same time to bring down the LCoE.

- Our R&D efforts are focused on the following:
 - Lowering the LCoE by 20% in the next five years with new turbines

- More efficient turbines to make previously unviable sites viable
- We will continue to increase our plant load factor and to stabilize the grid in India
- We envision gigawatt size projects supported by increasing digitization and best in class service
- Aligned with the government agenda, we are striving for sustainable and affordable energy for all by focusing our R&D efforts on developing high yield products that effectively bring down the LCoE and improve customers' Return on Investment (ROI). This has resulted in two path-breaking products:
 - The S97-120m (2.1 MW) turbine with hybrid tower which enables viability of low wind sites and has 35% PLF.
 - The S111 (2.1 MW) turbine prototype has been successfully tested in India and USA. In India it is amongst the few in its class to have the largest rotor diameter spanning 111.8 m. S111 is one of the highest yielding IEC Class III wind turbine.
 - S111 with a 120 m hybrid tower is the latest from Suzlon's 2.1 MW suite of products. The prototype is installed at Naliya, Gujarat and we are expecting it to deliver 40% PLF
- Further, the blades Suzlon designed utilize carbon fibre in key areas of the blade. This reduces the weight of the blade and allows us to design even more aggressive aerofoils that generate more lift and less drag in the outboard portions of the blade. Combined with smarter pitch control systems these technologies enable larger, more efficient rotors thereby capturing more wind
- With a coastline of 7600 kms, India has enormous off-shore wind energy potential and cabinet approval is a step in right direction to unlock this opportunity. Suzlon has access to the most matured off-shore wind energy technology and we are currently conducting a techno-commercial feasibility study in Gujarat, India.

- Wind-Solar hybrid is another concept that is gaining momentum in the industry and we are focusing on this as this option optimizes land usage, grid infrastructure and offers energy reliability through complementary forms of energy generation

ENERGETICA INDIA: Please help our readers understand the concept of "Gust Detection & Reaction". How does it help wind farms?

DUNCAN KOERBEL: The GDR (Gust Detection and Reaction) control feature helps the normal rotor-speed-controller to detect gusts and to react in a way that load peaks and overload speed are reduced as well as shut downs are avoided or at least moderated. Temporarily increased wind speed gradients with or without a strong change of wind directions will be detected as gusts

- The signals of the nacelle based anemometer and the wind vanes are used by the wind observer as no additional sensor systems are required. Special signal filtering and an adapting algorithm are included in the GDR wind observer. If a gust is detected the second part of GDR - the reactor - adds in coordination with WTG-controller a defined blade pitch offset as long as the gust has gone through and no new gust was detected. This short time pitch offset reduces the aerodynamic forces of the blades and as a consequence the rotational speed and the blade forces
- As the gust will be detected before the energy of the gust accelerates the rotor too much, the reaction time of the rotor-speed-controller will be reduced
- In case the GDR is able to prevent a hard shut-down, e.g. tripped by rotational over-speed, and the reaction leads to a softer brake program, some of the main local extreme loads will be reduced significantly
- All in all the GDR helps the WTG to react in time to prevent load peaks and/or shut down. The dilemma of

trade-off between high energy generation and lower loads can be solved by energy optimized controller in combination with GDR. After successful finishing of simulation and optimization phase, first trails on WTGs will be done by Suzlon

ENERGETICA INDIA: Suzlon has recently won the Golden Peacock Eco Innovation Award for its S97 120m hybrid tower wind turbine. Please let us know what is unique about this wind turbine?

DUNCAN KOERBEL: The S97 120m hybrid tower WTG, at 120 metres, is the first and tallest all-steel tower of its kind to be implemented in full scale in the world. The tower of the turbine combined a lattice tower base with a tubular tower, brought together by a unique transition piece. This piece is placed atop the lattice half and acts as a new foundation in itself for the tubular tower. This makes the transition from one type of tower to the other stable, safe and effective, while providing the WTG with the advantages of stability, as a result of the 24 sq. metre Lattice base, and height, as a result of the tubular tower.

Using less concrete in the foundation due to its lattice base, the S97 120m also brings the advantage of reduced steel use and less weight, resulting in greater cost effectiveness. The S97 120m has been designed to scale new benchmarks in hub height, thereby providing high energy yield, even in medium to low wind regions. As a result, the S97 120m has made previously unusable sites, viable.

The asynchronous induction generator, plugged with the time tested DFIG technology, enhances variable speed capacity by 30%. The WTG is compliant with the IEC ed.3 design standard which makes it ideally suited for Indian wind condition. Additionally, the S97-120m hybrid tower WTG is available in a high temperature variant, up to 50°C, making it suitable for smooth functioning in all climatic conditions. The reduced weight and unique design of the

S97 120m has opened up new markets and opportunities for better optimised manufacturing costs, logistics and installation time. Furthermore, the design of the S97 120m aids in achieving a lower Levelized Cost of Energy (LCoE) and offers a safe and secure investment with excellent, long term Return on Investment (RoI).

Advantages of the S97 120m over similar products in the market

The S97 120m, with its all-steel hybrid tower, is a one of its kind in the Indian market. Its lighter structure, enhanced annual power generation, ease of transport and convenient installation makes it more cost efficient than a conventional structure. It makes low wind sites viable while also ensuring 12% - 15% higher energy generation over other turbines of the same capacity. Having been introduced at the end of 2014, the S97 120m became a preferred choice for customers and has already sold 133 units, commissioning a total of 279.3 MW.

ENERGETICA INDIA: Why has the small wind turbine market in India not been able to grow?

DUNCAN KOERBEL: Wind Energy is not deployed to cater to individual household use but there are attempts being made to ensure the small domestic wind turbines contribute to the energy production. For eg. The onsite hybrid system of wind along with solar power installations contributes to approximately 6% of the energy consumed at One Earth, Suzlon's campus global HQ.

In a city/urban landscape the wind velocity gets obstructed and the energy yield from roof top small wind turbines gets impacted too. Hence it does not seem a viable option from cost-benefit analysis point of view. However, in India the investment in wind energy for captive use has worked very well, whereby, investments in wind energy can be made by individuals, corporates and SMEs, and the turbine can be installed at any windy sites pan-India.