Re-powering of Old Wind Turbines in India

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The article looks at the potential of repowering of wind turbines in India

As on date, the total installed capacity through Wind Turbine Generators (WTG's) in India is approximately 18.98 GW. This figure was approximately 18.11 GW as on Sep 2012 while the total electricity generation through WTG's in Financial Year (FY) 2012-13was approximately 26.05billion units. Therefore, the average Capacity Utilization Factor (CUF) in FY 2012-13 was approximately 16.42% which has been the trend since the past few years. If Renewable Energy Technologies (RET's) have to grow popular and commercially acceptable, this CUF has to be in the range of atleast 35 – 50%. And one way to increase the CUF for wind energy is through repowering of old wind turbines.

Wind Energy and its Potential in India

Wind speed and direction are continuously fluctuating. The wind will vary over few hours with weather system. Generally, tropics have steady moderate winds all year, temperate latitudes have much more variation in wind speed and in particular more high wind speed occurrences. Sites with more wind speed will generate more power. Mean wind speeds in India generally range between 5.55 – 7.50 m/s (20 – 27 kmph) with a Co-efficient of Variation (COV) of about 5.85%.

According to the Indian Wind Atlas 2010 published by C-WET, the annual average wind power densities in most of the potential assessed sites of India is between 200 - 250 Watts/m2 at a hub height level of 50 meter above ground level (MAGL). This is considered to be a benchmark criterion for establishing wind farms in India as per Centre for Wind Energy Technology (C-WET) and the Ministry of New and Renewable Energy (MNRE). Based on this, the conservative estimate of wind power potential in India is assessed at 49.13 GW at 2% land availability at windy locations of all states except Himalayan states, Northeastern states and Andaman and Nicobar islands where the land availability is assumed to be 0.5%. This would require a total land area of approximately 5458.89 square kilometers (@ 9 MW per square kilometer). If the installation is done at a hub height level of 80 MAGL instead of 50 MAGL, the estimate of wind power potential increases by a whopping 109.22% to 102.79 GW assuming all other parameters to be same. This is because of higher wind speeds at higher hub heights.

Repowering of Wind Turbines

Replacement of first-generation small-capacity wind-turbines with advanced high-capacity wind-turbines to increase the installed capacity and electricity output with a decrease in the infrastructure requirement is known as Repowering of Wind Turbines. The two main reasons which triggered the idea followed by execution of repowering were, a) acute power shortages and, b) inefficient utilization of potential windy areas. Apart from just being an obvious opportunity to increase the installed capacity and electricity output, repowering is also an economically viable solution. This is because, there is no need to acquire new land and the costs associated with siting related activities. Secondly, the maintenance costs of the aging WTG's can be avoided. And lastly, the advanced design of the new WTG's have resulted them into taller, stronger and sharper (No, I am not advocating for any children's health drink) which allow obstruction free wind flow to WTG's and also rotation in low-wind speeds; hence generating more electricity.

Having said this, there are some challenges and disadvantages too. The biggest being the Power Purchase Agreements (PPA's) signed with respective state utilities for 10-20 years may not get discontinued or revised before its stipulated time in spite of repowering. Other challenges involve disposal of old WTG's, need for additional electricity evacuation infrastructure (the current infrastructure not being enough), and complications related to land ownerships.

Potential and Current State of Repowering in India

For 18.98 GW of installed capacity through WTG's in India, currently there are approximately 35,500 number of wind turbines. The capacity of these wind turbines range

from 225 KW to 2000 KW each. Out of these, a large area is covered by more than 8,500 small wind turbines (< 500 KW capacity). The number of WTG's installed before 2002 stands at approximately 4400 (amounting to approximately 1.38 GW of installed capacity)while the number before 1997 stands at approximately 2663 (amounting to approximately 0.69 GW of installed capacity). Present day repowering solution targets old WTG's with a capacity of500 KW or less. Therefore, the number of WTG's that can be repowered stand at 2663 if WTG's older than 1997 are targeted and at 4400 if WTG's older than2002 are targetedwith Tamilnadu and Gujarat being the maximum contributors while Andhra Pradesh, Maharashtra, Rajasthan and Karnataka not far behind.Those WTG's which have a capacity of 500 KW or less but have not completed 10 years since commissioning are not assumed to be available for repowering as yet.

In India, repowering projects have been initiated at 2 sites till date – LMW near Coimbatore and Fenner India near Nagercoil.The LMW Coimbatore site had 29 WTG's of 300 KW capacity each and 2 WTG's of 500 KW capacity each prerepowering, which are planned to be repowered in phases to a final number of 15 WTG's of 850 KW capacity each. In phase 1, 8 WTG's of 300 KW capacity each and 2 WTG's of 500 KW capacity each have been replaced with 4 WTG's of 850 KW capacity each. At the Fenner India Nagercoil site, 11 WTG's of 225 KW capacity each have been replaced with 3 WTG's of 850 KW capacity each. Let us look in table 1 at the change in installed capacity and potential electricity generation for a sample period of 1 year for these 2 sites.

As can be seen from the table above, with an increase in the installed capacity of just 1.28% (for both sites combined), the total potential increase in the electricity generation for a sample period of 1 year will be 52.25% (for both sites combined). However, these sites have not been completely repowered yet which when done will lead to a much higher % increase in electricity generation. If a commonly accepted thumb rule is believed, repowering of old WTG's results in double the installation capacity and triple the energy output with half the infrastructure. If we use this thumb rule to the repowering of WTG's installed before 2002 (of 1.38 GW) then the scenario will look as seen in table 2.

TABLE 1

Site	Pre repowering Installed Capacity (MW)	Electricity Generation assuming a CUF of 16.42% (Million units)	Post repowering Installed Capacity (MW)	Electricity Generation assuming a CUF of 25% (Million units)
LMW Coimbatore	3.400	4.891	3.400	7.447
Fenner India Nagercoil	2.475	3.560	2.550	5.420

TABLE 2

State	Installed capacity (GW)	CUF	Electricity Generation (BU)
Pre repowering	1.38	16.42%	1.98
Post repowering	2.76	25.00%	6.04

Finances involved in Repowering

A repowering project may roughly cost INR 7-8 crores / MW. Therefore, if repowering is planned for 1.38 GW, then the cost incurred may be in the range of INR 9660-11040 crores. As per industry estimates, the repowering trend in India could translate into the sales of over INR 19,000 crore for repowering companies for a repowering potential of 1.5-2 GW.With anestimated payback period of less than 4 years, this seems to be a valuable proposition which has fueled a number of wind Independent Power Producers (IPP's) to buy old wind farms at attractive valuations, keeping in mind the land and existing evacuation infrastructure.

Conclusion

Today based on the installed capacity of WTG's, India ranks 5th in the world with China, USA, Germany and Spain being ahead of it. Given the still unexplored high potential of wind power in India with an equally good potential of repowering of old WTG's, it may not be a distant dream for India to surge to the number 3 position. Our very own Pavan Devta (The Lord of the Winds) has already bestowed his blessings to make this possible. It's now the turn of the Government and the Industry to bestow their blessings as wellby committing towards immaculate planning, execution and incentivizingof both new and repowering wind power projects in a way that gives everybody at least something to cheer about.

Disclosure: The data and information used at various junctures in the above article are approximate and accuracy of these is not guaranteed. It is as per the data available on various forums online and in books.

References:
http://www.mnre.gov.in/
http://www.cwet.tn.nic.in/
http://www.inwea.org/
http://www.energymanagertraining.com/
http://www.ijera.com/