Replacing old, underperforming wind turbines with modern ones that could offer better returns and more power than before opens up a lucrative opportunity in wind power - that of RePowering.

Compiled by Venkatesan R Iyengar with inputs from T Vijaya Kumar, V Sreekumaran Nair, K V Sajay, T Ponnurangam and A Gurunathan

Wind Power has a long history in India. For close to 2 decades the sector has witnessed a number of challenges, opportunities and changes. Over this time, the industry has made path breaking enhancement in turbine efficiency and reliability. Today we have turbines that offer a viable investment in low wind sites while also ensuring improved reliability. This advancement in technology also offers another lucrative opportunity. RePowering!!

Wind turbines that are over 15 years old cover a landscape that could easily be called the ‘Gulf of Wind Energy in India’. These turbines hardly do justice to the potential that this region houses. The performance has been below par, and it has been found that most of the turbines that are underperforming are in wind sites, which have much lower speeds. It is therefore natural to explore the option of replacing these with modern turbines that could offer better returns and more power than before. In Tamil Nadu, about 60 per cent of small wind turbines (<400 kW) installed before the year 2000 are operating with plant load factor (PLF) ranging from 10 to 15 per cent, whereas the new technology wind turbines can operate at a PLF range of 27 to 32 per cent in the same sites.
The RePowering Potential

The total installed capacity before 2002 was 1380 MW (Table 1). Most of these turbines were installed in Class I and II locations with smaller capacity turbines paving way for potential RePowering and thus better resource utilisation.

Key Factors

Wind Study and Micro-siting

Micro-siting is necessary for the optimisation of wind farm layout and locating new turbines as per the norms specified by respective state regulatory authorities. Since there would already be an existing wind farm, site prospecting is not an issue and it only needs to be validated with current wind/meteorological data to finalise the capacity and number of new wind turbine generators (WTG) that need to be replaced.

Micro-siting for a RePowering site would be a real challenge for the site personnel due to the presence of existing wind turbines in and around the site. Apart from maintaining the correct distance between the machines being proposed, it should be ensured that none of these machines violates the norms regarding inter-machine distance prevalent in the corresponding state. Any discrepancy in the micro-siting of the existing machines would adversely affect the micro-siting of the new wind turbines.

Removal of Existing Turbines

It is important to decide on the number and capacity of older machines to be removed as per the micro-siting details. Economic feasibility/viability is an important factor influencing the capacity and quantity of older machines to be removed based on the RePowering factor. The removal of older running machines should be timed and planned properly to avoid any generation losses and at the same time, to not create any hindrance to the installation of new WTG.

Installation of New Turbines

It is essential to ensure that the installation of new wind turbines in the existing wind farms does not affect the operation of existing wind turbines and vice versa. It is also important to plan the project well in advance to ensure that access roads, platforms, storage area and removal/re-routing of the existing lines for moving new WTG components inside the wind farms is smooth and does not affect any wind turbines in the vicinity.

Challenges

The challenges include securing necessary approvals and licenses from authorities as well as ensuring a favourable policy and maintaining regulatory transparency and support. It would benefit the industry to replace the inflexible, arbitrary and bureaucratic spacing requirements with a more flexible, fact based regulations. The Government should also encourage RePowering through various forms of incentives for capacity addition, increase in tariff, etc.

Gamesa’s RePowering Initiative Project Avatar

Super Sales India, a part of the Lakshmi Machine Works (LMW) Group joined hands with Gamesa in implementing the first RePowering project in India named ‘Project Avatar’. At the selected site, the existing

**Table 1. The RePowering potential - state wise wind turbine installations before 2002**

<table>
<thead>
<tr>
<th>State</th>
<th>Total capacity (MW) installed before 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamil Nadu</td>
<td>809.8</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>247.8</td>
</tr>
<tr>
<td>Gujarat</td>
<td>175.1</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>86.7</td>
</tr>
<tr>
<td>Karnataka</td>
<td>28.9</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>22.6</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>4.1</td>
</tr>
<tr>
<td>Others</td>
<td>5.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1380</strong></td>
</tr>
</tbody>
</table>

Source: Consolidated Energy Consultants Ltd. (CECL)/Ministry of New and Renewable Energy (MNRE)
A wind farm consisted of 29 units of 300 kW turbines and 2 units of 500 kW turbines at Kethanur village in Tirupur district, Tamil Nadu. Gamesa undertook a detailed study of the site and surrounding area and recommended that the 11x300 kW turbines could be replaced with 4 units of Gamesa G58-850 kW machines, which would improve the overall performance and output because of a higher efficiency factor. The 1st phase of this RePowering project was undertaken in March 2011. In July 2011, another repowering project in Aralvoimozhi was commissioned, where 5 units of the Gamesa G52-850 kW replaced 11 turbines - 10 units of 250 kW and 1 of 225 kW.

Project Avatar conceptualised and implemented by Gamesa has resulted in significant benefits to the customer:

- Installation of suitable turbines for a specific site i.e. a class III turbine for a class III project site as per International Electrotechnical Commission (IEC) classification.
- Replacing obsolete technology with technologically advanced variable drive, grid friendly Gamesa G58 – 850 kW turbines that have a 58 m rotor dia and 65 m hub height, thereby increasing the average PLF to 27 per cent.
- Improved overall performance and hence increased power generation from 12.5 million units to 30.0 million units, for the same capacity and with existing evacuation infrastructure. Gamesa is working with a more investors to adopt a similar concept by offering customised site wind power solutions based on a detailed project evaluation.

**Benefits**

**More wind power from the same area of land:** Wind power generation is multiplied without the need for additional land, efficient use of potential land and more capacity addition per unit of land area. A typical example comparing existing scenario and RePowering proposal for a wind farm in Coimbatore is given in Table 2.

From the table it is evident that for a similar capacity wind farm, the increase in annual electricity generation using Gamesa model WTG of rated capacity 850 kW is 116 lakh units. By opting for RePowering, one can expect an increase in generation of more than 100 per cent than the existing capacity.

**Fewer wind turbines:** The number of turbines is greatly reduced while the natural landscape is maintained.

**Higher efficiency, lower costs:** Modern turbines make better use of available wind energy, thus improving efficiency of the wind farm and lowering the operation cost.

**Better performance:** Modern turbines rotate at much lower speeds and thus reduce the noise level.

**Better power grid integration:** Modern turbines offer much better grid integration since they use a connection method similar to conventional power plants and also achieve a higher utilisation degree.

**Grid compliance:** New machines would be able to fulfil the grid code requirements.

**Reactive power:** New Machines will consume less reactive power.

**Endnote**

The repowering potential and its benefits offer an attractive opportunity to improve the quality of power generation and efficiency of the wind sites. The right policy framework and incentives could significantly change the landscape of aging wind farms in India.

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<table>
<thead>
<tr>
<th>Table 2. Comparison of existing scenario and RePowering proposal</th>
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<tr>
<td><strong>Parameter</strong></td>
</tr>
<tr>
<td>Capacity</td>
</tr>
<tr>
<td>Annual estimated generation</td>
</tr>
<tr>
<td>PLF</td>
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did you know

❖ There is evidence that wind energy was used to propel boats along the Nile as early as 5000 BC. ([www.uk-energy-saving.com](http://www.uk-energy-saving.com))

❖ Wind energy is a form of solar energy. Winds are caused by the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and rotation of the earth. Wind flow patterns are modified by the earth's terrain, bodies of water, and vegetative cover. This wind flow, or motion energy, when 'harvested' by the wind turbines, or modern-day windmills, can be used to generate electricity. ([www.esru.strath.ac.uk](http://www.esru.strath.ac.uk))

❖ Wind energy theory was discovered/formalised in 1919 by German physicist Albert Betz and published in his book Wind-Energie. ([http://interestingenergyfacts.blogspot.com](http://interestingenergyfacts.blogspot.com))

❖ The power from the wind is proportional to the cube of wind velocity, air density and the area swept out by the blades. Therefore the faster the air transfer and the large the blades the greater the amount of energy that can be converted. ([www.cyberphysics.pwp.blueyonder.co.uk](http://www.cyberphysics.pwp.blueyonder.co.uk))

❖ Turbines are designed to last for 20 years and after being decommissioned (taken down) around 80 per cent of the turbine is recyclable. ([www.theclean.org](http://www.theclean.org))

❖ The opposition usually met for a proposed wind farm development comes down to the ‘NIMBY’ factor (not in my backyard). ([www.energy-facts.com](http://www.energy-facts.com))

from india

❖ Maximum installation in a State: 5904 MW, Tamil Nadu (as on 31 March 2011)

❖ Maximum estimated gross wind power potential in a State: 10609 MW, Gujarat

❖ Maximum number of Wind Monitoring Stations installed in a State: 112, Maharashtra

❖ Highest capacity addition in a financial year: 2349 MW during the year 2010-11

❖ Highest capacity addition in a financial year in a State: 997 MW during the year 2010-11, Tamil Nadu

❖ First Wind Monitoring Station in India: Sultanpet, Tamil Nadu, established on 28 July 1986

www.windpowerindia.com

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