



Turbine transformation – a new lease of life for ageing wind turbines

While fresh-out-of-the-box wind turbines have their place in the wind power mix, there's also (a growing) demand for reinvigorated assets of a certain age. We explore the re-engineering market.

As the wind energy market has matured, assets are ageing and many turbines are passing the end of their warranty period. At the same time, operators in advanced markets like Denmark and Germany are moving towards more powerful and sophisticated equipment rated at two megawatts (MW) and upwards.

The result is that there are few turbines on offer at 1.5 megawatts and below. Plus, as the market has matured, larger manufacturers have acquired their smaller competitors and streamlined their offer, meaning that turbine models made by OEMs that have since been acquired are no longer actively supported.

Turbine technology itself has also moved on. Early turbines were two-speed models, with low speed and high speed options for different wind conditions. Today's turbines are fitted with power electronics and variable speed mechanisms that ramp up production as the wind blows. These enable operators to maximize production throughout the range of light, medium and strong winds.

Together these factors have led to a new market for refurbishment of turbines that are out of warranty, either for operators who want to improve performance or for a growing second hand market for wind turbines.

This market is actually substantial. I estimate that there are more than 30,000 old-style turbines in the world today that don't have power electronics. And their warranty periods have either ended already or are close to expiring.

Operators therefore face a range of possibilities. They can choose to extend



their warranties, refurbish turbines on-site or they can replace them with the latest technology. If they opt for replacement they can offset the cost by selling their aging turbines on what is now a fast-emerging second hand market.

Who's buying?

Small operators in developing markets such as northern UK, southern Italy, Eastern Europe, Africa, South America and various island territories are now taking the opportunity to buy aging second hand turbines. But while they are second hand, they have been mechanically and electrically refurbished to achieve greater performance and meet the demands of new grid codes.

Wind generation in these regions tends to be small-scale and grid-connected, often with one turbine, or three at the most. Operators are often either farmers looking to boost their income or industrial customers who use the turbines to reduce the fuel consumption and maintenance costs on diesel generators and clean up their energy sources.

The typical installer might be looking to benefit from a feed in tariff (FIT) that offers the best return on investment for installations rated at 200 – 250 kW. For example, a FIT for a farmer in Ireland might pay 300 Euros per MWh if producing at 250 kW but by stepping up to production at 300 kW then the FIT drops to less than 100 Euros per MWh.

This has led to strong demand for low-cost turbines rated at around 250 kW, a segment



that is not well served by the major turbine manufacturers, whose focus is now on multi-megawatt turbines for large wind farms in mature markets.

The need to upgrade

While aging turbines are available at small scale and there is clearly a demand, grid code requirements usually mean that it's not possible to take a 15-year-old turbine from one location and install it somewhere else.

One solution is to include the turbine as part of a system that includes capacitor banks and other systems such as a STATCOM. However, the drawback of this is that it is best suited to an installation with multiple turbines as part of a wind farm, rather than an individual turbine.

Recognising this, at ABB we identified the opportunity of re-engineering aging wind turbines rated at up to 1.5 MW. So from our centre of excellence in Barcelona, Spain, we have introduced a turbine refurbishment service. The objective of this service is to refurbish turbines electrically and mechanically to bring them up to modern standards.

With turbines being dismantled in countries like Germany and Denmark and for sale in developing countries in Africa and South America, Spain is a sweet spot for retrofitting turbines on their way to their final destination. In addition, we already had a facility with wind industry expertise in Barcelona and so it was a logical step to offer the new service from there.



There is growing demand for the service from resellers, who purchase aging turbines and want to refurbish and upgrade them to meet the demands of new grid codes that did not exist 10 years ago.

There is also an in-situ service available to operators, helping them make improvements to existing turbines that improve a wind farm's ROI by correcting operational issues or by gaining more production from individual turbines.

Three key points of electrical retrofit

Electrical retrofit is designed to bring older, but generally mechanically sound turbines up to modern operating standards. The service has three key points.

The first of these is reducing the rating of turbines to meet the requirements of the customer's FIT. During refurbishment, turbines can be limited from 400 kW to 250 or 200 kW while operating in the optimum manner. There is in fact huge interest in limiting turbines to 250 kW.

Second, full power converters are installed at the bottom of the tower, either in a switchgear room or a separate kiosk. Full



power converters are based on sophisticated power electronics equipment that meet the demands of the new grid codes, minimising curtailment and making the most of investment.

Previous generations of turbine used doubly fed converter technology, where one third of power passed through a converter but this can lead to problems with grid connectivity and reliability. Passing all of the power through a full power converter overcomes this and ensures that the output meets the grid code.

Third, there is usually a need for some electrical modifications to the generator itself, such as to transform an old two-speed pitch controlled turbine to a variable ramping up mechanism.

This requires modification of the generator, either in the form of re-winding to remove the lower speed, or installation of a brand new generator. During this part of the refurbishment service, care is taken to avoid changing the dimensions or adding any extra weight to the nacelle. This avoids the need for structural recertification, which is required to ensure that turbines are able to withstand the physical loads on the

blades, nacelle and tower imposed by the wind.

With full power converter the operator will gain additional production by moving to a variable speed mechanism, meaning they'll make the most of the wind across its range of speeds. This leads to greater overall levels of production and higher revenues.

Savings and availability

Refurbishment has two major benefits. The first of these is cost related. A refurbished second hand turbine can be acquired at around half the price of a brand new equivalent.

The second benefit is availability as a refurbished turbine can be available with a lead time of just a few months. So refurbishing turbines adds value, offers affordable and improved turbines and provides the means for clean, accessible electricity and better living standards. It is especially attractive in developing countries where it is not possible to get the investment required for brand new plant. ■

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