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The winds of change

Windfarm operators are waking up to the benefits of big data analytics software to boost output and cut maintenance costs. **Tanya Blake** reports

In 2015, wind energy provided 11% of our electricity, amounting to 34.01TWh – enough to power more than 8 million homes. But just how much energy are windfarms having to waste owing to inefficient turbines, unpredictable data or an overburdened, ageing grid?

Such issues have seen the Chinese government ask six of its local authorities to stop approving conventional wind energy projects until they have better infrastructure to transmit and use the power. The country already has nearly 71GW of installed wind turbines but the government found that, in the northern regions, a total of 3.39TWh of wind power, around 15%, was wasted in 2015 because of "low utilisation efficiency".

To overcome these issues and get the best performance out of their assets, operators are turning to big data analytics software to create the next breed of smart, efficient windfarms.

Team effort

Envision, the second-largest wind-turbine manufacturer in China, recently acquired BazeField, a Norwegian smart windfarm technology company. Felix Zhang, executive director of Envision, says that digitalisation of energy systems will mean greater control and improved efficiency "at every juncture," with Envision and BazeField looking to be at the forefront of the transition.

BazeField began developing its scaleable windfarm management system based on its experience of managing big data for industries including oil and gas. Chief executive Sigurd Juvik says: "We worked with a windfarm owner in 2009, and we recognised that this industry was pretty much in the Stone Age when it came to utilising data to improve operation of assets and in the development of the technology."

One driver for this is how the wind industry was structured from a contractual perspective, explains Juvik. "In the wind industry you both buy the asset from the OEM and then you let it entirely influence how you operate the asset, instead of putting too much effort into how you maintain the asset and produce the best performance."

Spot bottlenecks

Juvik adds: "There has been a radical change in the business. Now, for the first time, systems like BazeField can be used to look for bottlenecks using smart algorithms. There are ways you can work with the BazeField system to improve across the whole operation."

The BazeField system includes turnkey interfaces for turbine SCADA, grid, meteorological forecasts and trading systems. It also includes a suite of monitoring, analysis and operations management applications, key performance indicator measurements, and reports needed for supporting the operation and maintenance of

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windfarms, helping to free up workers and improve data management for analysts.

Tying in all of this data with condition monitoring sensors on the individual wind turbines aims to reduce downtime, improve availability and increase the efficiency of assets.

Juvik says: "One of the very low-hanging fruits is the easiness of detecting underperformance and lack of agreed availability when you can see all of your assets digitally in one place. A system working with big data will give you an answer of where you are losing your money or megawatts. Then you can start with more advanced things such as trend recognition and working better with the grid."

BazeField has worked with windfarm operators in Ireland that deal with major grid constraints and use the software to predict and work within them. Juvik says: "In Ireland you've got problems with grid containment and constraints which mean that you cannot put as much energy into the grid as you can actually produce. So if you have smart tools to help with predicting and managing this, you earn more money."

The system is scaleable from a single farm to large multi-site portfolios. Data can be accessed on a flexible dashboard design and accessed while on the move on Apple and Android devices as well as Windows Mobile.

BazeField software is in use by big players in the industry, such as Statoil, and the company provides turnkey support to market leaders including Vestas, Siemens and GE. BazeField wants to extend its global reach following its acquisition and grow from the 4GW of installed wind-power capacity that currently uses its system.

"We want to become a market leader by 2020 and put software in the centre of the smart energy sector," says Juvik.

Monitoring big data

OSIsoft is a big player in this arena, with clients in the wind industry, including E.On, EDF and Dong, using its PI system that monitors and analyses big data.

Chris Crosby, industry expert on renewables and nuclear power at OSIsoft, says: "It was classically used as a monitoring system so we are expert at interfacing to different sources of data, from control systems, SCADA systems, PLCs, other databases, and any sensors throwing out time-series data."

The company has built more than 450 standard interfaces to devices that generate data and can create various visualisation tools, from a simple key performance indicator-style dashboard to a very sophisticated board that looks like a control system. Like BazeField, the data can be accessed on any mobile device, making it suitable for engineers travelling between windfarms.

Making savings

While Crosby says that there are many companies in the sector that still manually gather data such as vibration readings, he is also seeing a more intermediate and advanced use of big data software among OSIsoft's customers to optimise their operations.

Xcel, a major US electricity and natural gas company, built an application and worked with the OSIsoft energy lab to find the data streams it needed from its turbines. It combined that with data streams from the weather to be able to predict and forecast the availability of the wind-turbine generators, the demand in the market and market prices. In being able to do that more accurately, precisely and with a higher degree of confidence, the company calculated that over the past six years it had saved $46 million.

Crosby says savings came as Xcel was now confident in its forecast ability and no longer needed to keep its gas turbines and coal plants

3.39 TWh

China has **71GW of wind turbines** but in the northern regions **3.39TWh** of wind power was wasted in 2015 because of **low efficiency**

DID YOU KNOW? **COST** IMPACT

A **recent survey** commissioned by enterprise software company SAP polled more than **100 senior executives** in the UK manufacturing sector. It found that more than half (51%) saw cost reductions as a major potential impact of **Internet of Things technologies**. But almost a fifth (19%) expected no investment in related technologies this year.

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running on standby.

Dong Energy has used the PI system to not only optimise its windfarm operations, but its business too. "They put more sensors on these offshore turbines, collected more data, and brought that back onshore into software from Esri, who we have a partnership with," says Crosby.

The realtime data was brought into Esri's visualisation tools so that not only engineers but also those in management could understand the health of the assets.

The data was also integrated into Dong's asset management system. So if, for example, a vibration reading falls beyond a safe set limit for an extended period, an alert is sent to the asset management work order system and a work order is automatically generated. The software can also automatically order labour, parts and supplies.

Fewer maintenance trips

Crosby says: "They automated that whole loop. It provided the visualisation to the leadership. What they claim is that by doing this they should be able to have two ships instead of four travelling to the wind-turbine generator a year, which could save them €20 million a year."

This kind of automated, decentralised intelligence is what Crosby sees as the next step for applying Internet of Things technology in windfarms. "Putting more sensors and intelligence out there means that one wind turbine could sense it has an oil temperature problem and can schedule itself for maintenance. Meanwhile, the one next door realises it's under-producing and alerts someone to the problem," says Crosby.

"The theory is that that kind of intelligence and control moves back to the single wind turbine instead of having to do all that centrally."

And, as price pressures impact upon the renewable energy sector, this kind of optimisation and automation will only seem more attractive to windfarm operators.

Crosby says: "Collect all the data you can, as automatically as possible, and carry out as much analysis as possible. Leave the engineers to do higher-level analysis. Don't have your engineers chasing data and doing basic analysis – have the system do all that for you." ■

Innovation weathers the storm and cuts costs

Envision Energy has developed a 3.6MW two-blade offshore wind turbine that uses partial pitch and carbon-fibre main shaft technologies. Each 62m E128 blade consists of a 20m inner section with a fixed blade angle called an extender and a pitchable 42m outer blade. Under high wind conditions the partial pitch blades will experience different counteracting load-vector directions, reducing extreme loads and the need for weightier shafts and foundations.

Envision says that this means the E128 is able to withstand extreme weather conditions, even typhoons. In addition, using carbon fibre and just two blades reduces construction cost for offshore use by more than 20%. The prototype has been successfully running for more than two years in Denmark.

Meanwhile, Iowa State University engineers have developed Hexcrete, a concept using precast concrete technology to build taller wind-turbine towers. The Hexcrete concept features precast panels and columns made from high-strength and ultra-high-performance concrete. The columns and panels are tied together by cables to form hexagon-shaped cells that can be stacked vertically to form towers as tall as 140m.

Sri Sritharan, leader of the Hexcrete project, says it has many advantages over steel towers, including ease of transport and assembly, and the ability to go beyond today's standard of 80m and therefore reach faster and steadier winds at heights of 100m and above.

Following a recent presentation to industry, the university hopes to build a full-scale tower in a bid to commercialise the technology.

Alternative turbines are also being tested by major players. EDF's vertical-axis floating turbine has been created for waters up to 200m deep. Called VertiWind, the turbines are able to be installed in particularly windy areas out at sea using water-filled buoys and cables that attach them to an underwater anchor. EDF says the system is more profitable and overcomes issues in the Mediterranean where the winds are strong but the seabed drops away quickly to a great depth close to the coast, making it impossible to use standard wind-turbine foundations.

A farm of 13 turbines is soon to be installed off the coast of Fos-sur-Mer in southern France and is expected to produce 26MW.