From performance management to improvement

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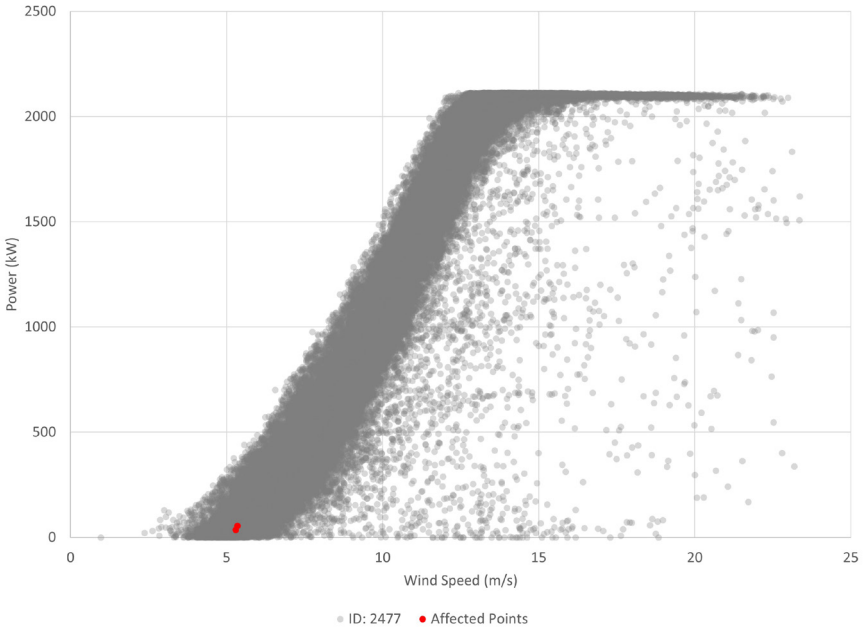
To support the green energy transition, it's time for the wind industry to rethink what Asset Performance Management means, and move beyond visualization and monitoring towards performance improvement.

Asset reporting, data visualization and performance monitoring have become standard for wind plant owners, asset managers and financial stakeholders, to ensure turbines are running safely and meeting performance expectations. Asset performance management solutions (APMs) began to gain popularity about a decade ago, with the goal of monitoring and reporting wind plant KPIs like downtime and availability. This was driven in part by investor reporting requirements, as well as for tracking availability guarantees from OEMs. Many larger wind companies have invested substantial resources in developing custom software and dashboards to manage their wind assets, with varying success.

APMs have garnered a lot of attention from investors, from private equity and venture capital, in addition to strategic players already in the wind market seeking a shorter path to bespoke analytics programs. Despite the perceived need for an APM from across the market, they have often failed to detect issues that impact turbine reliability and efficiency, ultimately failing to improve asset performance.

Monitoring Is no longer enough

Market conditions over the past few years have not been kind to the wind energy industry. Pandemic-induced supply chain



Turbine is continuously trying to start, but fails because it does not reach a sufficient generator speed in time. Over 100,000 startups aborted per year at the farm, but no significant power curve behavior was observed

delays have pushed back the commissioning of new wind plants around the world. Global permitting policies have caused even further delays, creating a steeper climb to reach decarbonization goals. According to a recent report by American Clean Power, over 8GW of clean energy capacity that was expected to come online in the US during the second quarter of 2022 was delayed.

OEMs, meanwhile, have nearly universally reported declining financial performance over the past several quarters, due in part to delivery delays and increases in commodity prices. And while the industry and governments seem laser-focused on expanding wind capacity worldwide, existing assets continue to deliver lower-than-expected returns for investors.

According to analysis by WindESCo over the past several years, there is a five-year upside potential of $8M-$10M[1] per gigawatt of installed capacity on operating assets from issues that can be detected using high speed SCADA data.

Why current implementations fall short

Today's APM solutions provide a unified view to asset owners and investors for reporting. Ten-minute data that is generally used by APMs is sufficient for understanding turbine and fleet output over time and for internal and external reports. APMs fall short, however, on actually detecting issues that lead to turbine underperformance and in fixing those issues.

Stakeholders in wind energy are seeking solutions to improve the margins of their portfolios in this increasingly competitive landscape. Fortunately, there are opportunities to capture turbine performance, improve reliability and increase margins without expensive retrofits. Instead, asset owners and managers can leverage their turbines' high speed data to increase turbine output by 1-2% through solutions like WindESCo's Find, Fix, Measure.

Identifying issues that impact margins

WindESCo Find, Fix, Measure goes beyond monitoring turbine performance to uncover actionable issues, recommend fixes, and measure improvements over time. Find, Fix, Measure continuously detects 60+ anomalies in turbines at scale. Below are examples of some of the most common issues detected by Find, Fix, Measure.

Non-optimal cut in behavior

WindESCo has observed turbines that do not cut-in at appropriate wind speeds. Turbines may attempt to start up thousands of times, with only one successful start. Non-optimal cut in behavior creates problems when wind speeds are sufficient to maintain operation, but the turbine does not start, missing potential energy production. This cannot be seen in 10 minute data, because no significant power curve behavior is observed due to the turbine not producing power.

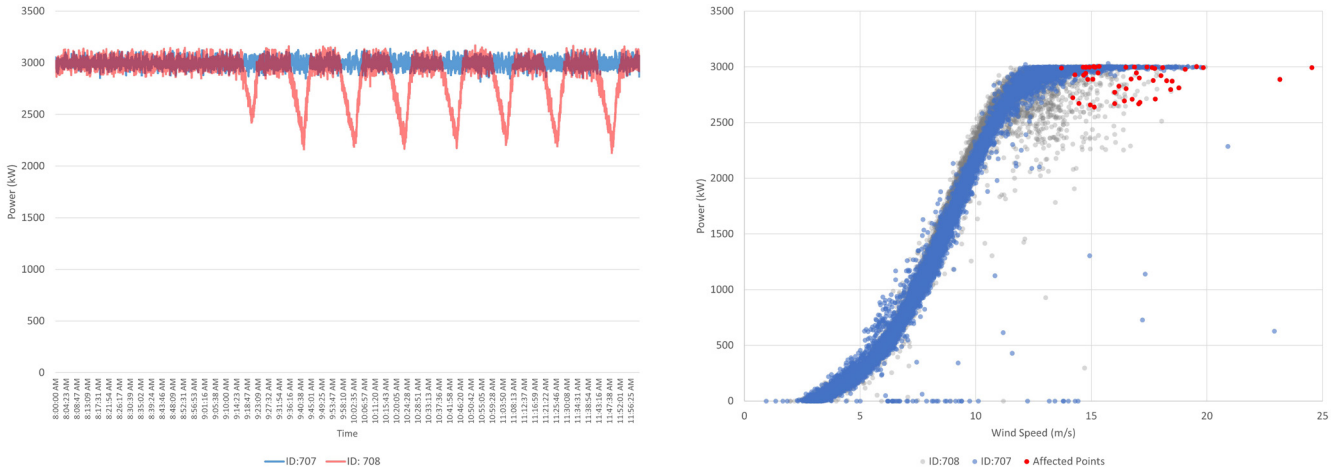
WindESCo identifies regions of failed or non-optimal cut-in by comparing wind speed, pitch behavior, and quantifies the AEP opportunities. If the AEP opportunities are significant enough to be addressed, WindESCo recommends next steps to optimize the cut-in behavior

Rated power oscillation

A given turbine is exhibiting fluctuations, or oscillations, in the rated power signal. These fluctuations may be periodic oscillations, or they may be changes in the rated power, unrelated to wind speed changes, on the order of 10s of seconds or faster.

If a turbine is operating below rated power, and it is not expected, this will directly impact turbine output. As noted in Image 3, a turbine can exhibit significant and frequent reductions in power, but the power curve (right) does not highlight the magnitude of these events, which are missed in the 10-minute data.

1 Median 5-year present value using a discount rate of 9%



Turbine exhibits significant and frequent reductions in power, but the power curve does not highlight the magnitude of these events

Static yaw misalignment

This occurs when the measured yaw error is 0°, but the turbine is not pointing directly into the wind. This happens because the turbine cannot see the difference between measurement and reality, making the misalignment invisible to the turbine controller. Yaw misalignment cannot be detected using 10-minute data typically used in power curves and displayed by APMs.

To illustrate this, Image 1 shows the power curves of two turbines with similar power curves, one represented by blue points, the other by red. The turbine represented by red has significant yaw misalignment that is not detectable in the 10-minute data. The wind plant operations and asset management teams would have no way of detecting this missed AEP opportunity from the power curve alone. In this example, the impact of yaw misalignment was 1.1% AEP for the turbine and 0.6% AEP for the farm. Once corrected, this resulted in an increase of $4,300/Yr for the turbine, and $320,000/Yr for the wind plant.

These examples represent just three of the most issues that impact turbine performance. WindESCo's automated solutions check for more than 60 anomalies, with more added each month. And unlike pure AI solutions, WindESCo's tech stack is backed by over a hundred years of domain expertise, with every issue highlighted to customers substantiated by WindESCo experts. This ensures the validity of the finding, improves the technology over time and saves operations and asset management teams from hundreds of hours of sifting through immaterial data.

Prioritizing improvement opportunities

Wind teams are up against long lists of projects to keep their assets running and their teams safe, pushing AEP improvement programs lower on the list of priorities. WindESCo helps teams put reliability, availability and productivity projects into action by defining additional revenue opportunities for various issues. In order to get the most out of the high speed data's detection, performance issues must be prioritized by comparing the amount of increase in AEP to the likelihood of quickly fixing the issue.

For example, static yaw misalignment requires only parameter changes in the controller to recover lost AEP and can be handled immediately. Adjustments to turbine parameters to address seasonal wind changes can be planned for in advance. Issues that require a trip up tower can be scheduled with other regular maintenance over time to best utilize farm resources. WindESCo Find, Fix, Measure not only detects turbine issues, but also ranks them by AEP opportunity and the level of effort involved in completing the fix to help create prioritization.

Conclusion

While data visualization has become a standard tool for asset performance management, many commercial and built solutions fall short of enabling teams to perform evidence-based actions that improve the overall financial health of a wind fleet over its lifetime.

Through advanced analytics, expert-backed AI and constant improvement, WindESCo Find, Fix, Measure provides continuous monitoring of high-speed data that not only monitors turbine performance, but helps teams prioritize fixes that increase the availability, reliability and productivity of wind assets. When applied across a fleet, WindESCo Find, Fix, measure can deliver between $8-10M in present value over five years per gigawatt of capacity under subscription.

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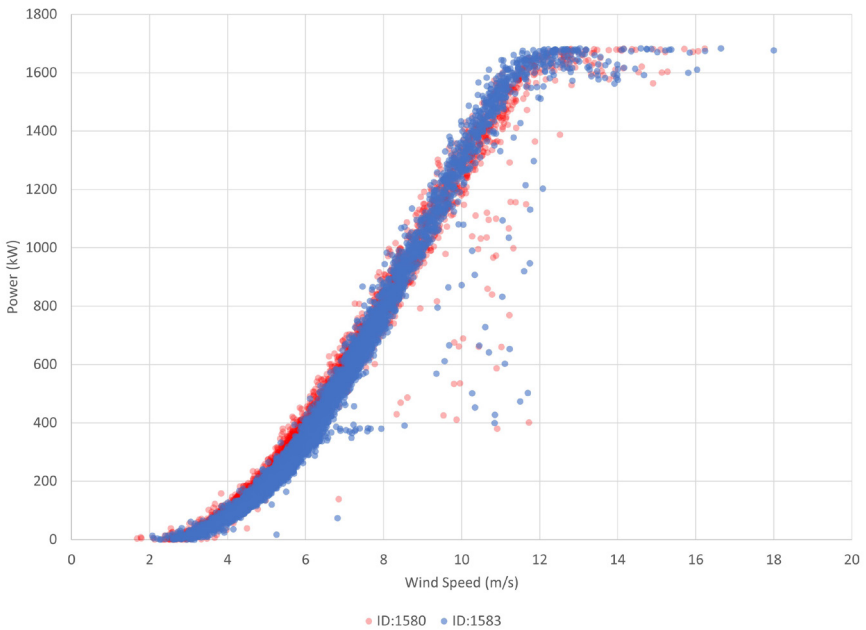

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