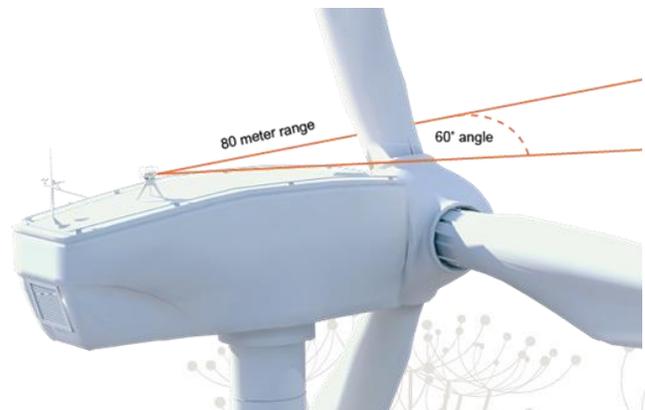


Use latest Technology to improve Performance and save Costs!

Meventus applies a set of proven and new methodologies to both improve performance and reduce long term maintenance costs for your wind farm

Improving a wind farm's performance begins with assessing the current operation, as it is important to understand what is occurring in the park, and what any potential problems are before developing a strategy to improve performance. Every park is different, so simply implementing a post-construction product that improved a similar park may not produce the desired results.

Performance improvement using a nacelle mounted Lidar:



Our preferred approach is to start with a **Basic Data Analysis** on the available park data (SCADA and any wind measurements). One can generally derive a good understanding of the park's performance using this data, including identifying problem turbines.

Should the performance assessment confirm there is underperformance or problematic turbines, an improvement strategy will be implemented based on the specific needs. Some examples of improvement measures include **Ground Lidar Measurements** to create a reference data set and further understand the site conditions and a **Nacelle Lidar Campaign** on selected turbines to perform various improvement activities such as yaw angle alignment, Nacelle Transfer Function (NTF) adjustment or static sector management as applicable depending on the results from the root cause analysis.

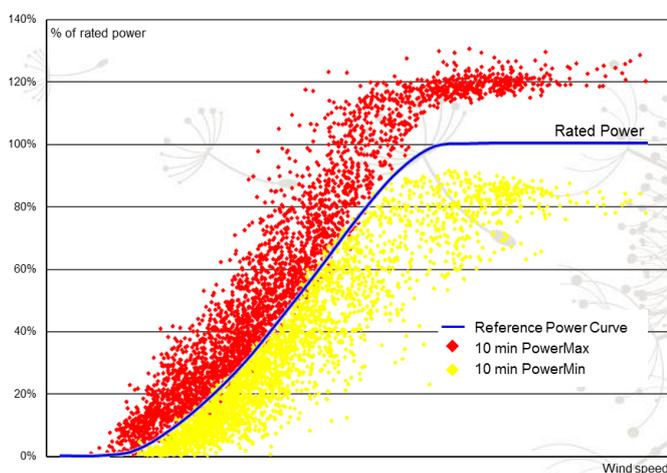
Meventus' cooperation with both lidar providers and control system developers enables us to implement **Dynamic Yaw & Pitch Control** as a retrofit solution for the most common turbine models. This permanent switch to a pro-active control mechanism through upstream lidar input compared to a reactive anemometer input from behind the rotor not only allows for smart AEP improvements, but also for significant fatigue load reductions and eventual life cycle maintenance cost reductions.

Meventus' approach to Wind Farm Performance Improvement (exemplary):

Phase	Activities	Benefits	Duration
Basic Data Analysis	<ul style="list-style-type: none"> • SCADA data- and other wind measurement analysis • Simple power curve assessment 	<ul style="list-style-type: none"> • Identify problematic turbines • Generic performance assessment 	~ 2-3 weeks
Ground Lidar Measurement	<ul style="list-style-type: none"> • Create referenced data base • Verify/adjust Nacelle Transfer Functions (NTF) • Measure wind speed, direction & turbulence 	<ul style="list-style-type: none"> • Trustworthy real time reference data base • Low cost to move to get several data sets 	~ 16-24 weeks
Nacelle Lidar Campaign	<ul style="list-style-type: none"> • Measure wind speed, direction & turbulence for specific WTGs • Root cause analysis • Verify/adjust NTF • Correct yaw angle misalignment • Static sector management 	<ul style="list-style-type: none"> • AEP increase: ~ 2-6% • Life cycle maintenance cost reduction: ~ 1-5% 	~ 12 weeks
Dynamic Yaw & Pitch Control	<ul style="list-style-type: none"> • Automated interface between nacelle lidar and pitch/yaw control • Pro-active upstream input instead of re-active from behind the rotor • Dynamic yaw angle alignment, pitch control and sector management 	<ul style="list-style-type: none"> • AEP increase: ~ 5-10% • Life cycle maintenance cost reduction: ~ 5-20% 	5 years or longer

To demonstrate our confidence in our Wind Farm Performance Improvement capabilities and to minimise your financial risk with our engagement, Meventus offers this support on a success fee basis, where our fees will consist of a relatively small, fixed down payment and a certain share of the realized savings over the duration of the campaign.

Maximum and Minimum Instantaneous Power within 10 Minute Scans:



- Blade pitching is a reactive action to a wind speed increase, thus delayed, and the power level can overshoot the rated level (red dots)
- Once the blades have been pitched to regulate the maximum power and a reduction in wind speed occurs, the power will drop to a level that is below the production potential of the turbine (yellow dots) resulting in an energy loss before the blades are pitched to the best angle,
- Proactive pitching with a nacelle lidar can reduce losses and fatigue loads

Please contact Meventus for a customized wind farm performance improvement proposal, client references or different fee models.



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