



POWER CURVE

Increase your wind turbine annual energy production with a Power Curve upgrade solution.



Vortex generator technology

INCREASE ANNUAL ENERGY PRODUCTION BY 2-6%



The Power Curve technology improves the efficiency of turbine rotors by mitigating poor blade aerodynamics in two distinct areas.

INTRODUCTION

THE BIG PICTURE

Renewable energy is central to the preservation of our planet. Unlike other energy sources, renewables will never run out and have little to no impact on our immediate environment.

Wind energy is among the most prominent of renewables. As with most other modern forms of energy, however, erecting and operating wind turbines is a very costly business. So, being able to maximize returns is crucial to turbine owners.

A major challenge today is declining energy production of aging equipment. Turbine maintenance becomes even more important, as existing wind projects must remain profitable and competitive for the green transition to progress.

CONSEQUENCES OF BLADE DEGRADATION

There can be many sources of declining turbine production, and dirty and eroded blades are one of the well known causes.

As blades erode or become dirty, their aerodynamic efficiency diminishes. This is known as 'airflow separation' or 'aerodynamic stall'.

The poorer the aerodynamics become, the less energy is converted from the wind into mechanical torque. The less torque is generated, the less power the turbine produces.

Studies show that even light erosion can significantly reduce the annual energy production of a given wind turbine.

NEAR THE ROOT

On the inner part of the blade, vortex generators are installed to improve inherently poor aerodynamics of thick airfoils.

TOWARDS THE TIP

On the outer part of the blade, vortex generators are installed to restore lift and AEP lost to surface erosion.



Near the root, blades have poor aerodynamic properties, as the blade geometry and structure needs to transition from the outer aerodynamically efficient profiles to the inner circular load-carrying structure. The result is thick airfoils prone to airflow separation.

Towards the tip, aging blades may suffer from surface roughness due to the wear and tear that comes with traveling at high speeds. The resulting erosion weakens the boundary layer, leading to premature airflow separation.

In both areas, Power Curve vortex generators are installed to create vortices that energize the boundary layer, enabling the airflow to stay along the blade surface. This postpones the separation point, and lift forces are reinstated, improving turbine AEP performance.

Power Curve Benefits

OPTIMIZING WIND ENERGY PROJECTS, BLADE BY BLADE

OPTIMIZE BLADE AERODYNAMICS

No turbine can endure the elements through years of operation without some wear and tear. Our vortex generator technology reinstalls lift forces lost to blade wear.

INCREASE TURBINE AEP

Power Curve vortex generators improve the efficiency of the turbine by vitalizing the airflow across the blades. As a result, annual energy production is significantly improved.

STABILIZE AERODYNAMIC LOADS

Blade erosion leads to premature airflow separation, giving rise to increased dynamic stall loads. By controlling the airflow with vortex generators, these loads are stabilized and minimized.

REDUCE AERODYNAMIC NOISE

Premature airflow separation causes the turbine to generate aerodynamic separation noise. Our vortex generators help eliminate aerodynamic noise by stabilizing the airflow.

VALIDATED BY DTU WIND DEPARTMENT

The Power Curve technology has been thoroughly tested and validated by the Technical University of Denmark (DTU), a world-leading institute in wind energy research.

Vortex generator solutions

THREE UPGRADE OPTIONS – YOUR CHOICE

1

TURNKEY

One-stop-shop retrofitting

We take care of the complete upgrade process from turbine assessment to VG design, manufacturing, installation and performance reports.

Recommended for most global operators.

2

KIT

Power Curve upgrade kit

Engineered per project, the pre-packed upgrade kit comes complete with vortex generators, materials, tools and installation specification.

For operators with in-house installation capacity.

3

OEM

Power Curve VG panels

The OEM package includes simply Power Curve vortex generator panels designed and specified by either the client or by us.

For OEMs with in-house design and installation capacity.



Our solutions are specifically designed to improve performance both on new wind turbines and on turbines that no longer generate their initial electricity output due to blade wear.

With a Power Curve upgrade, you can expect an increase in turbine annual energy production of 2-6%, depending on the state of the blades and the location of turbines.



TESTIMONIAL

EURUS ENERGY AMERICA OPTS FOR ROLL-OUT

Eurus Energy America is upgrading their turbines at Combine Hills I and II with Power Curve vortex generators. The project follows successful test results, which showed an average increase in AEP of 3-3.5%.

Sites

Combine Hills I & II

Number of turbines

104

Turbine model

Mitsubishi MWT1000A

Predicted AEP increase

3-3.5%

FROM MEETING TO PERFORMANCE TESTING

Eurus Energy America (EEA) initially met with Power Curve at AWEA 2014, and subsequent talks led to an agreement to evaluate Power Curve’s potential for increasing the AEP of EEA’s largest wind project, Bull Creek Wind in Texas.

Vortex generators were installed in November 2015 by aerial truck on six turbines selected for the trial, each adjacent to a control turbine to serve as point of reference for comparison.

The test period ended December 2016, giving EEA and Power Curve 25 months of total data, including 12 months of SCADA measurements prior to the installation of vortex generators.

PROGNOSIS AND UPGRADE DECISION

EEA’s data analyses showed that the six power-upgraded turbines accumulated 3-3.5% more energy on average after the installation of vortex generators than their respective control turbines.

Following the results at Bull Creek, a contract was signed in late December 2016 for a full upgrade of all 104 turbines at EEA’s Combine Hills I and II wind projects in Oregon.

As an owner of renewable energy generation projects, obtaining an AEP increase in the range of 3-3.5% over the remaining lifetime of the assets is of significant value to EEA.

“Our evaluation of Power Curve’s technology demonstrates to us that it will allow our projects to produce more energy from the same wind resources.”

JOE STEVENS
VP of Operations and Asset Management
Eurus Energy America

“You always have to tread carefully when you’re trying to modify your equipment, but the results show that Power Curve vortex generators can indeed measurably improve the performance of the turbines.”

DARREN WEISS
Senior Performance Engineer Consultant
Eurus Energy America



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