

# FeatherEdge<sup>®</sup>

from Biome Renewables

## Quietly Powerful Serration Technology

One of the main issues faced by the wind industry is noise. Whether from a combination of factors like poor siting, regulatory regimes, or blade aerodynamics, the challenge of staying within noise limits is real, and even more acute in certain geographic regions.

Losses due to excess noise generated by wind turbine blades are damaging for operators. They involve curtailment requirements and additional operational rules which reduce revenue and profit margins. While a change of siting is not feasible for operation, changing the blade aeroacoustics is an option that can greatly benefit operators, regulators, and the local community.

Further, a solution for limiting noise on a turbine blade and avoiding curtailment can unlock improvements in the power curve through specific controller adjustments.



FeatherEdge deployed on an operational wind turbine

REDUCE

noise by up to

**3.4 dB(A)**

beyond standard  
STE serrations

(IEC ed.3, at source)

## The Challenge of Aero-Acoustics

The primary source of noise from wind turbines in operation occurs along the trailing edge of the outer third of the blade. Here, air mixes rapidly from the pressure and suction sides of the blade, creating a rapid pressure change in the boundary layer. Turbulence and associated noise from this area is known as turbulent boundary layer - trailing edge noise (TBL-TE noise), and is the primary cause for noise which humans can here below 1500Hz.

Biome Renewables developed its FeatherEdge serration technology specifically for these problems by unlocking the mysteries of the owl's silent flight.

## Far-Field Noise Reduction

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Recent IEC (ed.3) field validation has confirmed that FeatherEdge is now the clear market-leading solution for noise reduction, achieving more than 50% improvements to standard STE offerings. Utilizing industry-standard noise modeling techniques (ISO 9613-2), FeatherEdge has been independently shown to **deliver >5 dB(A) reduction in sound power level (at 800m) above and beyond** today's saw-tooth STE technology: unlocking a game-changing technology to the industry.

### Benefits for current operating assets:

- Control mode optimization reduces the level of production curtailment and increases the AEP of turbines, staying within permitted noise limits.
- Average curtailment seen in industry is 3-5% per 1dB.

### Benefits for developers include:

- Improved project ROI and economics
- Reduced project compliance risk
- Increased flexibility of turbine models including increased nameplate capacity
- Increased turbine density and reduced siting restrictions



## Installation and Certification

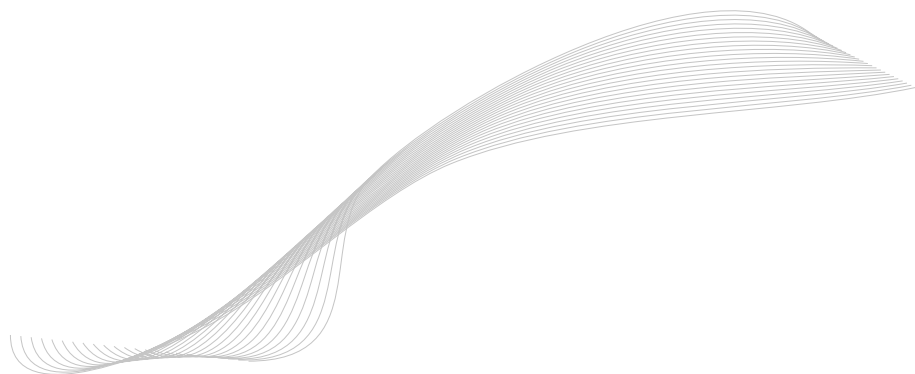
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FeatherEdge is installed using industry-standard procedures and materials, according to approved specifications. Global certification is in process this year with

**TUVNORD**

For **retrofits** on operating assets, Biome has a network of certified 3rd party installation teams that are equipped with platforms. Installation takes as little as 1 day per blade, and can be arranged as required.

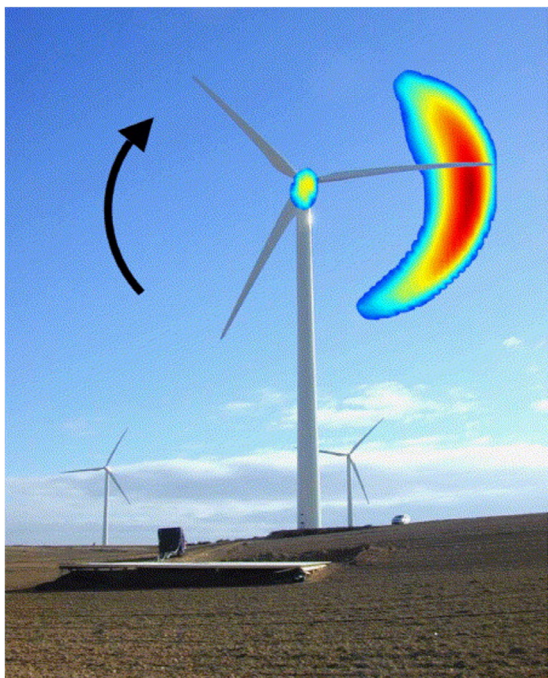
For **new turbine sales** and development, Biome works with leading OEMs. Please be in touch about these opportunities.



# Whisper Quiet

Inspired by the design of the owl's silent flight, Biome's FeatherEdge turbine blade serration technology has been designed to address the challenge of TBL-TE noise.

Its patented double-tip trailing edge serration design specifically directs air flow to mix at discrete locations, guiding how the pressure equalizes and reducing the turbulence that would otherwise form. By doing this in two controlled locations per radial blade section, FeatherEdge is able to impart a novel technique into the solution, reducing noise that would otherwise be noticeable to people in the vicinity.



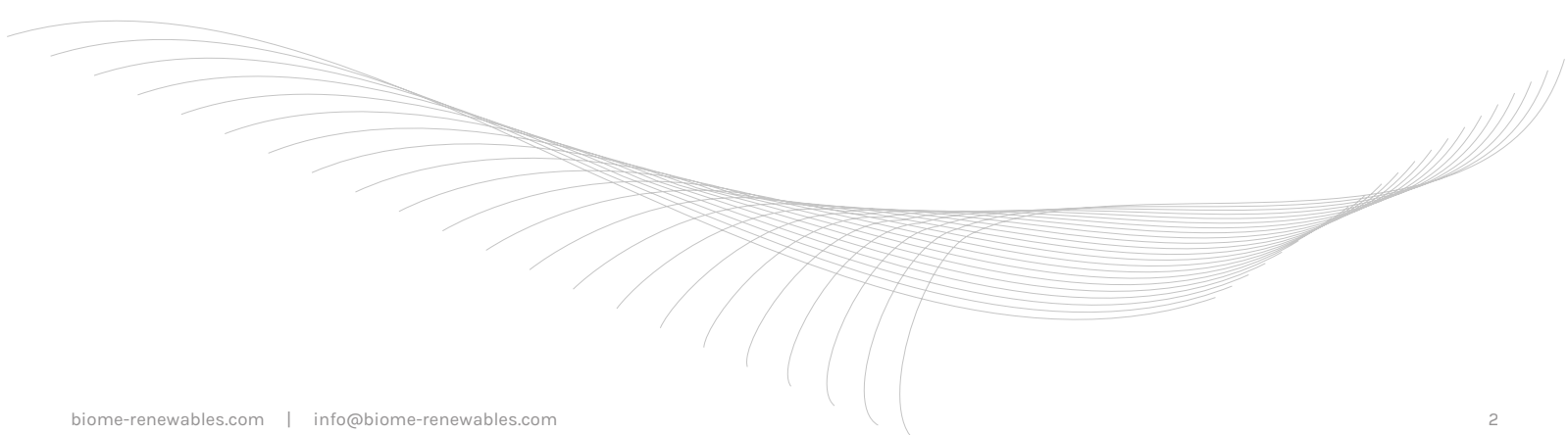
TBL-TE noise emissions from a turbine blade



The trailing fringe of an owl's feather has un-locked new potential for noise reduction.

The geometry of our serrations is tailor made for the unique geometry of every radial span, allowing for peak performance. Because of the precision achieved and in-depth knowledge that has been accumulated in-house, FeatherEdge is able to knock-out certain target frequency bands, further reducing noise. In this way, it's like noise-cancelling headphones for a wind turbine.

The resulting noise reductions silence current industry standards of 'saw-tooth' serrations.



## Improving the Power Curve

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The control strategy of a wind turbine determines its power curve. In regions around the knee of the power curve, noise emissions play a critical limiting factor in the turbine performance that is achievable. With the ability to reduce noise emissions, the control strategy can be enhanced to improve turbine performance by bringing under-performing turbines back to parity, or exceeding a previously established power curve.

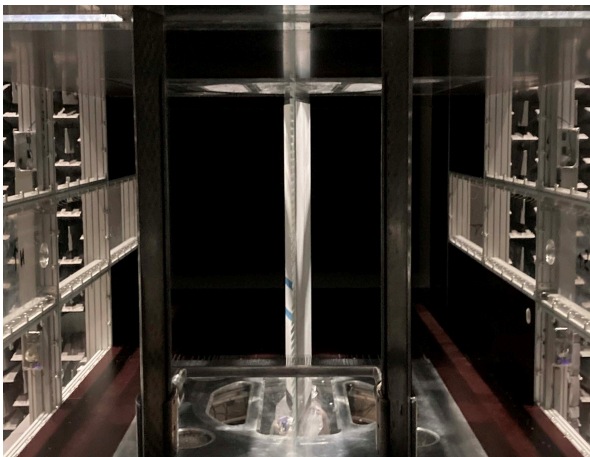
Both solutions deliver similar benefits: enhanced turbine performance, reliability in the field, enhanced financial reliability and increased revenue to wind farm operators. This, in turn, unlocks a further value proposition to the market: increased competitiveness in wind farm siting and enhanced reliability in wind farm profit modeling.



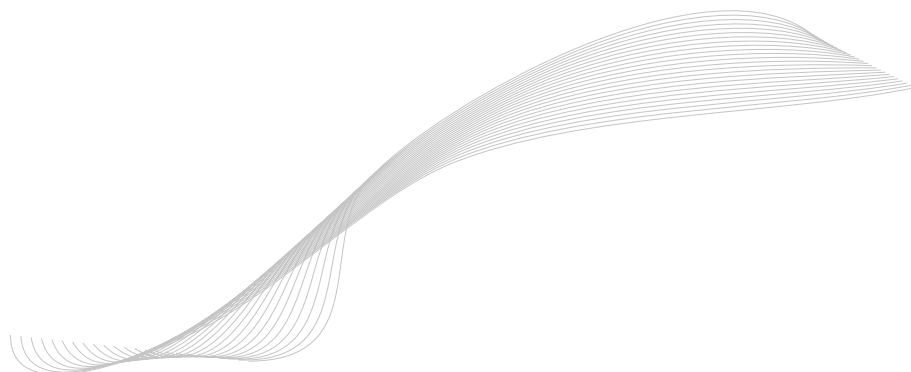
## Wind Tunnel Testing

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Biome has performed independent wind tunnel aeroacoustics assessments at Deutsche WindGuard GmbH at their acoustically-optimised large wind tunnel in Bremerhaven, Germany, and at DTU's Poul le Cour wind tunnel, one of the largest and most advanced in the world. These tunnels offers high wind speeds at low levels of turbulence, together with the most advanced drive and control techniques for ideal conditions for acoustic research and development and have aided to refine the technology, ready for market deployment.



Wind tunnel testing at DTU



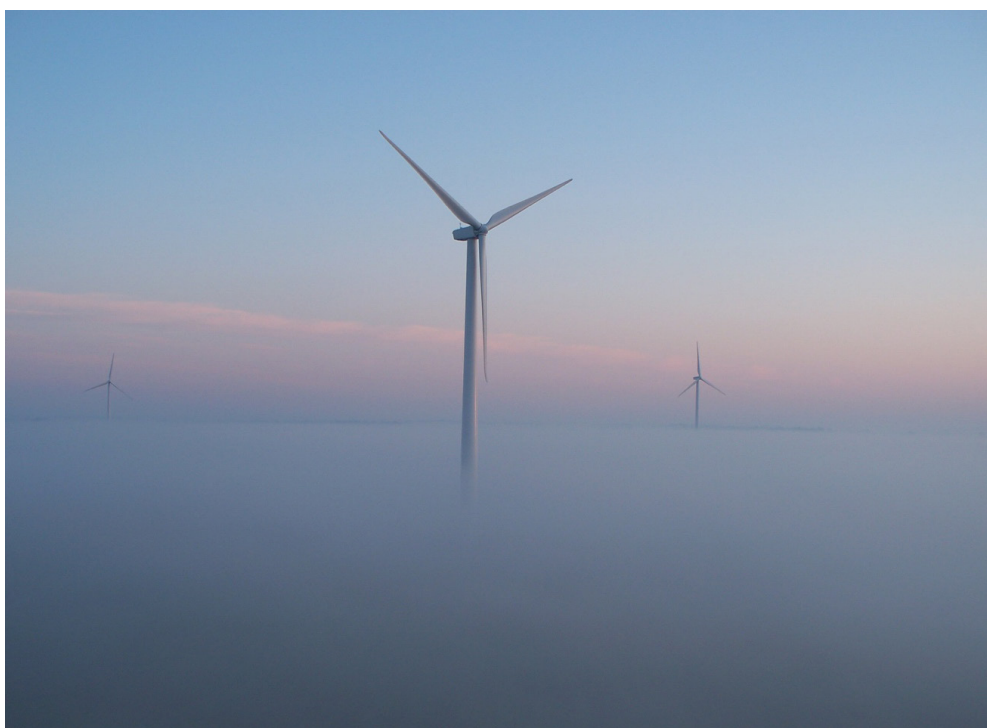
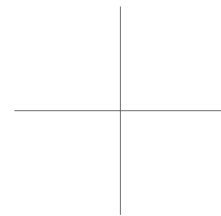
## Field Deployments

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Biome is currently undertaking numerous projects with customers in North America and Europe in both the development and operational phases.

**If you are interested in increasing your revenue, please get in touch to find out more.**

While the potential of our technology is starting to make waves, our goal is that owners and nearby residents shouldn't hear a thing.



At Biome Renewables, we are inspired by billions of years of evolution to create clean energy technologies that enable the Global Energy Transition. Leveraging intelligent nature-inspired solutions, we use engineering and evolved design to develop practical solutions across a wide range of problem areas. In this way, we unlock the potential of innovation to change the way the world generates power in the 21st century.

This is the power of **Evolved Design**.

