The blades of modern wind turbines have poor aerodynamic properties at the blade root, due to their geometry and operational limitations. The required length of modern blades requires a structurally circular blade root, with aerodynamically sub-optimal chord sections extending to the widest chord length. As such, turbines almost universally sacrifice energy capture at the centre of the rotor disc. Further, this lack of performance is driven by a pressure imbalance between outer efficient blade sections, which display high pressure, and central inboard sections nearest the root, which display low pressure. When the turbine is operating, this creates a suction effect towards the center of the rotor disk, and the phenomena of Rotor-Root-Suction (RRS), creating additional performance loss. Incoming flow separates off these un-optimized blade sections along their surface and creates turbulences and associated vibrations that drive increased loads and higher fatigue on critical turbine components.

This lost potential energy has been easy to justify in the industry on account of ever-expanding blade lengths, which drive higher capacity. However, when the turbine is operating properly, RRS accounts for the largest performance loss of the turbine - up to 10% of the swept area is effectively wasted. As turbines get larger, the problem area gets larger. As such, there is always the potential for aerodynamic improvement of their performance.

Most turbine retrofits only play at the margins. The PowerCone cuts to the heart of the issue in every way, redistributing wind to maximize performance.

The result is not just more power, but power from a place where no longer blade or smarter software can find it.
Your Aerodynamic Advantage

The PowerCone is a turbine retrofit that unlocks wind power’s true potential.

By addressing the aerodynamic problem of RRS using a novel twin-hybrid aerodynamic mechanism, the PowerCone channels wind away from the central region of the rotor, creating torque in the process, before directing this flow onto the leading edge and suction side of the rotor blade, promoting laminar flow. Through its refined geometry, inspired by the beak of the Kingfisher and the flow path of a falling maple seed, the PowerCone equalizes the pressure distribution across the entire rotor disk and reduces the impact of gusts, boosting performance for the whole turbine while reducing loads on the rotor.

More Power

You can’t create wind, but with the PowerCone, you can make the most of what's blowing.

Through our novel aerodynamic approach, flow at inner radial locations is moved radially outward upwind of the rotor, causing a slight increase in the effective wind speed. This allows the turbine to capture more of the free-stream air across the entire rotor disc and put it to better use, reducing turbine cut-in speeds by 0.8 m/s, shifting the entire power curve to the left. The effect is increased yield beyond the immediate location of the product and annual energy production increases of up to 10-13%. This elevated performance greatly reduces the levelized cost of wind power and improves wind farm economics.
Reduced Loads

The modular PowerCone is designed so its center of mass is in-line with the rotor, with its span occupying approximately 20% of the rotor diameter of the turbine, regardless of MW class. Working with DNV Turbine Engineering, the additional mass of 3-4% was determined to be negligible, while aerodynamic and fatigue loads on the rotor were modelled to be reduced. Through our patented aerodynamic design, flow separation on the rotor is nearly eliminated.

The position of the PowerCone is optimized based on the turbine type to create a slot between the device's trailing edge, and the turbine blade's leading edge. Flow coming off the device is directed to this slot, and passes through at accelerated velocities to the suction side of the blade, keeping the flow attached and turbulence to a minimum through a wide variety of pitch positions.

The length of the PowerCone blades is designed to locate this secondary flow effect at rotor locations where separation is most problematic, to yield the most benefit. As a result, this energized boundary layer of air reduces vibrations that would have been directed to the drive-train of the turbine.
Bat Curtailment

Operating wind turbines in areas of bat populations can lead to lost production due to curtailment. With the PowerCone, you can help make up these losses by producing more power in the ramp-up portion of the power curve, from your curtailed cut-in speed to rated power.

Icing

Operating wind turbines in cold climates can lead to lost production due to curtailment. With the PowerCone, you can help make up those losses by producing more power in the ramp-up portion of the power curve. The PowerCone does not lead to increased risk of rotor icing, and does not carry the same risk of icing as the outer portion of the blade. Even so, the PowerCone is designed to IEC 61400-1 standards to withstand the loads due to ice accumulation.
The PowerCone has more than 25,000 person-hours behind its development. Wind tunnel, real-world and computational studies have given us a confident platform to make assertions about PowerCone performance. Working with leading technical partners such as DNV-GL, Capstone and leading research institutes around the world, data and information gathered to date can be overlaid onto power curves from real wind farms. Data from the power curve, shown on page 2, comes from an IEC Class IIa wind regime in Ontario Canada, and is reflective of expected power performance. Our upcoming pilot will solidify these gains.

Seamless Integration

The PowerCone has been specifically designed as an enhancement device that can be fitted to 98% of installed turbines globally, both onshore and offshore. Manufactured from composite glass fiber, it is designed to IEC specifications and manufactured to ISO 9001:2015 standards to be OEM agnostic, with varying blade lengths to ensure you are getting the most of what’s available. Installation is complete in 1 day using a telescopic crane, with custom easily-installed brackets and steel hard-points that mount onto the static pitch bearing in a secure, effective location. With no moving parts and extra tie-off points for workers, there is little impact to your established maintenance regime.

Valuable Partnerships

The PowerCone has more than 25,000 person-hours behind its development. Wind tunnel, real-world and computational studies have given us a confident platform to make assertions about PowerCone performance. Working with leading technical partners such as DNV-GL, Capstone and leading research institutes around the world, data and information gathered to date can be overlaid onto power curves from real wind farms. Data from the power curve, shown on page 2, comes from an IEC Class IIa wind regime in Ontario Canada, and is reflective of expected power performance. Our upcoming pilot will solidify these gains.

Through the PowerCone, you unlock the power of Evolved Design.

The beak of the kingfisher has inspired the PowerCone’s design