

# Economic Advantages

## The Vindicator™ Forward Looking Laser Wind Sensor — Maximizing Efficiency and Reducing Maintenance Costs

### Economic Advantages of the Vindicator™ Laser Wind Sensor

There are definable and quantifiable advantages to the use of the Vindicator™ laser wind sensor. These advantages will result in increased profit to the wind farm operator through increased energy output, reliable energy scheduling, and lower maintenance costs. The Vindicator™ system will increase power output by 10%, reduce maintenance costs by another 10%, and minimize the occurrence of catastrophic turbine failure due to wind shear and unexpected gusts!

The Vindicator™ sensor works by integrating with a wind turbine's control system, sensing the approaching wind at various ranges up to 300 meters, and reporting this information to the turbine controller in sufficient time to affect changes in blade pitch and yaw angle.

### Maximizing Efficiency

#### Yaw Angle Control

The average wind turbine is out of alignment with the wind throughout most of its operations. The wind is always changing direction; even when the wind is steady from one heading, transient changes of as much as 15 degrees are common. For every degree out of alignment, energy output drops by 1%; a turbine that is only 15 degrees out of alignment loses 15% of its efficiency. The Vindicator™ laser wind sensor sees the wind as it approaches the turbine and allows the controller lead-time to orient the blade disk into the wind. Decreasing the average annual out of alignment condition from 15 degrees to 5 degrees will result in a 10% increase in turbine power output.

#### Blade Pitch Control

Blade pitch position is equally important to turbine efficiency. The more efficiently blades are positioned, the more energy is transferred to the turbine generator. Just as wind direction varies, wind speed varies greatly as well. Gusts, lulls, and turbulence are always present. With accurate, real-time information provided by the Vindicator™ sensor, the turbine controller will be better able to harvest energy from the passing wind. With correct control of turbine blade pitch, turbines produce more energy, emanate less noise, and will operate throughout a larger range of wind speeds.

### Greater Efficiency In Lower-Speed Winds

Due to growth in the wind energy industry, most of the best wind sites in North America have been developed — what that leaves for future development are the less desirable, lower average annual wind speed sites. The Vindicator™ wind sensor is critical to ensuring the success of these operations because it maximizes power generation from lower speed, less consistent winds.

**RESULT: Energy output annual gain of at least 10%**



# Economic Advantages

## Increased Component Lifetime/Reduced Maintenance Costs

### Asymmetrical Load Alleviation

The wind energy industry states that 10% of the annual cost to generate power is directly attributable to maintenance and repair. The Vindicator™ wind sensor effectively enables “side load,” or off-axis stress reduction on mechanical components by allowing turbines adequate time to optimally configure. Bearings, nacelle mounts, and supporting structures are spared the damaging stresses of asymmetric wind loading.

NREL reports that LIDAR wind sensors, like the Vindicator™ system, will reduce overall component wear by 10% annually when integrated with a turbine’s control system; thereby increasing dynamic component lifetime and reducing maintenance costs (Technical Report NREL / TP-500-39154).

### Wind Shear:

Wind turbines experience very different wind speeds and direction at the top and bottom of the rotor disk, commonly referred to as *wind shear*. These unbalanced forces generate an enormous amount of stress on the blade hub. The result is increased hub bearing wear, generator drive-train wear and support structure fatigue. In fact, blades that are not adjusted properly have been known to flex so much that they have actually impacted the support tower, resulting in catastrophic turbine failure. It is very common for a turbine to require major repairs long before the warranty period has ended.

The Vindicator™ laser wind sensor sees wind gusts, shear, and turbulence as it approaches the turbine and reports these variations in speed and direction to the turbine controller. This allows sufficient time for an individual blade to adjust pitch, allowing the wind gust to pass with minimal stress on the blade hub.

### RPM Control

As with any mechanical device, a wind turbine has mechanical limits. When a limit is exceeded, component failure will result. With the Vindicator™ sensor feeding information to the control system, turbines will be permitted to operate throughout a greater range of wind speeds without sacrificing power output or safety.

**RESULT: Maintenance Costs Reduced by 10%**

## The Bottom Line

The numbers add up! A 10% increase in energy output plus a 10% decrease in maintenance costs, equals greater profit to wind farm operators.

The Vindicator™ laser wind sensor offers yet one more important advantage to the wind energy industry. The Vindicator™ sensor yields more predictable and certain turbine power production. Increased stability and annual production will enable producers to demand higher prices for their wind energy. By increasing the capacity factor of a wind field through an increase in average annual output, producers can demand a higher rate in both rate negotiations and on the spot market for the electricity they produce. Reliable energy yields greater returns to the producer.

## In a Nut Shell...

The Vindicator™ laser wind sensor will increase the average wind farm’s annual revenue significantly, reduce the occurrence of catastrophic turbine failure, acoustic interference, and add a level of stability to wind energy pricing.

**For more information about the Vindicator™ laser wind sensor system and additional laser sensor products, please call:**

**Catch the Wind, Inc.**

10781 James Payne Court, Manassas, VA 20110  
703-393-0754 • [www.catchthewindinc.com](http://www.catchthewindinc.com)

