



# The next generation of AEP boost. Senvion Turbine Control Upgrade 2.0.

Five high-performance features increasing on average 1.8% AEP.

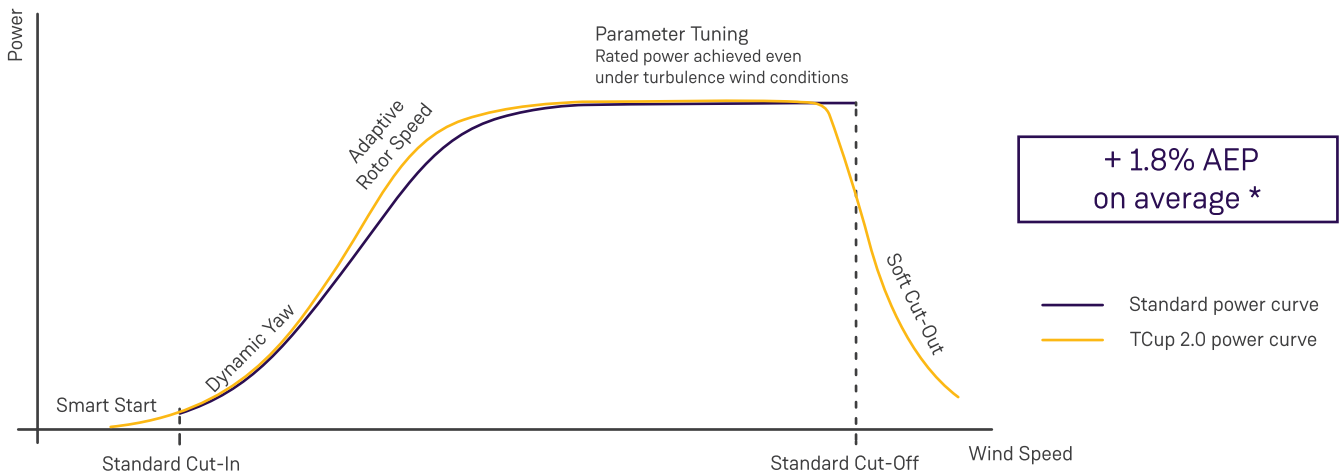
Siemens Gamesa Renewable Energy Service is continuously developing a series of performance enhancing hardware and software technologies to help producers achieve even greater gains for their Senvion wind turbines.

The new Turbine Control Upgrade 2.0 offers greater performance by increasing the Annual Energy Production (AEP) of the Senvion wind turbines by 1.8% on average\*. This is possible due to further optimization of two proven features provided within the previous version of the Turbine Control Upgrade and the addition of three newly developed features. Based on the analysis of operational data, Siemens Gamesa Renewable Energy Service is able to deliver control algorithm solutions to provide yield gains.

The Turbine Control Upgrade 2.0 is a bundle of performance-enhancing software products, derived from our data analysis activities. It has the following optimized and newly added features:

- Smart Start
- Dynamic Yaw
- Adaptive Rotor Speed
- Parameter Tuning
- Soft Cut-Out

The combination of these five high-performance features can increase the AEP of your wind farm by 1.8% on average\*.



**New features and greater performance.**

The ‘Smart Start’ feature applies a self-learning algorithm which optimizes the start-up procedure of the wind turbine to increase the energy production in the lower partial load area. The algorithm is lowering the start-up wind speed in small steps after each successful start of the turbine.

The ‘Dynamic Yaw’ feature has been improved by optimizing the yaw behavior of the wind turbine with faster reaction to changing wind directions. The yaw system is even more precise to reduce the inflow angle and increase the energy production.

The newly added feature called ‘Adaptive Rotor Speed’ enables a higher rotor speed in the upper partial load range. It leads to a longer operation at optimal tip speed ratio, a higher rotor efficiency at upper partial load and consequently a higher AEP due to a stronger ascent of the power curve in this range. When reaching rated power, the turbine is set back to rated speed.

The ‘Parameter Tuning’ enables the turbine to achieve its rated power output even under high turbulence wind condition. This is based on optimized parameters within the standard pitch algorithm. The original rated power of the turbine remains unchanged.

Finally, the new ‘Soft Cut-Out’ feature enables the wind turbine to operate even beyond standard cut-out wind speed and therefore extends the power curve. Instead of shutting down at the standard cut-out wind speed, the turbine slowly reduces the rotational speed and the power output down to a new maximum cut-out wind speed. The extension of the cut-out wind speed increases the AEP of wind turbines at high wind speed sites.

**Benefits of Servion Turbine Control Upgrade 2.0:**

- Particularly effective for turbines located on complex terrain and low air density
- Site specific adjustment of start-up speed based on self-learning algorithms
- Optimized yaw behavior increases the AEP
- Reduction of loads due to improved rotor alignment
- Increased power output in upper partial load area by higher rotor speed
- Optimized pitch behavior under high turbulence wind conditions increases the AEP
- Reduced idle time increases output at high wind speed

Should you need further information about the Servion Turbine Control Upgrade 2.0 solution, please contact us. We will be happy to support and provide you with a customised offer.

\*depending on turbine type and sites conditions.