

# Gearbox services powered by digital technology



Our renewable electricity energy needs are growing in a world that is constantly evolving. The market requires more renewable energy for less money. The reduction of government subsidies means that the industry needs to start looking for ways to increase its efficiency.

## More energy for less money

There are different possibilities for lowering the levelized cost of energy, such as avoiding unexpected downtimes (reducing the operational costs), extending the lifetime of the infrastructure, and increasing the power output.

By integrating digital technology into the intelligent gearboxes developed by ZF Wind Power, customers will be able to improve all three aspects.

## Avoiding unexpected gearbox downtime

The cost of an unexpected gearbox failure

can be significant, especially when cranes or vessels are needed at short notice. Additionally, when certain spare parts are not available at the right time, it can cause significant turbine downtime.

Thanks to digital technology, every gearbox will leave ZF Wind Power's factory with its

## DIGITAL BIRTH CERTIFICATE



own unique digital birth certificate. The certificate contains all the gearbox manufacturing information and can be accessed online by ZF's and partnered service organizations. This way, ZF's service team can calculate the consumed lifetime of each bearing and gear pair within a gearbox, combining the actual measured loads with knowledge about the mechanical strength of each component. Consequently, several fatigue-related failure mechanisms can be limited.

But it's not only mechanical data that can be extracted. ZF Wind Power can also link measurement data from vibration and oil quality sensors to its cloud platform to detect problems with the gearbox early on and better plan proactive maintenance.

These analytics enable ZF Wind Power to ensure that the right spare parts are available when and where they are needed. Plus, analytics can predict possible future problems and downtimes are shortened thanks to professional service.

### Extending the operational lifetime

Loads applied to an individual wind turbine may not always match the designed load envelope since these depend heavily on the exact turbine location and the local wind conditions. This may lead to early gearbox damage and potentially unplanned turbine downtime in case of a failure.

The remaining lifetime of the individual components can be estimated by combining the knowledge of the loads that were applied to the gearbox with the historical failure data. Well-substantiated decisions can be made to replace components in good time.

By adding ZF Wind Power's unique 'dynamic load monitoring' sensor solution, it is possible to make sure that the loads applied to the gearbox are always within specifications – thus, avoiding damage and extending the operational life of the gearbox.

### Increasing the energy output

The data from the 'dynamic load monitoring' sensor can also be used to increase the output of the turbine. By feeding this information into the turbine controller, active torque control can be used to increase the load on the gearbox maximally without causing any damage. This will help turbine owners get the most energy out during high wind conditions or at high grid demands.

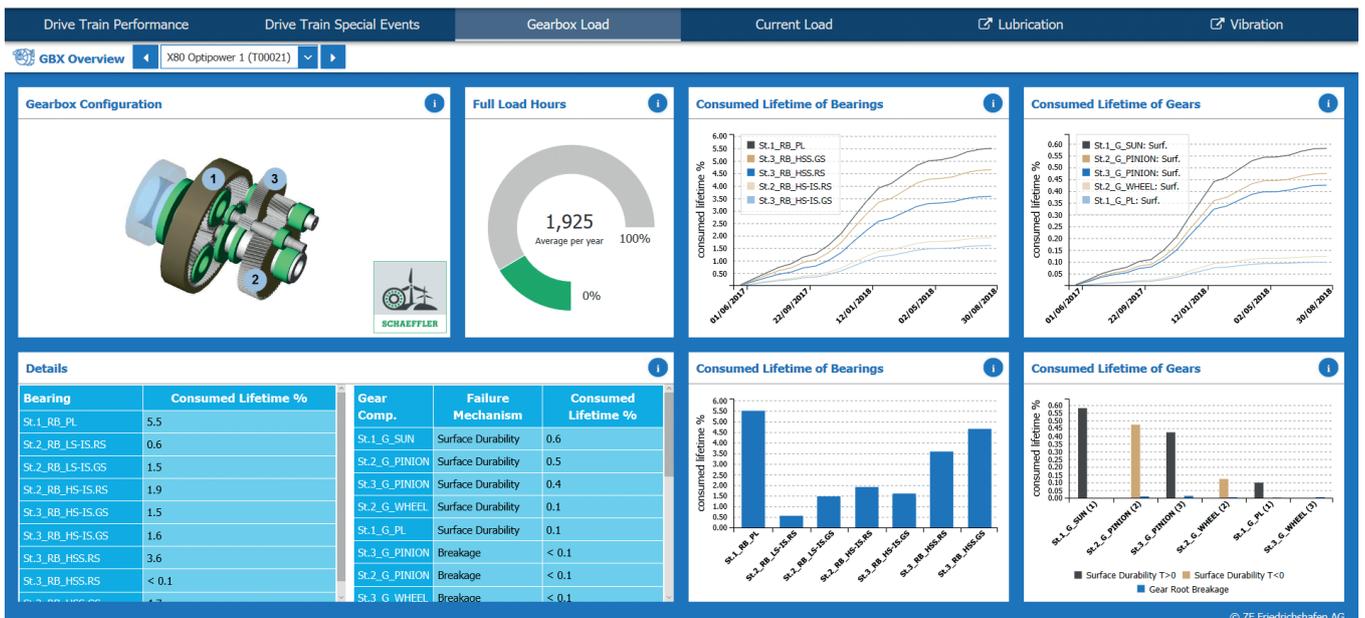
### Digitalization and modularity for an optimized LCOE

'SHIFT', ZF Wind Power's modular approach, goes hand-in-hand with digital technology to optimize the LCOE. The platform's standardized building blocks offer more flexibility in gearbox development and it integrates intelligent gearboxes as digital solutions. The gearboxes contain integrated sensors that combine all the data needed to optimize the energy yields and operational costs of wind farms.

Let's illustrate this with an example of the loads that turbines might experience. Thanks to load monitoring data, we know which gearbox variants are needed on specific wind sites. 'SHIFT' lets you optimize the gearbox to site-specific loads or even mix the different variants at a single wind site. This way, project development costs will improve while the product lifetime increases.

### Cloud Access

ZF Wind Power provides consumed lifetime calculations and analytics for drive train dynamics as a cloud service. Figure 1 shows the consumed lifetime calculation for a typical gear pair and each bearing for a typical gearbox. Figure 2 contains an overview of the drive train dynamics for different operating conditions (power groups).



The table shows the highest dynamic amplitude measured for each power group within the period selected by the user. Additionally, the graphs show the evolution of the rotational speed, torque, power over time, and their frequency and order analyses.

**Digitalization will drive full gearbox service and availability contracts**

Supported by smart digital technology and analytics, ZF Wind Power offers full gearbox service and availability contracts.

‘We want to make sure our customers get the right service and spare parts at the right time,’ says Antti Turunen, head of ZF Wind Power’s service organization. ‘By using smart digital technology and analytics to steer our proactive maintenance and spare parts management program, we will be able to focus on planned up-tower repairs.’

ZF uses consumed lifetime analytics in first-level service contracts to help customers optimize their spare parts stock management. By making sure that the right parts are available at the right time and the right place, turbine downtime is minimized in the event of a failure while

keeping the spare parts inventory at a minimum. Customers enrolled in this program have access to guaranteed genuine ZF spare parts at prices that are agreed upon in advance.

[www.zf.com/windpower](http://www.zf.com/windpower)

**ZF Wind Power**

ZF’s advanced technology solutions contribute to the transformation of the global energy system in which reliable, robust, and efficient products and systems conserve precious resources.

Using its combined expertise in automotive and industrial technology, ZF is determined to support its customers in making wind power the leading renewable energy source for the future. Sustainability

lies at the heart of our endeavors.

Using state-of-the-art manufacturing plants and worldwide service locations, ZF is dedicated to delivering customized solutions and services on a global scale, as well as meeting the individual needs of the global wind energy market.

As a continuous innovator, ZF anticipates the trend towards intelligent systems by enabling performance optimization of the entire wind turbine.