

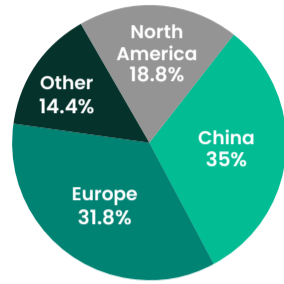
How to Improve Wind Turbine Operations: Predictive Maintenance

Increase availability and control costs via condition monitoring

WIND POWER BY THE NUMBERS

340,000+
Wind turbines operating globally

\$101.5 B (USD)
Invested to-date in Wind Capacity globally



Installed Capacity

In U.S. wind comprises 20% of total power
(and the largest source of renewable generating capacity in country)

WIND UNPREDICTABILITY IS CHALLENGING

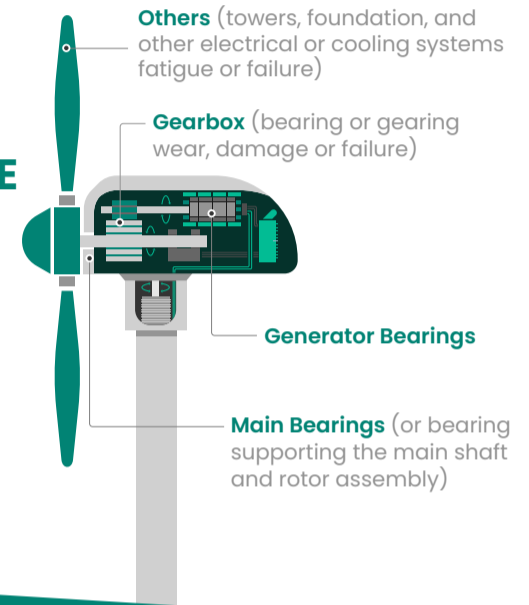
Shifting conditions cause varied fatigue and damage

- Speed and direction of wind changes frequently
- Atmospheric conditions such as:



LEADING FAILURE CAUSES GENERATE COST PRESSURE

When unmanaged and unmonitored, maintenance costs can quickly and significantly add up



“In wind turbine operations, reducing repair costs delivers higher savings than reducing downtime; however, both are important.”

-Bently Nevada Wind Team

KEY BENEFITS OF PREVENTATIVE O&M STRATEGY VIA CONDITION MONITORING

Proactive monitoring of turbine components identifies atypical part operation before failure occurs

- IDENTIFIES** when turbine part requires repair
- AVOIDS** down-tower component replacements
- REDUCES** costs associated with replacement parts and use of cranes

REPAIR COST DE-ESCALATION IN ACTION

Here's what a real-life wind farm condition monitoring solution looks like:



RUN-TO-FAILURE VS. CONDITION MONITORING

Proactively deescalating maintenance costs is key to successful and sustainable wind operations

	REPLACEMENT REPAIR COST (In USD)	PREVENTATIVE COST (In USD)	Savings
Bearings	\$12-\$15,000	\$1,000	up to 93% savings
Gearboxes	\$300,000 <small>when a crane is required</small>	\$15,000	up to 95% savings

ACHIEVE TOTAL ASSET PROTECTION

A comprehensive condition monitoring solution -- trusted hardware, software and service expertise -- effectively de-escalates maintenance costs



COMPREHENSIVE
CONDITION
MONITORING
SOLUTION