

# Basic Knowledge Wind Power



The success of modern wind power plants would be inconceivable without contributions from a wide variety of sub-disciplines. Condition Monitoring Systems (CMS) are becoming increasingly important for economic aspects in the operation of wind farms.

## Aerodynamics

Aerodynamics is the science of the behaviour of bodies in a compressible gas (air). Aerodynamics describes the forces that make a windmill turn or that lift an aeroplane off the ground.

The design of a rotor blade for modern wind power plants has to take into account both the aerodynamic properties and the mechanical load-bearing capacity. Blade profiles which have been optimised in extensive simulations are often used in order to satisfy the requirements of large-scale wind power plants.

## Gear technology

When transferring power from the rotor axis to the generator, two principle requirements must be met:

- good synchronisation properties with as little fluctuation in the speed and torques as possible
- good adaptation of the speed range between rotor and generator

Although considerable progress has been made in recent years in the development of frequency converters, established drive train designs are based on the use of transmission gearing. The gears make it possible to adjust the speed and/or frequency of the generator to the requirements of the alternating current grid.

## Energy conversion

In order to be able to use wind energy, the kinetic energy of the wind first has to be converted into rotational energy. The rotational energy can then be used in a generator to produce electrical energy. As with all energy conversion processes, losses have to be monitored in each separate step. Assuming the maximum usable wind power (the Betz limit), aerodynamic, mechanical and electrodynamic losses occur.

## Machine monitoring

The construction and operation of a wind power plant go hand in hand with high investment costs. Failure of the rotor bearings, gears or rotor shaft leads to financial losses.

In order to avoid failure, wind power plants are continuously monitored by vibration analysis. The aim of these analyses is to detect and replace damaged components early, before the damage results in failure of the turbine.

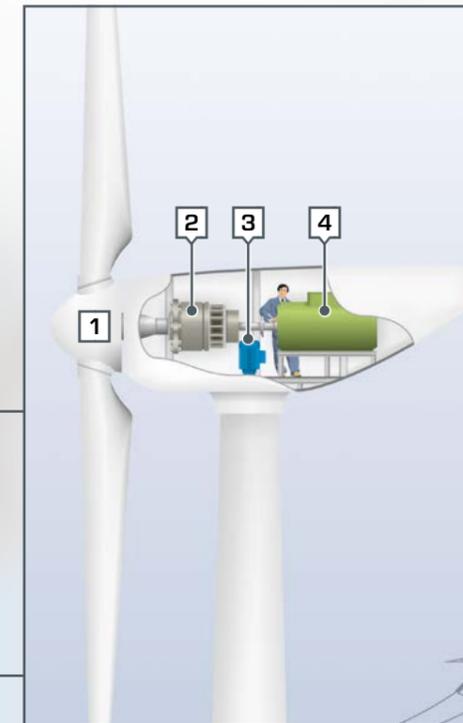
Besides the rotor and the generator, wind power plants consist of lots of individual components which together form a functional and efficient wind power plant.

The following aspects play a key role in education specialist technicians and engineers in the field of wind energy engineering:

- functional principle and interaction of the individual components
- installation and operational monitoring

Wind power plant:

- 1 rotor
- 2 gearing
- 3 yaw motor
- 4 generator



## Global wind energy supply

The graphic shows the average global wind energy supply as regions marked in colour

