A Converterless Drive Train Concept for Grid Friendly Wind Turbines

The WinDrive Success Story

Uwe Reimesch

GM Sales – Voith Turbo Wind

VOITH
One of the large family-owned companies in Europe

1867

First Workshop

2010

5 Billion Euro Sales

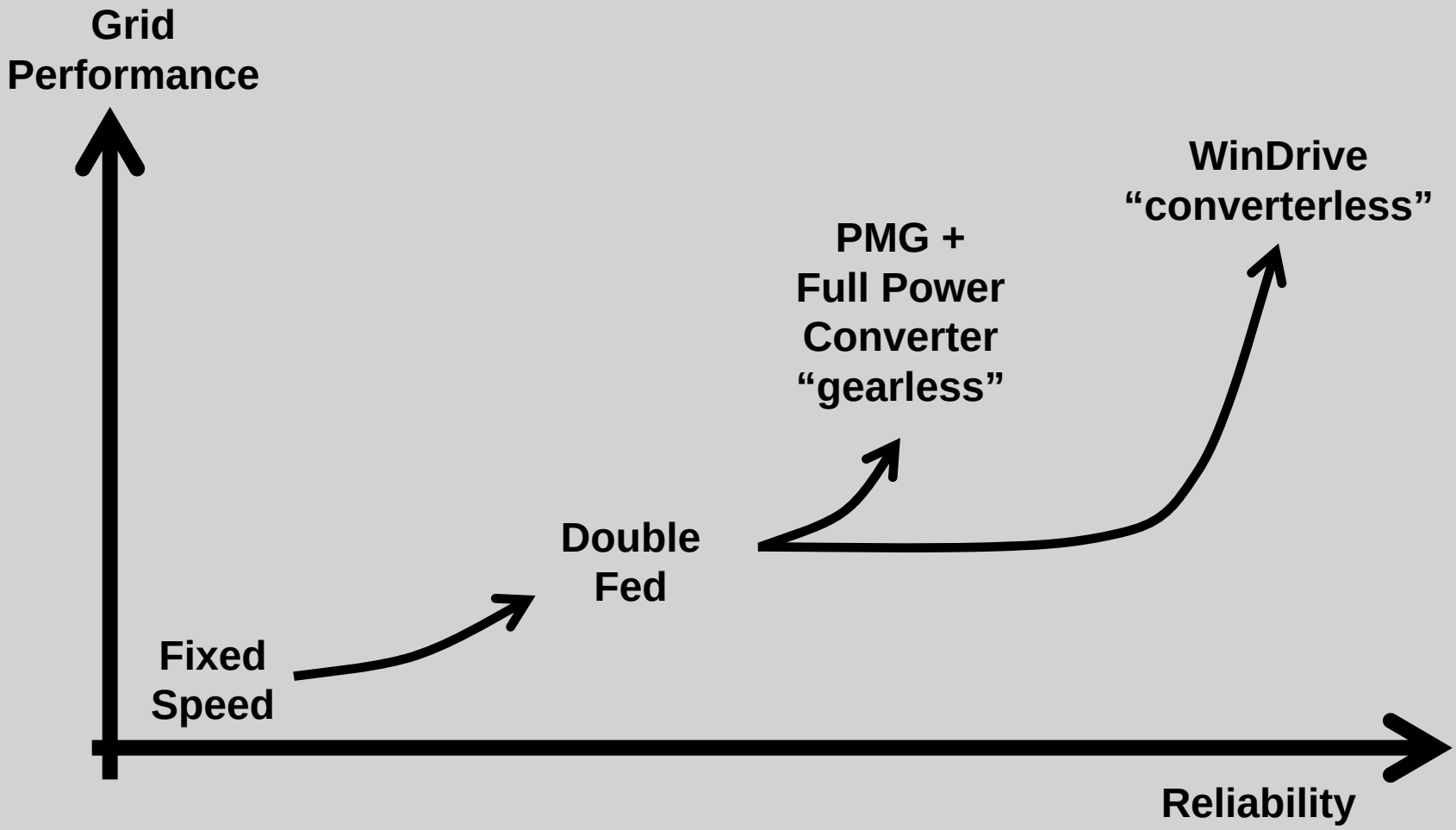
39,000 Employees

100% Family owned

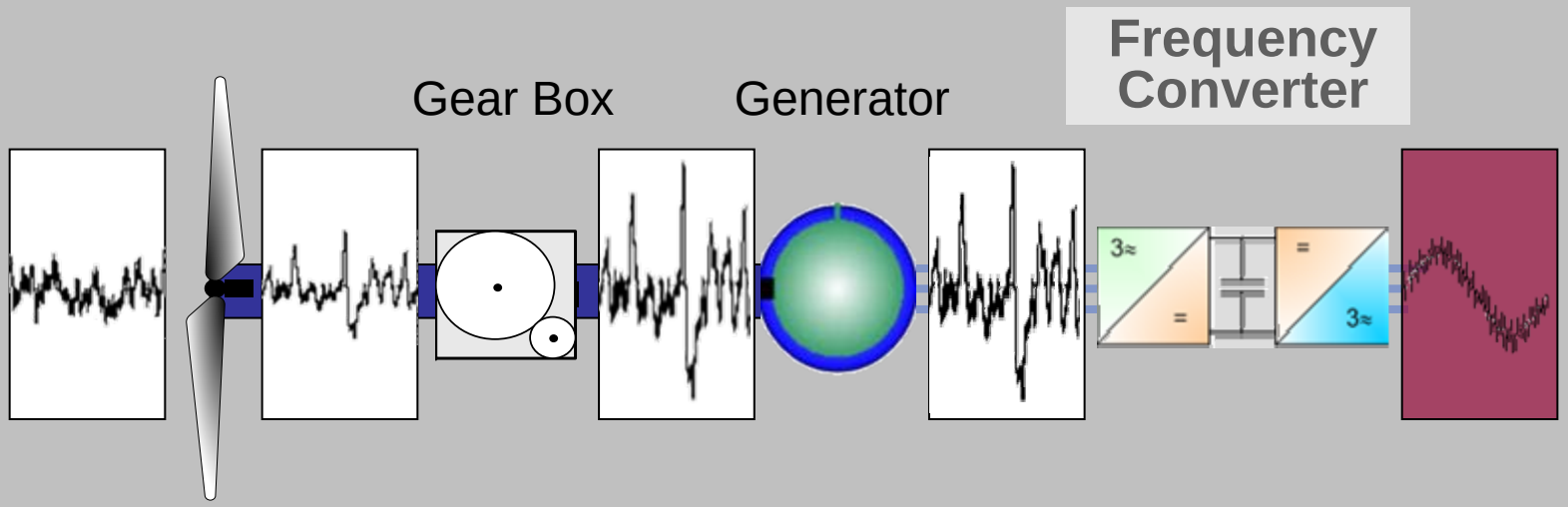
The WinDrive Success Story

"There is nothing
more powerful than an idea
whose time has come."
Victor Hugo

Wind Turbine Evolution

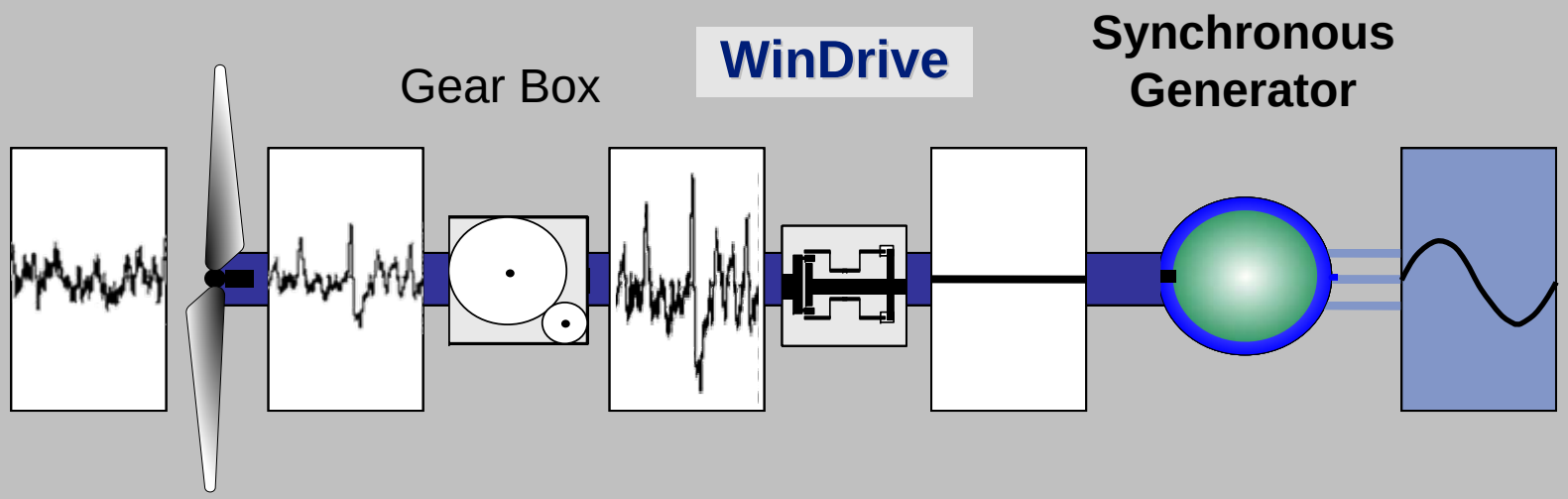


Traditional Drive Train Concept with Frequency Converter

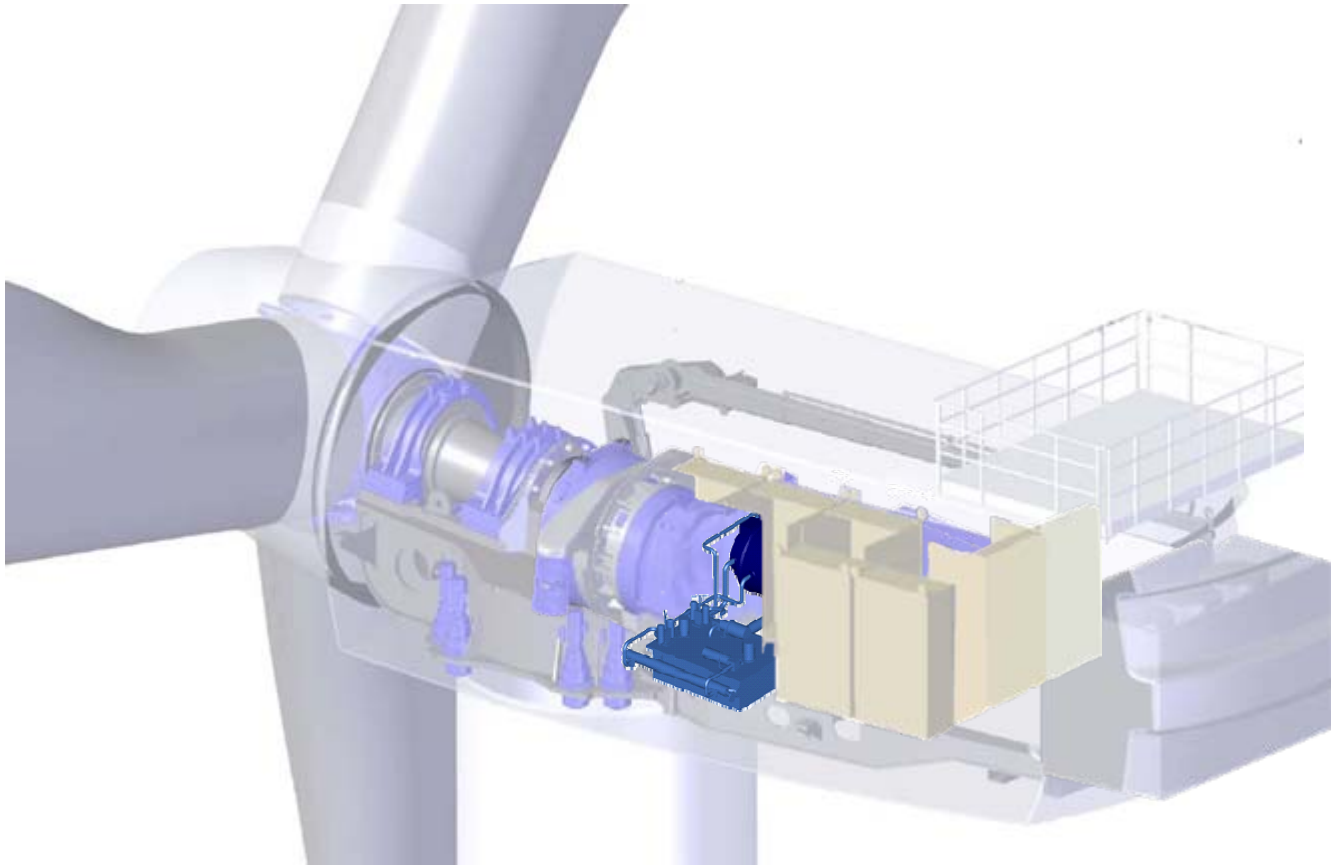


Turbulent Wind	Variable Speed	Variable Speed	Variable Frequency AC	DC	Constant Frequency AC

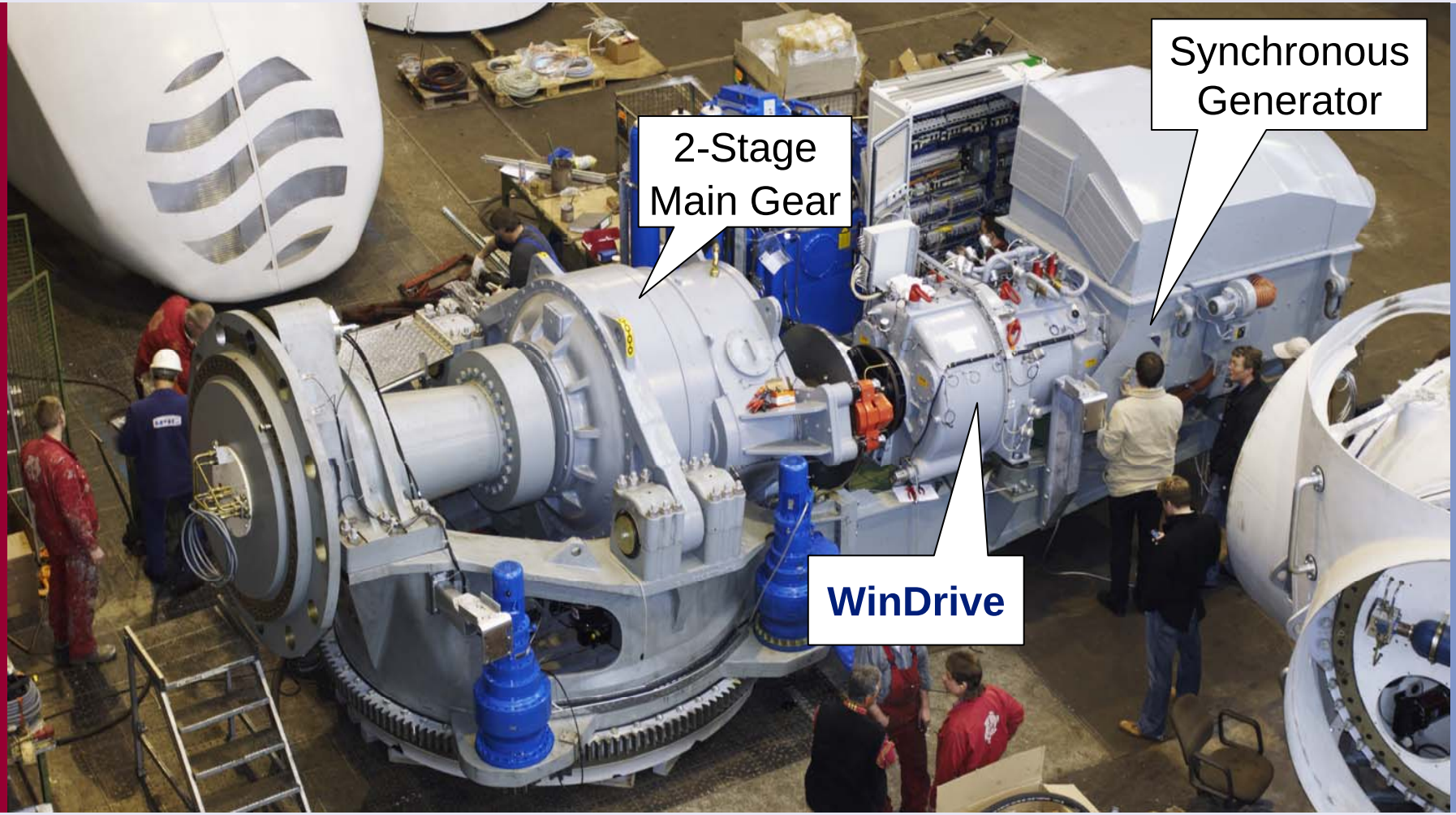
Innovative Drive Train Concept with WinDrive for Large Wind Turbines without Frequency Converter



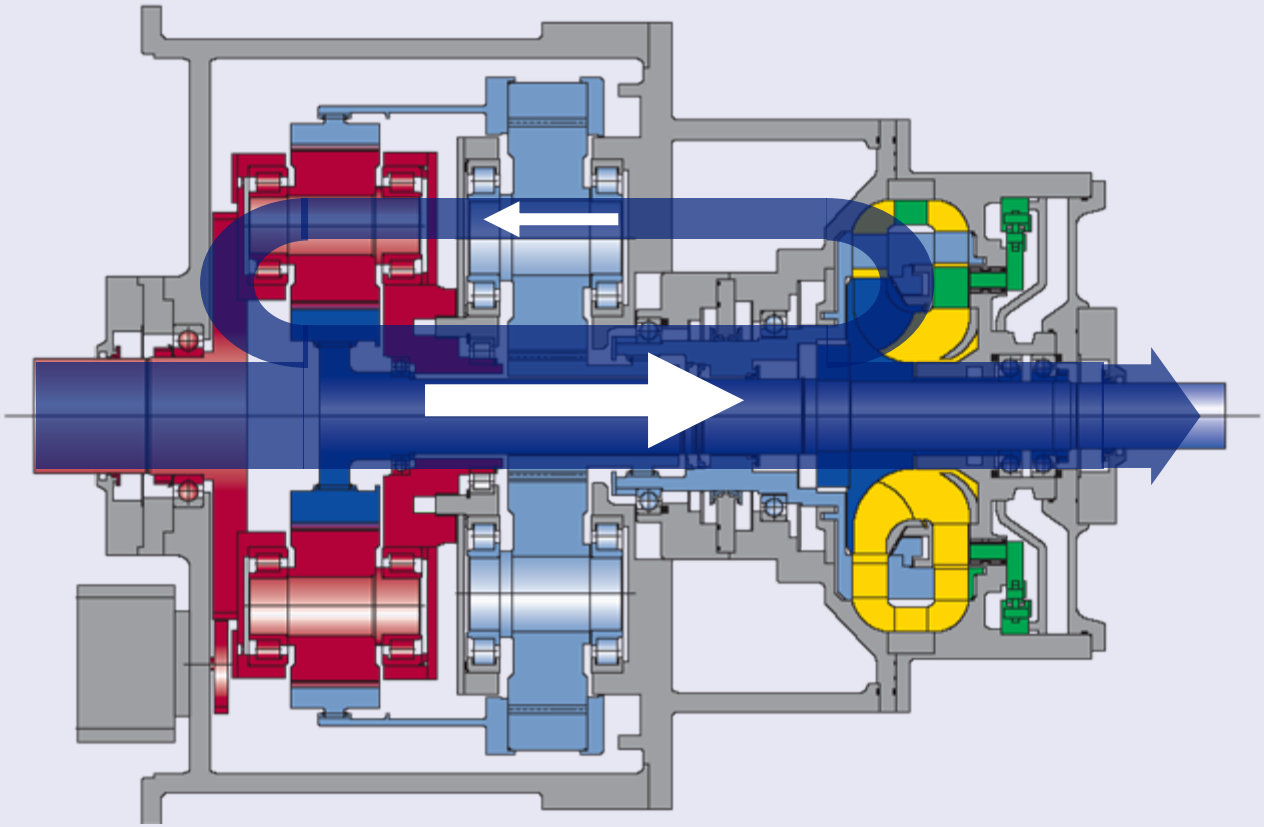
Concept
Drive Train



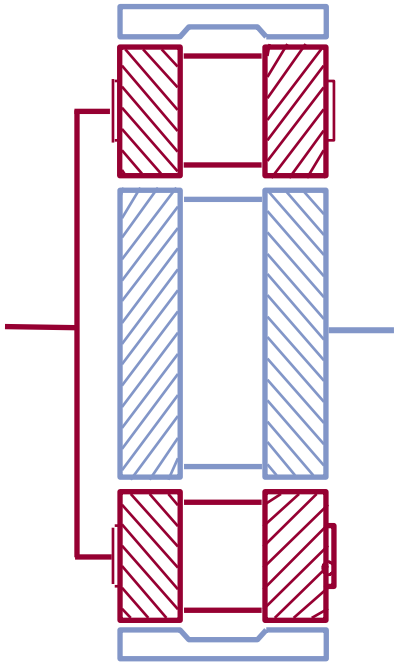
Concept

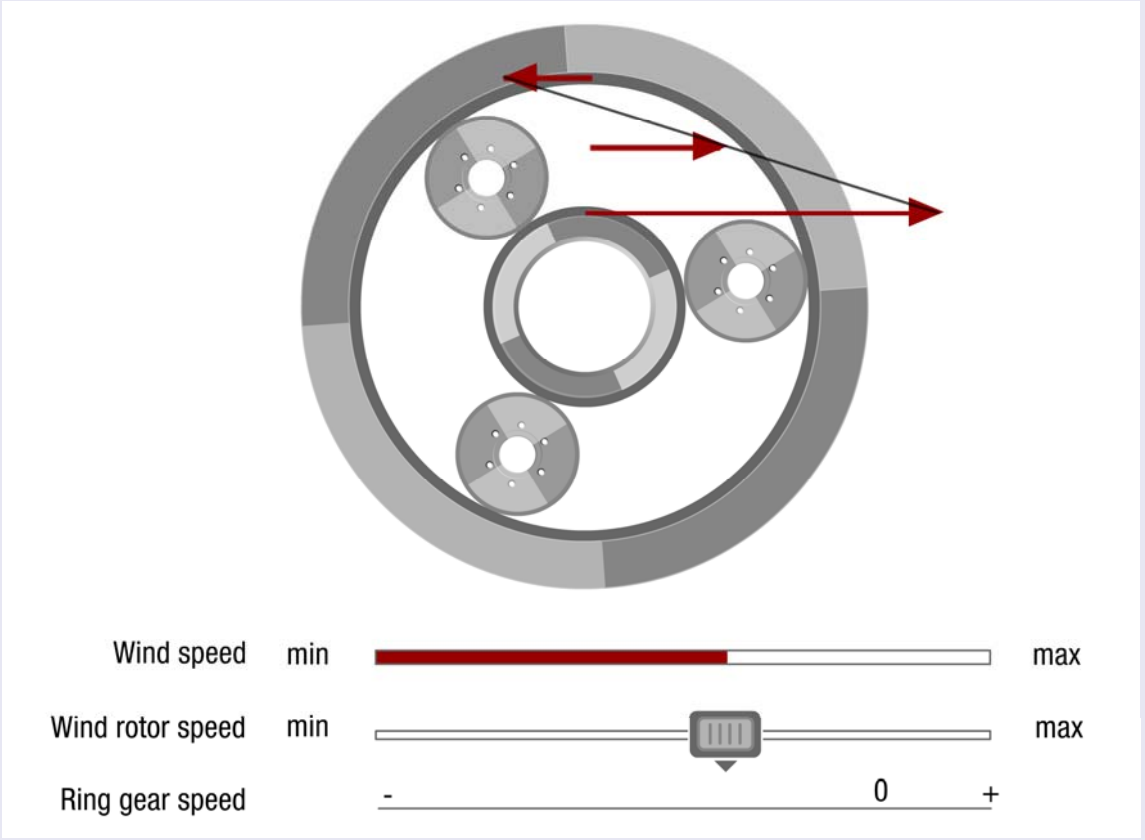


Function WinDrive



Function
Superimposed Planetary Gear

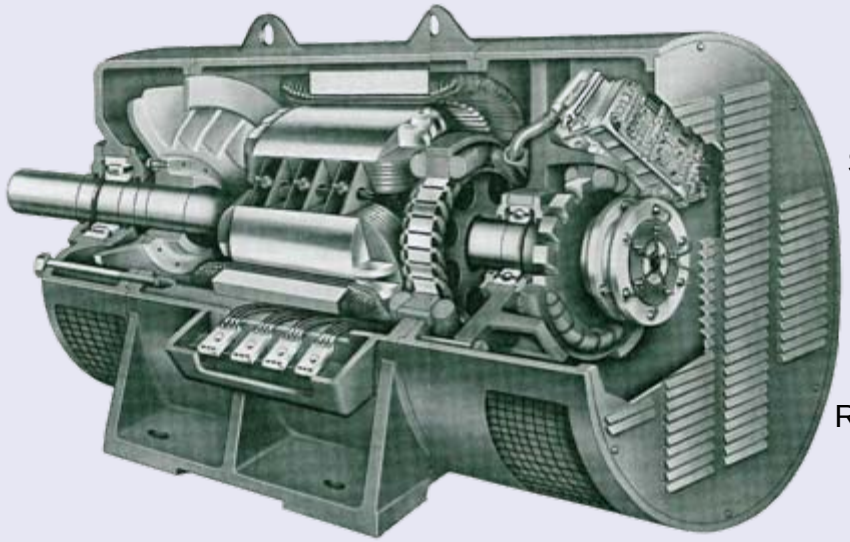


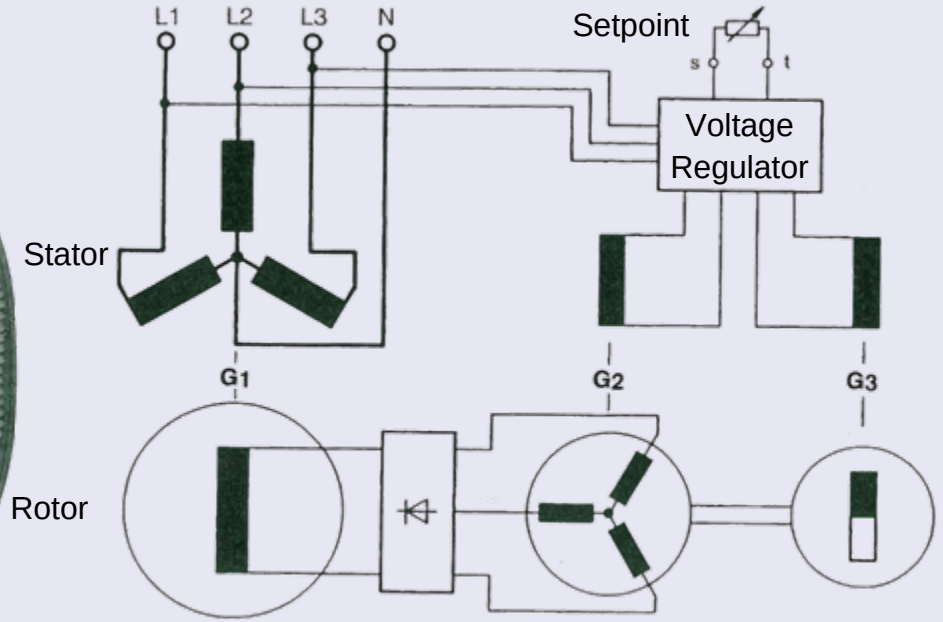


Grid Requirements
What does the Grid want?

1. Feed In Quality:	**Low Inrush Current** **Low Flicker Effect** **Low Harmonic Frequencies**
2. Grid Support:	**Dynamic Adjustment of Active and Reactive Power**
	Low Voltage Ride Through Capability and High Reactive Short Circuit Current
	Support of Grid Voltage and Grid Frequency
3. Transmission:	**High Static and Transient Grid Stability at Low Short Circuit Ratio (SCR)**
	Capability of Black-Start and Isolated Operation

Synchronous Generator
Which Machine can deliver what the Grid wants?





G1 = 3-Phase Main Machine

G2 = 3-Phase-Excitation Machine

G3 = Supporting Excitation Machine

Full Grid Code Compliance by Synchronous Generator What are the Benefits?

Advantages of Synchronous Generator for the Grid:

- Low Harmonics & Low Flicker Effect
- Precise Adjustment of Reactive Power (Inductive & Capacitive)
- Voltage Drop to 0 Volt & Hight Short Circuit Current (Inductive)

Advantages of Synchronous Generator for the Operator:

- Established Basis of Worldwide Electricity Generation (~ 99%)
- Low Maintenance & High Efficiency (vs Asynchronous Generator)
- Proven Robustness & High Reliability (No Slip Rings, No Brushes)

Result: Lowest Cost of Energy

Reliability

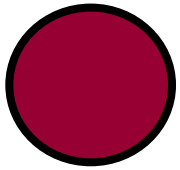
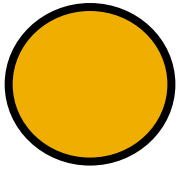
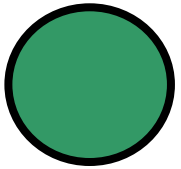
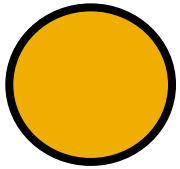
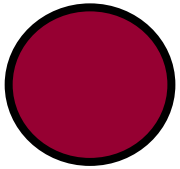
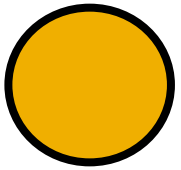
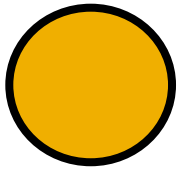
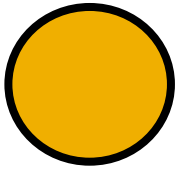
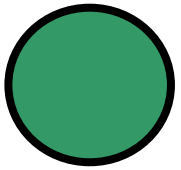
Frequency Converter Technology

MTBF < 2 Years

Variable Speed Drives Oil- & Gas Industry (1-34 MW)

MTBF > 39 Years

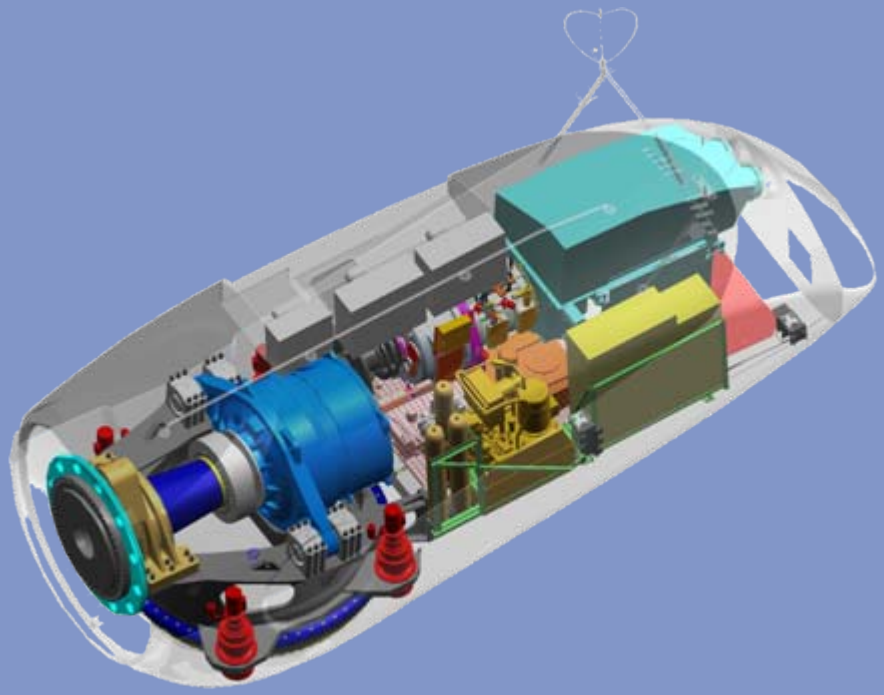
Technology Comparison

	gearless	gear & converter	converterless
light			
simple			
grid friendly			

The WinDrive Success Story

“The time has come"

The WinDrive Success Story



Lübeck, Germany 2005:

Development start of
2 MW turbine with DeWind

“Creating a grid friendly turbine by upgrading from DFIG to WinDrive technology – evolution instead of revolution“

The WinDrive Success Story

Cuxhaven, Germany 2007:
First kWh fed into grid by DeWind D8.2 prototype

“After a 12 month development period the prototype was up and running in auto mode within 40 hours“

The WinDrive Success Story

Veladero, Argentina 2008:

Highest turbine at 4 200 m above sea level (DeWind D8.2)

“Reliable performance in thin air between diesel gen sets and rock crushers“

The WinDrive Success Story

Bremen, Germany 2009:
Development of 6.5 MW turbine with second partner BARD

“The WinDrive System is the perfect combination of existing technology and convincing innovation that allows us to meet the requirements of the utility companies“

The WinDrive Success Story

Lanzhou, China 2009:
Development start
of 2 MW Wind turbine with
Lanzhou Electric Corporation

“Replacing DFIG by high tech made in Germany to build China‘s first 10 GW wind farm“

The WinDrive Success Story

Beijing, China 2009:

Development start of 3 MW turbine with Guodian United Power

“Top 5 power provider in China and largest windfarm operator in Asia to aply state of the art technology to the fastest growing market for wind power“

The WinDrive Success Story

Texas, USA 2010:

“Little Pringle“ to become first wind farm using WinDrive technology

10 sets of DeWind‘s D8.2

“Successful connection of a converterless and gridfriendly wind farm with power station like behavior“

Status Quo
Proven Track Record

	Cuxhaven, Germany 2 MW, 50 Hz	Veladero, Argentina 2 MW, 50 Hz	Sweetwater, USA 2 MW, 60 Hz	Hilltop, USA 2 MW, 60 Hz
Start	**Dec 2006**	**Dec 2007**	**Jan 2008**	**Feb 2009**
Availability Drive Train	**100%**	**100%**	**100%**	**100%**

Status Quo
One, Two, Four

One Record

Highest Turbine

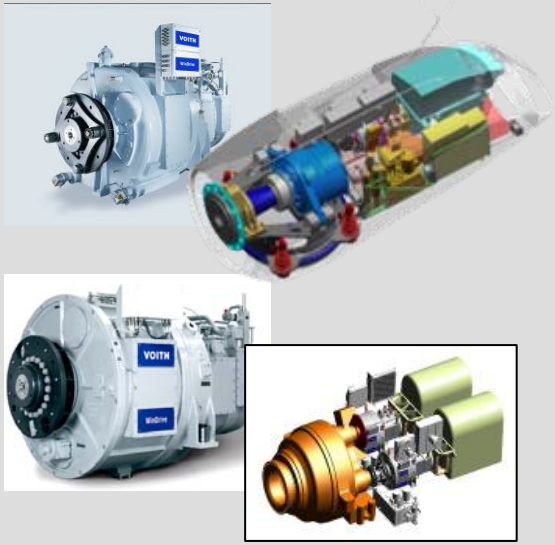
Innovationspreis der deutschen Wirtschaft
Erster Innovationspreis der Welt®

HERMES AWARD 2009

Two Awards

Innovation Price Finalist

Hermes Award Winner



Four Partners

DeWind, BARD, LEC,

Guodian United Power

The WinDrive Success Story

“The time has come"

The WinDrive Success Story

“You have come"


VOITH
Engineered reliability.