

Build Your Own Wind Turbine with Windtec Technology Transfer



Our Core Competencies

- Development and licensing of customized wind turbines for self-manufacturing
- Development and supply of full electric system
- Established supply chain ready for volume production
- Globally comprehensive field service and component localization support
- Basic through advanced customer training courses
- Next generation and proven solutions certified by GL (Germanischer Lloyd)

Founded in 1995, AMSC Windtec[™] is the leading engineering company for developing complete electrical and mechanical system designs for wind turbines for self-manufacturing. The designs are completely tested and certified to international standards.

Windtec offers a unique opportunity to highly qualified companies who want to enter the wind energy business as fast as possible. By licensing Windtec technology, your business relationship with Windtec will allow you to have all the necessary technical knowledge and training to basically “build your own wind turbine,” within approximately 12 months.

Windtec is with you throughout the whole process. All designs, including calculations and documentation, adhere to strict international certifications, including IEC and Germanischer Lloyd (GL). Along with the complete design comes a full set of documents for purchasing, quality

assurance, assembly operation and maintenance of the wind turbine.

We also provide electrical systems including proprietary pitch, control and converter solutions that are GL certified. Windtec will provide you with the expertise to set up your turbine supply chain and localization to make procurement of parts faster, easier and more cost effective.

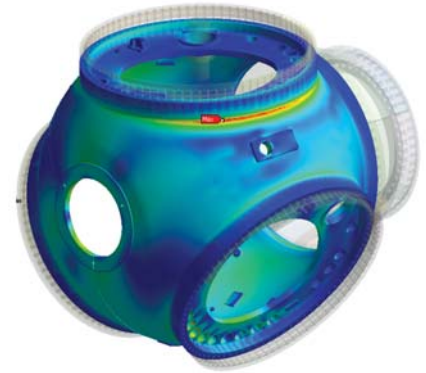
Windtec fully supports your goals of becoming an independent and successful wind turbine manufacturer

Once the concept has become a reality in the form of a first reference turbine, Windtec will verify simulated results with live measurements to make sure all your requirements are met. When the wind turbine is fully certified, Windtec offers global service and support for assembling, factory test, on-site commissioning and performance optimization.

Windtec Expertise for Your Turbine Project

Mechanical Engineering Services

- Calculations: Complete load calculations to IEC 61400, Germanischer Lloyd and DIBt standards, including the certification process
- Wind turbine components: Design, calculation, optimization and certification of complete wind turbines or individual components
- Towers: Calculation and design of towers made of steel and/or concrete, including certification
- Documentation: Manufacturing drawings and bills of materials, documents for purchasing, quality assurance, assembly, operation and maintenance
- Measurements: Specification and support regarding measurements (loads, power curve and noise) on wind turbines and comparison with simulations
- Training and support: All necessary training for assembly, installation, commissioning, operation, maintenance and localization



Electrical Engineering Services

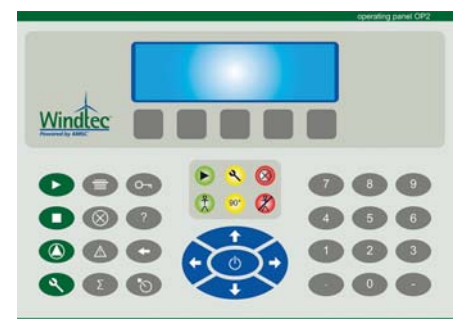
- Control systems: Design, simulation, implementation and optimization, including special control
- Power converters: Design, simulation, implementation and optimization of variable-speed electric drives
- Pitch systems: Design, simulation, implementation and optimization of electrical pitch systems and supply
- Electrical systems: Complete design of the electrical systems for a wind turbine to IEC and Germanischer Lloyd standards, including the certification process
- Documentation: Testing, quality assurance, assembly, operation and maintenance
- Commissioning: Workshop and field tests and optimization of wind turbines



Software Engineering Services

Windtec designs include:

- Control system, consisting of PLC control (the PLC controls the converters and all sub-components), converter software/ parameters and pitch system software/ parameters, offers multilingual support.
- SCADA system, called “Wind Park Management” (WPM), controls the turbines of one wind park.
- Data processing/analyzing system, called wtDataCenter, collects and analyzes recorded data from several wind farms.
- Condition monitoring system, called wtCMS, tracks and reports the condition of main shaft bearings, generator and gearbox bearings and gearbox teeth to closely monitor the reliability and availability of wind turbines.



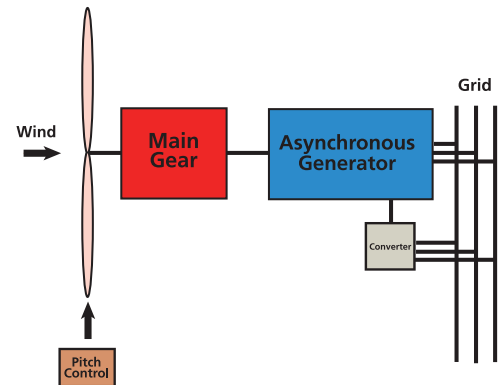
Our Drive Train Solutions

Product Portfolio

Windtec technology transfer offers the wind turbine manufacturer a highly efficient, fully developed wind turbine design. The design can include variable speed, pitch-controlled wind turbines with power ratings from 650 kW to 10 MW and larger.

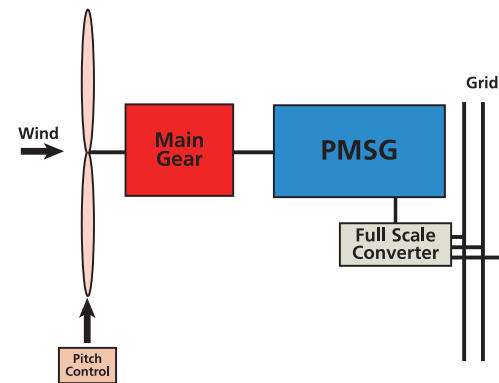
Double Fed Drive Train Technology

- Conventional technology for 10 years
- Proven state-of-the-art technology used in thousands of commissioned wind turbines worldwide
- Cost efficient to manufacture
- Windtec WT82 high efficiency rotor blade available as a license for self-manufacturing



Full Scale Conversion Drive Train Technology

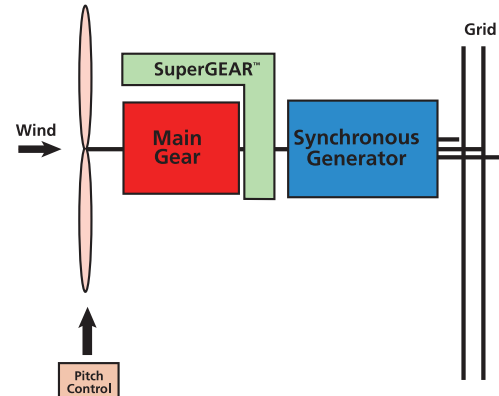
- Excellent power quality
- High efficiency (PMSG better than DFIG)
- Redundancy system in case of converter failure
- Gearbox protection as generator is not connected to grid
- Simple switch between 50 Hz and 60 Hz
- Windtec WT76, WT86 and WT93 high efficiency rotor blade design available as a license for self-manufacturing



SuperGEAR™ Drive Train Technology

The SuperGEAR™ technology (patents pending) is Windtec's latest technology. This unique technology is specifically designed for offshore applications and produces turbines that are more stable, efficient and reliable.

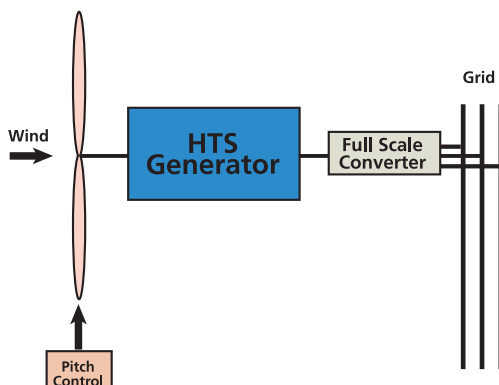
- Best possible power quality available on the global market
- High efficiency especially for high wind speeds
- Direct medium voltage connection to grid — no converters and transformers required
- Gearbox protection by SuperGEAR stage



HTS Direct Drive Train Technology

Ultra low speed direct drive generators are in development in the 10 MW class using superconductor (HTS) wire technology. This unique AMSC Windtec solution will enable light weight, efficient and reliable large offshore wind turbines.

- Next generation technology for above 8 MW turbines
- Lighter than conventional turbines and highly efficient
- HTS wire for turbine supplied by American Superconductor
- Simple switch between 50 Hz and 60 Hz



Why License and Self-manufacture Instead of Buying Wind Turbines From Others?

Buying a Windtec license means receiving all of the technology for building a wind turbine with the complete specification of mechanical, electrical parts and software. Self-manufacturing wind turbines and localization of production has the following advantages:

1. **Break-even faster and make more money now** and over the life of the turbine by doing your own manufacturing and maintenance.
2. **Three ways of making money:** Turnkey projects for your own wind farms, selling complete wind turbines or selling only the components to others.
3. **Becoming a licensee decreases costs** of transportation, purchasing, localization and in-house manufacturing.
4. **Reduced lead time** with Windtec technology license. Build first reference turbine within approximately 10 months. By comparison, most wind turbines average up to 2 years from design to the first reference installation.
5. **Build your own industry/manufacturing cluster.** More than 80% localization is possible after 3 years for self-manufactured licensed wind turbines. Compliance with all local utility requirements is guaranteed.
6. **Established component supply chain** with Windtec's customer and supplier network.
7. **Ongoing Windtec support and training** for component sourcing, commissioning turbines and trouble shooting. Professional high quality on-the-job training and support from development stage to full-scale manufacturing maximizes your success.
8. **Latest state-of-the-art high-end technology** with superior power quality due to innovative, certified technology concepts (e.g. SafetyLOCK™). A harmonized control system with supervisory control and data acquisition (SCADA) enables 365/24/7 active monitoring of your turbine.

Key Windtec Customers Around the World

Ebara Pfleiderer Wind Power Co., Ltd

Doosan Heavy Industries & Construction Co. Ltd.

Fuhrländer AG

Shenyang Blower Works Group Co., Ltd.

Ghodawat Industries (India) Pvt. Ltd.

XJ Electricity Generation Protection & Automation Co.

Model Enerji A.S.

CSR Zhuzhou Electric Locomotive Research Institute Co. Ltd.

Dongfang Turbine Co., Ltd.

Hyundai Heavy Industries Co., Ltd.

AAER Inc.

Sinovel Wind Co., Ltd.

TECO Electric & Machinery Co., Ltd.

Wikov Wind a.s.

Windtec Electrics Optimized for Windtec's Turbine Portfolio

Comprising the following major components:

- Nacelle Control Cabinet
- Converter Cabinet
- Power Supply Cabinet
- IPS (Internal Power Supply)
- Overvoltage Protection
- Hub Cabinet
- Power Caps Cabinet
- Servo Pitch Motor
- Tower Base Cabinet
- SCADA (Wind Park Monitoring System)
- CMS (Condition Monitoring System)



Most Important Facts for Decision Making

Pitch System

- Reduced number of components for higher reliability
- Integrated aerodynamic fail-safe braking system (SafetyLOCK™ device)
- Ready for individual pitch control (IPC)
- Reduced loads on existing turbines to extend life-cycle and increase rated power

Converter System

- Reduced number of components compared to competitive products
- Filters only where needed — no common mode filters on both sides of the converter
- IGBT converter technology with long-life foil-type capacitors
- High-frequency, common-mode filter applied to reduce “stress” on the entire electrical system
- Complete enclosed converter/control cabinet (IP54 standard)
- Fast communication between PLC and converter — a key feature to suppress oscillations on the drive train

Control System

- ONE interface only — converter, yaw and pitch system can be controlled and configured by the programmable logic controller (PLC)
- No additional software needed for turbine reconfiguration
- Easy and fast modification of the PLC algorithms if needed (via remote access)
- Very simply, an effective and highly reliable solution
- Continuous monitoring of component condition for fast reaction

SCADA

- Monitoring Functions (graphic overview, summary displays, turbine detail)
- Control Functions (basic controls, advanced controls, error trigger functions)
- Data Collection (availability data, turbine data)
- Reports (availability report, error report, event report)
- Remote Access (dial in, internet VPN)

A simple and efficient system due to Windtec’s unique experience in wind turbine design



Windtec Technology Transfer Portfolio

| Availability | Wind Turbine | Power | Description |
|-------------------|--------------|----------|---|
| Available | WT1650df | 1650 kW | Double Fed Induction Generator, IGBT Converter |
| | WT2000df | 2000 kW | Double Fed Induction Generator, IGBT Converter |
| | WT2000fc | 2000 kW | Permanent Magnet Synchronous Generator, Full-Scale Converter |
| Design Freeze | WT3000df | 3000 kW | Double Fed Induction Generator, IGBT Converter |
| | WT3000fc | 3000 kW | Permanent Magnet Synchronous Generator, Full-Scale Converter |
| | WT3000sg | 3000 kW | SuperGEAR™ Drive Train, Synchronous Generator |
| Under Development | WT2500fc | 2500 kW | Permanent Magnet Synchronous Generator, Full-Scale Converter |
| | WT5000fc | 5000 kW | Permanent Magnet Synchronous Generator, Full-Scale Converter |
| | WT5000sg | 5000 kW | SuperGEAR™ Drive Train, Synchronous Generator |
| | WT10000hts | 10000 kW | HTS Synchronous Direct Drive Generator, Full Scale Medium Voltage Converter |

Partial listing of available Windtec models for licensing. Not all technology licenses are available in all markets. Please consult with a Windtec representative for details.

AMSC Windtec

About AMSC Windtec GmbH — A history of innovation in wind energy development

Following nearly 9 years of development and commissioning work, Windtec GmbH was founded in 1995 in Klagenfurt, Austria and became the leading independent engineering company involved in designing complete electrical systems for wind turbine applications. Their projects ranged from 650 kW land-based wind turbines to 10 MW and larger offshore wind turbines. In 2005, they began delivery of complete electrical systems to Japan, China and Germany. AMSC Windtec became a wholly owned subsidiary of American Superconductor in early 2007.



Windtec introduced the concept of “Build Your Own Wind Turbine” technology transfer for manufacturing of self-designed wind turbines by original equipment manufacturers. They provide complete customer-specific design and development of high quality wind energy systems and work side by side with their customers through the first reference turbine, assembly and certification process. Today, the Windtec technology transfer model is being adopted by Windtec customers on all major continents and Windtec continues to innovate new proprietary products to give their customers the market advantage in wind turbine technology.

American Superconductor

American Superconductor Corporation (NASDAQ stock symbol: AMSC) serves the utility, industrial and wind power markets. AMSC is a leading energy technologies company offering an array of solutions based on proprietary technologies: programmable PowerModule™ power electronic converters, high temperature superconductor wires for transmission power cables and motors and generators, and AMSC Windtec designs and technology for wind energy systems. The company’s products, services and system-level solutions enable cleaner, more efficient and more reliable generation, delivery and use of electric power. With offices around the world, AMSC provides utility and industrial customers worldwide with D-VAR® voltage regulation systems that dramatically enhance power grid capacity, reliability and security. The company’s technologies are protected by a broad and deep intellectual property portfolio consisting of hundreds of patents and licenses worldwide.



Subsidiary of American Superconductor Corporation

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