



Success on solid ground

Reliable performance and innovation in onshore wind power

Answers for energy.

SIEMENS

Convincing performance

Onshore wind power, the most familiar form of renewable energy, faces bright prospects.



The demand for electricity generated from renewable sources is growing at a fast pace. Market analysts are predicting a steady growth of onshore projects to meet the global demand. In short, onshore wind energy appears headed towards a bright future.

Thanks to technical innovation, the generating capacity of onshore wind power plants can be on par with many conventional power plants. Furthermore, efficiency improvements in turbine and generator design have made onshore wind power a viable option even for regions with moderate wind conditions.

Another trend on the wind power horizon is re-powering, which can help substantially boost the efficiency and the power output of earlier generation wind power plants.

Siemens is one of the world's leading suppliers of wind power solutions for onshore, offshore, and coastal sites. The company has a proven track record for delivering wind power projects on time and within budget. As a market leader, Siemens combines technological innovation, experience, and expertise along the entire energy conversion chain to deliver readily available one-stop solutions.

Designed to comply with major grid codes, onshore wind power solutions from Siemens can come fully "plug-and-play ready," thus paving the way for a cleaner and greener future of power generation. They also provide excellent investment protection: Siemens is a market leader in terms of experience and reliability. Onshore wind solutions from Siemens are widely renowned for their outstanding availability and durability.





At West Wind, New Zealand, Siemens supplies one-stop solutions and a comprehensive range of services for onshore wind power generation



Siemens' most popular wind turbine, the SWT-2.3 nacelle, awaiting deployment

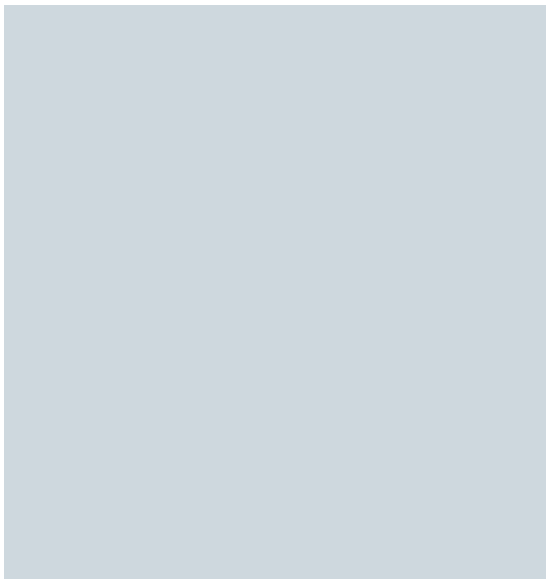
Spearheading innovation, providing reliability

When decades of experience pay off

As one of the world's only energy infrastructure companies with proven know-how and expertise throughout the entire energy conversion chain, Siemens is much more than a wind turbine supplier. Siemens customers benefit from products, solutions, and services that have evolved from more than 150 years of technology leadership in power generation, transmission, and distribution, and from unparalleled project management skills based on three decades of global experience in onshore wind projects.

Siemens presently has production facilities in Europe, the Americas, and Asia, and the company continues to expand its global footprint by locating production facilities in all its key market regions.

The strong local presence, optimized supply chain management, and a comprehensive range of services across the entire project life cycle make Siemens a reliable business partner and the preferred supplier for onshore wind power projects around the globe.



The yaw assembly area. Attention to quality and workmanship form the foundation for the reliability of Siemens wind turbines

The fine art of performance

Onshore wind power plants are a great contribution to a more sustainable, ecologically sound power generation landscape. However, like any other power generation project, wind farms are, first and foremost, expected to generate profit. With this in mind, Siemens has taken every effort to design, manufacture, and supply components and systems that deliver top-class performance in every respect.

This is why Siemens wind turbines can deliver outstanding performance in line with demanding industry requirements. Competitive energy yield in all IEC classes, best-in-class electrical capabilities, and advanced noise control can all help contribute to high availability, making the company a high performer in every respect.

The spirit of innovation

Continuous innovation drives onshore wind power. The commitment to innovation at Siemens can be felt in every product, service, and solution. Constantly striving to be better has led to Siemens providing market-leading technology.

However, innovation requires a solid foundation. That is exactly what 30 years of experience in onshore wind power have provided. It is the solid heritage all Siemens wind turbines have in common.

Meticulous testing and an overtly careful product release policy help Siemens deliver technically mature products to the market. The latest example is the world's first compact direct drive wind turbine with a 3 MW capacity. Siemens thoroughly tested direct drive technology before producing the first prototypes. The prototypes will be extensively tested before being moved into serial production. It is this commitment to quality and performance that make Siemens wind turbines deserved of their reputation.

The benefits of superior technology

Over the years, Siemens wind turbines have set the standard for robustness and reliability. Designed with the most demanding applications in mind, the turbines feature a rugged, conservative structural design, mechanical systems designed for low maintenance, and are made from high-quality components. Operational expenses can be reduced through fewer unscheduled services, better serviceability, and well-sourced spare parts.

Siemens onshore wind turbines can help yield substantial capital expenditure savings thanks to their unparalleled electrical capabilities and their superior SCADA flexibility, which can help save interface costs. The unique NetConverter® system, a standard feature of all Siemens onshore wind turbines, allows highly flexible generator operation and can help adapt the power output to relevant grids.

Reliable workhorses and trendsetting innovation

Proven performance across the board

SWT-2.3 wind turbines



SWT-3.6 wind turbines



SWT-2.3 wind turbines

Siemens SWT-2.3 wind turbines are available with rotor sizes of 82, 93, and 101 meters, which makes these turbines a choice for a broad range of wind conditions. They are renowned for their outstanding performance and availability.

SWT-3.6 wind turbines

The SWT-3.6 wind turbines offer rotor sizes of 107 and 120 meters. The larger swept area captures more wind to provide even greater energy output, which makes these most powerful Siemens wind turbines an ideal choice for re-powering.

SWT-3.0-101 wind turbines

The newest wind turbines from Siemens have the potential to revolutionize the market: the smart and compact machines contain roughly half the parts of a geared turbine. Early performance measurements indicate remarkable reliability and performance.

Turbine noise control

Even though Siemens wind turbines are among the quietest on the market, noise from wind turbines may, under certain conditions, affect close neighbors to wind farms.

Stopping turbines to curb noise emissions is not an attractive option, and therefore Siemens has developed a unique system for noise control.

For noise sensitive sites the wind turbine can switch from normal operations to noise-adjusted operation based upon day of the week, time of day, and wind speed and direction.

Turbine load control

Siemens wind turbines can be delivered with the unique Turbine Load Control system, TLC®.

The TLC system allows turbine installation on sites where the wind conditions exceed the design criteria of the turbine.

The TLC system monitors turbine loads in real time and adjusts turbine operation if actual loads exceed design loads.

TLC allows for dynamic load control and can be tailored to any individual site.

Turbine life monitoring

Most wind turbines will not be exposed to actual loads corresponding to the design loads and may have a technical life beyond the normal design lifetime. It may be difficult, however, to assess the extent of additional technical lifetime on an individual turbine basis.

The TLC system continuously monitors the actual lifetime and provides a real-time status of actual life versus design life. For asset management the knowledge of actual residual life may provide a very valuable basis for future repowering decisions.

Siemens' new, compact direct drive wind turbine SWT-3.0-101



Convincing innovation

Siemens wind turbines share a common bond. Each turbine iteration has been based upon valuable experience from previous generations. Today, Siemens wind turbines utilize advances in the fields of aerodynamics, structural dynamics, noise reduction, and grid performance.

Convincing performance

Over 9,000 Siemens onshore wind turbines, providing more than 11,000 megawatts of clean, renewable energy, are currently in operation all over the world.

Convincing position

Siemens continues to go from strength to strength and is currently on track to be one of the world's top three suppliers of wind turbines by 2012.

Convincing safety

All Siemens onshore wind turbines feature superior design of components and systems to maximize safe and reliable turbine operation.

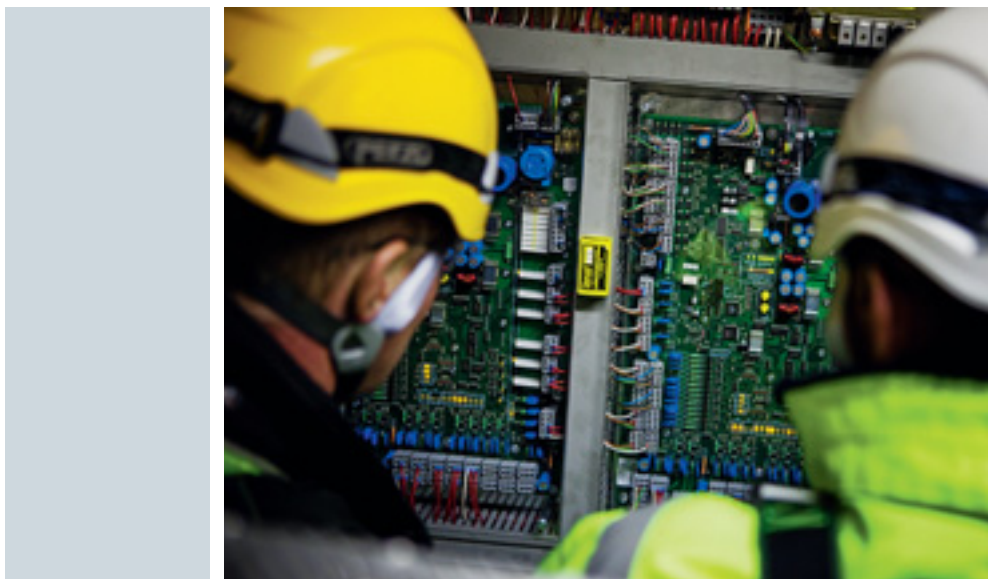
Convincing services

Beyond the warranty period, Siemens can offer long-term service and maintenance contracts to help provide years of safe and reliable operation of the wind turbine.

Service crew at work on a SWT-2.3 nacelle at Farr wind farm, Scotland



Effective servicing of wind turbines requires experienced service technicians



Built to last

High-quality components make for superior systems

Rotor

At Siemens, innovation is a means to an end rather than an end in its own right. Siemens uses state-of-the-art rotor blades combining various best-of-class design features to produce a superior blade. This offers maximum energy extraction from any available wind resource.

The rotor blades are made of fiberglass-reinforced epoxy, manufactured using the proprietary Siemens IntegralBlade® process. Unlike conventional wind turbine blades, the IntegralBlades are cast in one piece in a closed process. The process eliminates glue joints and provides optimum quality and strength in the blade.

The blades are mounted on double-row pitch bearings fitted to a large rotor hub. The pitch actuation system is hydraulic, offering maximum robustness and safety.

Tower

Siemens onshore wind turbines are mounted on tubular steel towers fitted with internal personnel hoists and lifts.

A prefabricated power module is located at the bottom of the tower and provides the platform for the power converter, the turbine transformer, and the medium-voltage switchgear.

Nacelle

The nacelles of the Siemens turbines are ideally suited for severe operating conditions. Major components such as the main shaft, the gearbox, and the yaw system are all of particularly heavy dimensions.

The automatic lubrication systems have redundant lubricant reserves to enable continued operation even if scheduled maintenance is severely delayed. The nacelle's steel and fiberglass canopy design provides optimum lightning and fire protection.

All safety systems are failsafe and have layers of redundancy. Fully integrated climate control and comprehensive surface protection can also help extend service life.

The overall performance of Siemens turbines is well-proven and all details are designed using Siemens' market-leading engineering practices.

Local service technicians have the backing of a global service organization

Siemens service technicians are dedicated to caring for wind turbines



Service and maintenance

Expert service and maintenance at the right time is almost as important for profitable wind power projects as selecting the right wind turbine equipment. That is why Siemens has developed industry-leading predictive service capabilities that can help reduce unplanned downtimes and help keep turbines running longer.

Central demand planning, excellent diagnostics capabilities, and competent field service teams can offer fast response times and well-planned service operations.

Siemens' flexible service programs can be adjusted to match the owner's skill sets, objectives, and interest in participation, and local technicians can rely on the backing of a global service organization. The comprehensive range of service and maintenance options, therefore, can help owners to maximize revenue and earnings throughout the entire project lifetime.

Monitoring

Siemens turbines are equipped with the unique Siemens WebWPS SCADA system. This system offers remote control and a variety of status views and useful reports from a standard Internet browser. The status views present information such as electrical and mechanical data, operation and fault status, meteorological data, and grid station data.

Voltage and frequency control, and other grid-related adjustments, can be implemented by the integrated park pilot utility in the WebWPS SCADA system.

In addition to the WebWPS SCADA system, the turbine is equipped with a Web-based turbine condition monitoring TCM® system. The TCM system is designed to continuously carry out precise condition diagnostics on main turbine components and give early warning of many possible component problems in real time. Based on the TCM system, Siemens can detect and correct many problems at an early stage, which can help reduce maintenance costs, optimize availability, and maximize energy output.

Grid performance

Grid stability requirements grow as more wind power is fed into the grid, and Siemens sets the standard in the field of grid compliance.

Power conversion is implemented with Siemens' NetConverter® system. This system is characterized by full conversion of the power generated, efficiently decoupling generator and turbine dynamics from the grid. The NetConverter system can offer maximum flexibility in the turbine response to voltage and frequency control, fault ride-through, and output adjustment. As a result, Siemens wind turbines can be configured to comply with a variety of relevant grid codes in major markets and can be readily connected to the grid.

Long-standing worldwide expertise in onshore wind power plants

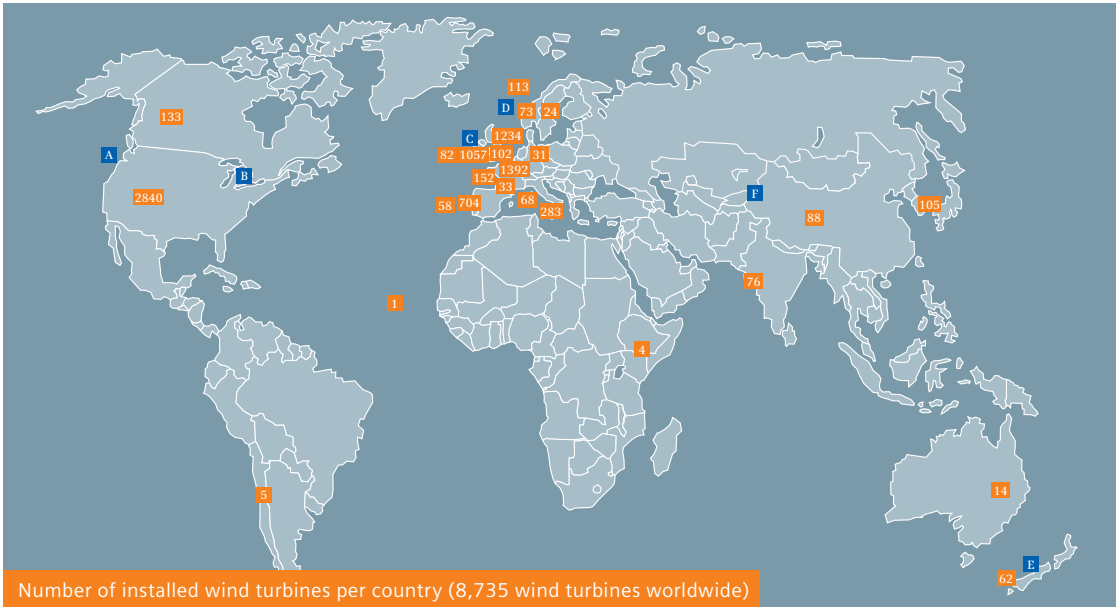


photo courtesy of Cannon Power Group

Selected references from key regions

A

Windy Flats and Tuolumne Wind Farms
2009

Location: Near Goldendale, Washington, USA

Rated capacity: 156 x 2.3 MW (358.8 rated MW total)

B

Wolfe Island
2008

Location: near Kingston, Ontario, Canada

Rated capacity: 86 x 2.3 MW (197.8 rated MW total)

C

Whitelee
2008–2009

Location: 15 km outside Glasgow, Scotland

Rated capacity: 40 x 2.3 MW (92 rated MW total)

Extension: 100 x 2.3 MW (230 rated MW total)

30 years of experience

From the first 22-kW-rated wind turbine sold by Bonus Energy up to the multi-megawatt turbines manufactured by Siemens today, Siemens products have helped harness the power of wind.

During 30 years of continuous presence in the wind industry, wind turbines manufactured by Bonus Energy and Siemens have gained a reputation for high quality, logical and solid design, and continuous innovation. Today, Siemens offers the largest series-production wind turbine on the market – SWT-3.6. Siemens is deserved of its reputation for creating innovative wind turbines that deliver reliable performance.

Big is beautiful

The large-scale wind farms developed in recent years require significant project management know-how in order to be completed successfully. Siemens has extensive experience in this field and has proven itself as a competent supplier of large, complex projects. In 2009, Siemens was awarded the contract for the UK's largest onshore wind power plant project, Clyde wind farm in Scotland.



D

Smøla 2002/2005

Location: Smøla, Norway
Rated capacity: 20 x 2 MW
(40 rated MW total)
Extension: 48 x 2.3 MW
(110.4 rated MW total)

E

West Wind 2009

Location: West of Wellington, New Zealand
Rated capacity: 62 x 2.3 MW
(142.6 rated MW total)
Specific feature: challenging location

F

Xinjiang 1989

Location: Xinjiang Province, China
Rated capacity: 13 x 150 KW
(2.0 rated MW total)
Specific feature: Asia's first wind farm

MW = megawatt
KW = kilowatt

Published by and copyright © 2010:
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Renewable Energy Division
Order No. E50001-W310-A152-X-4A00
Printed in Germany
Dispo 34804, c4bs No. 7491
fb 2847 WS 04105.

Printed on elementary chlorine-free
bleached paper.

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