

Wind industry

Harnessing the power of the wind



Decarbonizing a power sector that currently produces 41 percent of energy-related CO₂ emissions is at the heart of efforts to cut global emissions. Wind is one of the most promising sources of large-scale, emissions-free renewable power generation. Since 2000, total installed capacity has grown on average by about 30 percent per year.

The International Energy Agency predicts the world's energy needs will be almost 50 percent higher by 2030 than they are today. Global demand for electricity grew 30 percent between 2000 and 2007, and is expected to increase an additional 76 percent by 2030.¹

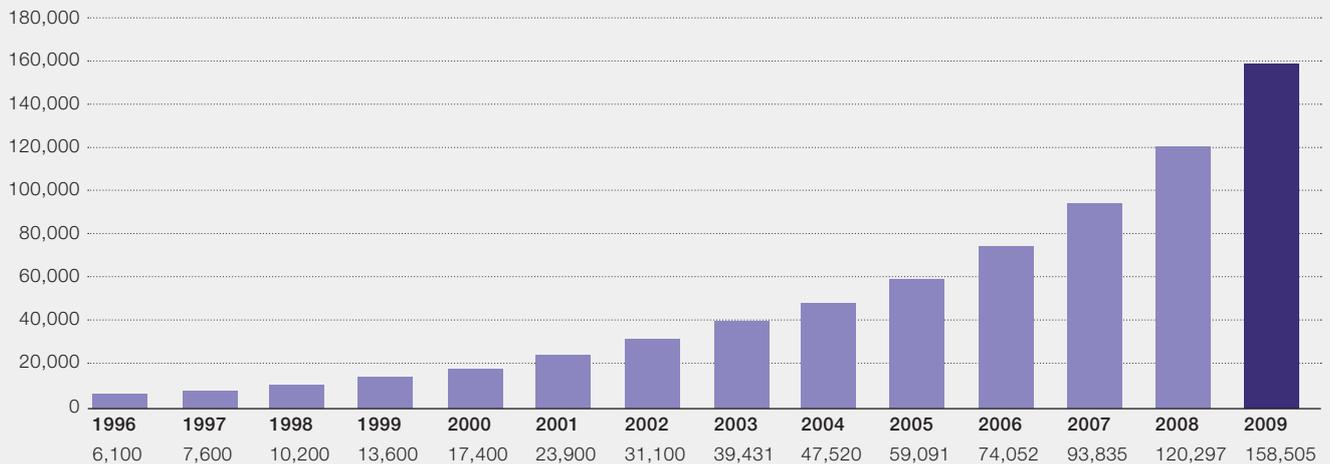
The IEA also predicts that CO₂ emissions will rise by 40 percent over the same period, unless steps are taken immediately to accelerate the deployment of emissions-free power generation and improve current levels of energy efficiency.

The wind power industry has developed into a powerful alternative to the scenario of energy consumption and carbon emissions endlessly rising together. As a result, the sector has expanded exponentially, fueled by increasing energy demand and a focus on renewable alternatives, as well as technical improvements and wind power's new-found competitiveness compared to traditional methods of power generation.

Wind industry

Harnessing the power of the wind

Global cumulative installed capacity 1996-2009 in megawatts (MW)



Source: Global Wind Energy Council

Also at play is a desire by many countries to reduce their dependency on fossil-fuel imports from politically unstable markets. By the end of 2009, accumulated global wind power capacity was about 158,000 megawatts (MW), an increase of 32 percent compared with the end of 2008.²

Increasingly competitive technology

In terms of technology, the industry has grown by leaps and bounds. Since the early 1980s, wind turbines have increased their power generating capacity by a factor of more than 200, according to the European Wind Energy Association (EWEA). In the beginning, turbines were a few stories high and could generate about 50 kilowatts (kW) of power. A single machine installed today can have blades longer than a football field, and is capable of generating 7 MW of power - enough to meet the yearly power needs of 4,250 average European homes.³

Encouraging renewable technologies such as wind power is one of the ways the European Union plans by 2020 to cut greenhouse gas emissions by 20 percent from their 1990 levels, and ensure that 20 percent of the energy used in the EU comes from renewable sources, such as wind and solar power.

EWEA estimates that the wind power capacity installed in Europe by the end of 2009 - a total of 74,700 MW - will avoid the emission of more than 106 million metric tons of CO₂ per year.⁴ This is equivalent to taking 20 percent of all the registered passenger cars in Europe off the road.⁵

Growth in all regions

The global wind power industry changed significantly in 2009. The United States replaced Germany as the world leader by total installed capacity,⁶ and China asserted itself as a global

leader not just in terms of wind power use but also in manufacturing. With three of the 10 largest turbine manufacturers and a world-leading 13.75 gigawatts (GW) of new capacity installed in 2009 (more than one third of the world total 38.1 GW), China is now the world's largest market for wind power.⁷

In the US, 10 GW of new capacity was added in 2009, a 39 percent increase over 2008. That accounted for about 40 percent of the country's new power production capacity. The US and China led the world in new capacity, with the latter experiencing another year of 100 percent growth.⁸

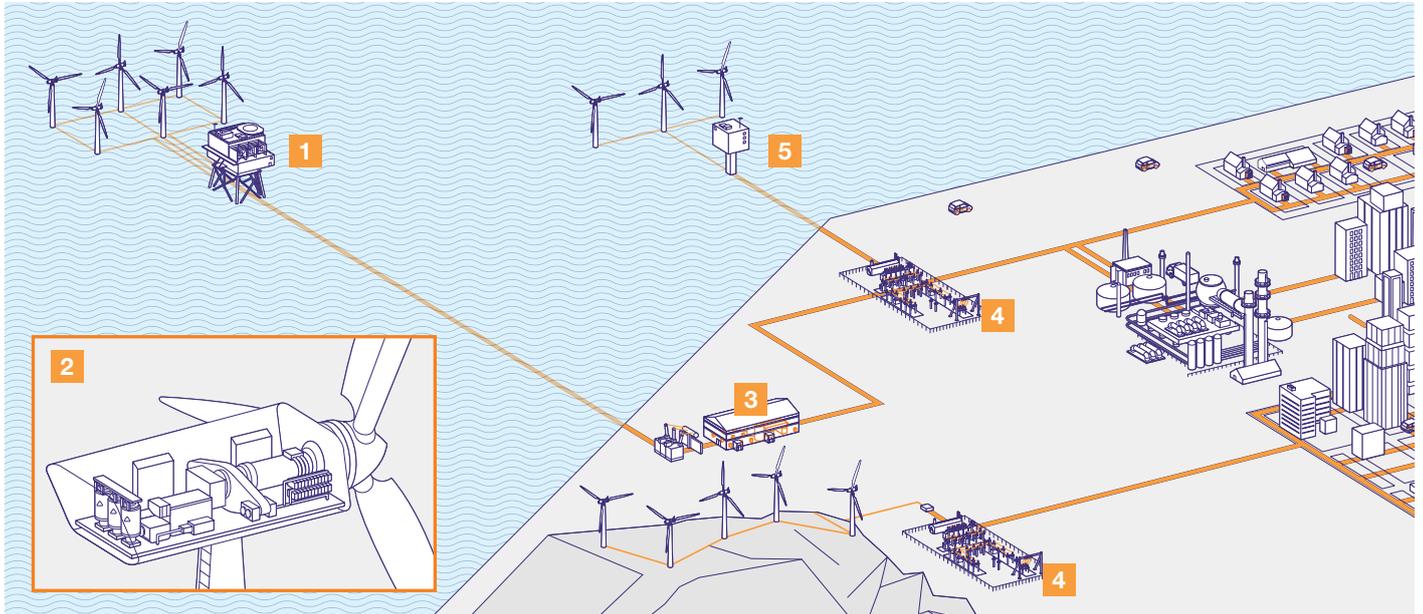
These results combined with continued strong growth in Europe to make 2009 a banner year for wind power in spite of exceptionally challenging economic conditions. While there is certainly an increasing public awareness of wind's benefits and national energy policies continue to shift toward renewable energy sources, government stimulus such as the American Recovery and Reinvestment Act were essential in driving investment.

Over the next five years, the wind sector is expected to grow by 13.5 percent, on average. Total market value is estimated at \$75 billion for 2010, rising to \$124 billion in 2014 with installed capacity reaching 447 GW in the same period.⁹

According to the Global Wind Energy Council, "the 158 GW of global wind capacity in place at the end of 2009 will produce 340 terrawatt hours (TWh) of clean electricity and save 204 million tons of CO₂ every year." As the global economy recovers and demand for clean energy continues to increase, wind power is likely to extend its reign as the renewable energy source of choice.

Wind industry

Harnessing the power of the wind



- [1] High-voltage direct current power transmission system
- [2] Wind turbines
- [3] Onshore HVDC converter station and power transformer
- [4] Substations (also can be used offshore)
- [5] AC platform

ABB: a leading industry supplier

Wind power is an important business for ABB and the company is an important player in the industry. Total wind-related revenues in 2009 came to \$750 million and all five of ABB's divisions participated. ABB experienced significant growth in Asia, and in China in particular, whereas in US and European markets, new orders were down.

ABB's customers include turbine manufacturers, engineering contractors, independent power producers and utilities, thus covering both the generation of electricity and its transmission to the grid. A turbine manufacturer might purchase generators, transformers, converters and a host of low-voltage products from ABB to incorporate into their turbine design.

An engineering contractor building a wind farm might look to ABB for a turnkey substation, cabling system and engineering services needed to connect the wind farm to the grid. ABB even supplies robot systems used to paint the massive blades of wind turbines.

Onshore generation remains the largest area of activity, where the trend is towards larger turbines generating more power. Offshore wind projects are in the early stages of development, and so far account for just 1 percent of installed capacity. Offshore turbines are usually above 3 MW, and even larger machines for offshore use are under development.

ABB can provide offshore customers with the latest low- and medium-voltage technology, simpler turbine designs and high-voltage direct current (HVDC) transmission links to stabilize and connect offshore power generation to the onshore

Wind industry

Harnessing the power of the wind

grid. ABB is the world leader in this type of transmission technology as well as AC interconnections and links, with decades of experience and dozens of project references.

ABB is one of the world's largest independent suppliers of internal electrical components, controls, grid connections, service and maintenance plans for wind power projects. Since the 1980s, ABB has delivered more than 20,000 wind turbine generators, which are the beating heart of wind power systems.

ABB recently launched a new slip ring generator series featuring an enhanced rotor design and modular interface. The new generators cover power ranges from 1.5 to 2 MW, and feature adaptable connections that ensure easy integration into the different types of wind turbines in use today. They are also an excellent choice as replacement units at existing wind parks.

ABB has also launched a new switchgear tailor-made for wind turbines. It is the slimmest medium-voltage switchgear available today, and small enough to fit through the narrow doorway of the turbine tower.

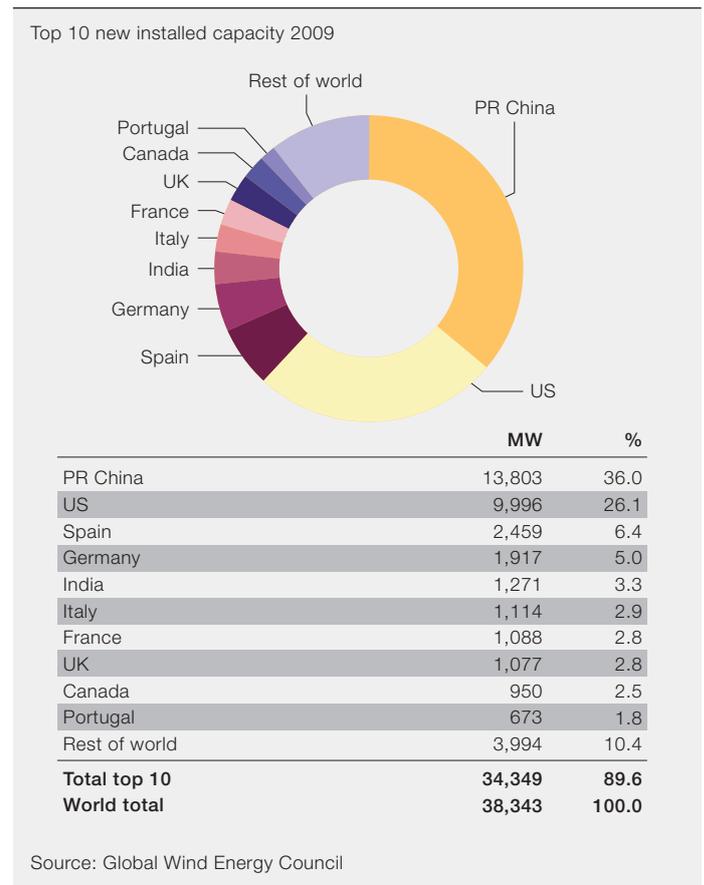
If generators are the heart of wind power systems, grid connections are the arteries that correct electrical voltages and move wind-generated electricity into the power distribution grid, where it can be used by all. As the wind industry grows, however, it is often bumping up against the reality of an electrical distribution network that in mature markets was conceived and largely built 100 years ago.

Many transmission lines and interconnections are now too small to accommodate the amount of electricity that power companies would like to push through them. That impacts wind-generated power in the sense that the best sites are as yet barely tapped, because there is no way to move the electricity from where it is generated to the load centers that need it.

Weak power networks tend to be those with transmission lines in lower voltage ranges, which are most common in rural or isolated areas where wind power projects are usually found. Unpredictable wind-generated power fed into a weak transmission network causes problems such as voltage fluctuations, or "flicker" (also known as harmonic voltage disturbances), which can cause some equipment to overheat or malfunction.

As wind farms increase in size, ABB is designing products to extract the most power from turbines without destabilizing their grid connections, so that wind parks can operate like any other power plant. ABB has a portfolio of technologies (flexible AC transmission systems, or FACTS) that can increase the amount

of power a transmission system can handle by 10 to 50 percent, while at the same time improving the system's stability and flexibility.



Wind industry

Harnessing the power of the wind

ABB references

- ABB has delivered the power transmission link for the 400 MW Borkum 2 wind farm 125 km off the coast of Germany in the North Sea. It is the world's most remote wind farm, and is expected to save 1.5 million metric tons of CO₂ emissions per year by removing the need for additional fossil-fuel generation. The transmission system provided by ABB is underwater and underground, thus minimizing environmental impact.
- ABB fast-tracked an order for 156 transformers to expedite the expansion of one of the biggest wind parks in the US, at Buffalo Gap in Texas. Transformers are essential technology for turning turbine-generated energy into usable electric power. Buffalo Gap 2 went live in June 2007 and the park produces 354 MW of emissions-free power, enough for 100,000 Texas homes.
- In China ABB is involved in large-scale projects such as the country's largest wind farm, Jiangsu Rudong on the Yellow Sea coast, and the Huitengshile wind farm in Inner Mongolia. A compact ABB substation, distribution transformers and ring main unit help Rudong feed about 230,000 MWh of electricity each year into the local transmission network, avoiding 200,000 metric tons of CO₂ emissions annually.

Further reading: www.abb.com/windpower

¹ International Energy Agency, World Energy outlook, 2009

² Global Wind Energy Council, Global Wind Report, 2009

³ European Wind Energy Association, Wind Benefits, 2008

⁴ European Wind Energy Association Fact Sheets, 2010

⁵ European Wind Energy Association Fact Sheets, 2010; The European Automobile

Manufacturers' Association says average annual emissions are 2.4 metric tons for each of the 225 million passenger cars in the region

⁶ Global Wind Energy Council, Global Wind Report 2009

⁷ BTM Consult, World Market Update 2009

⁸ Global Wind Energy Council, Global Wind Report, 2009

⁹ BTM Consult, World Market Update 2009