VestasGlobal

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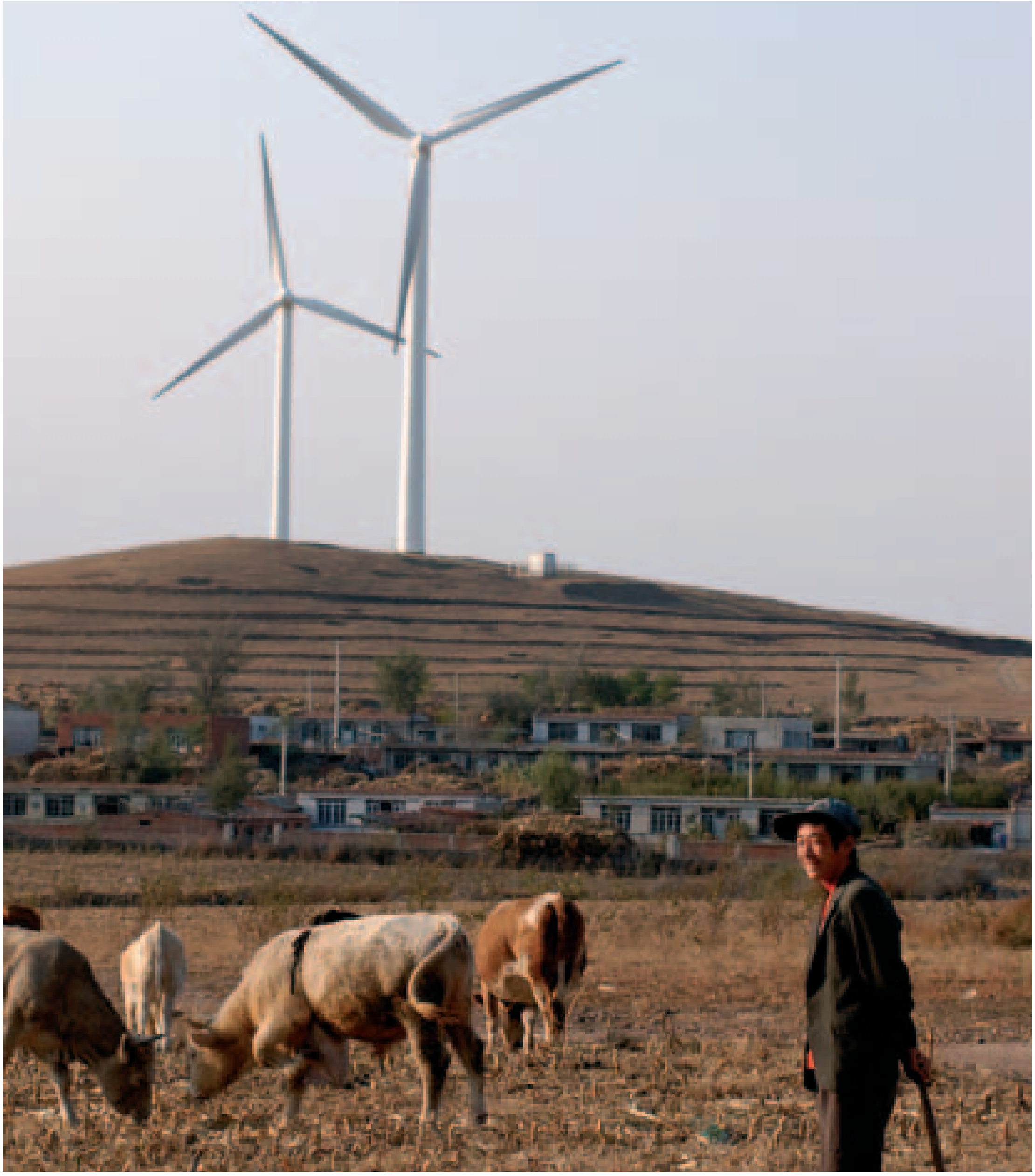

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We face the challenge

When Svend Sigaard steps down on 1 May 2005, it will be the end of an 18-year career with Vestas – the first 15 as CFO and the last three as President and CEO. In the time that Svend Sigaard has been with the company, Vestas has grown from a small business with 60 employees in 1987 to a sizeable multinational with a workforce of more than 9,500 in 2005. In other words, he has played an important role in the remarkable development that both the wind power industry in general and Vestas in particular have experienced during the period. In particular, he was one of the prime movers behind the combination of Vestas and NEG Micon in 2004 – a move that has given Vestas the presence required to maintain its position as the world leader in the wind power industry. You can read more about Svend Sigaard's time at Vestas on pages 4-6.

The development of the wind power industry has involved a great many challenges over the years, and weather, climate and terrain in particular make high demands on experience, technology and knowledge when it comes to erecting wind turbines all over the world. VestasGlobal takes a closer look at some of these challenges in the article on pages 12-13. At the same time, adapting wind turbines to match national electricity grids is an increasingly difficult task – see pages 10-11 for details.

Vestas' constant focus on development is intended to create an even better and more competitive product, and to make it clear that wind energy is a viable and financially sound alternative to conventional sources of energy. VestasGlobal examines the financial considerations which, according to a British economist, should be included when preparing the energy mix for supplying a country with energy. See pages 7-9.

VestasGlobal also casts an eye over development in China – one of the countries that is expected to become a significant growth market on account of its energy requirements and the growing environmental awareness among both politicians and the general public. See pages 14-16.

Good reading!

Jens Anders Jensen
Executive Vice President and CSO
Vestas Wind Systems A/S

Lake Bonney, Australia

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Editors: Jens Anders Jensen (Editor in Chief), Henning N. Klausen, and Hanne Poder Sørensen
Text: Charles Butcher, Barbara Berger, Mikael Sand and Hanne Poder Sørensen

Svend Sigaard

The goal has been reached

After 18 years in Vestas, President and CEO Svend Sigaard is saying farewell.

From around 60 employees to around 9,500. From a turnover of approximately EUR 14 million to one of EUR 2.6 billion. From 75 kW wind turbines to giant 4.5 MW models. Wind power has grown from being simply an "alternative" source of energy to being a viable and competitive option.

These are just some of the facts which prove that things have really been happening for Vestas over the past 18 years – a period that Svend Sigaard has witnessed at first hand. He joined the company as CFO on 1 April 1987 and will be saying goodbye to it as President and CEO on 1 May 2005.

VestasGlobal asked him to take a look back over his exciting years in the wind power industry.

The first orders were quite a kick

The first success was achieved back in 1987. Following suspension of payments and the threat of bankruptcy, Svend Sigaard and Johannes Poulsen (President and CEO, 1987–2002) were appointed to lead the new Vestas Wind Systems A/S into the future. A range of investors pumped around EUR 1.5 million into the company, but according to Svend Sigaard, more capital was needed if Vestas was to survive and become a healthy business.

"Financially, we were very close to the edge. So it was quite a kick when we sold the first of the turbines we had in stock. The purchaser was an American. He collected the turbines in Lem, Denmark, and then took care of all the transport and installation – so it was a very easy order. Fortunately, we picked up a lot of other orders in 1987 and generated a turnover of around EUR 14 million. It was pretty good, but then again, things had to get rolling again," recalls Svend Sigaard.

Keeping a cool head

Another major event for Vestas occurred at the start of the 1990s, when the company was selected as the supplier for the largest project in the world at that time (the Sky River project in the United States) which consisted of 342 V21-225 kW wind turbines – a total of 77 MW!

At that time, it was a huge order and Svend Sigaard remembers that the negotiations were long and tough. The office in Lem was the scene of many a late-night conference to get everything in place. At that time, the work to reel in large orders was just as nerve-wracking as it is today.

"Payment for the turbines only arrived on the last day of the year, and even though there was a lot of stress and tension in the air, we managed to keep a cool head and bring the order home. That is also how it is today, with major projects becoming more and more widespread," explains Svend Sigaard.

Long hours spent in tough negotiations were the key to Vestas' success in landing the contract for delivery of 342 V27-225 kW wind turbines to Sky River in the United States.

New capital needed

Svend Sigaard also mentions 1994 as an exciting year. This was the year that new owners took over Vestas when Dutch investment funds acquired 83 per cent of the shares in the company. Similarly, the flotation of the company on the Copenhagen Stock Exchange in 1998 stands out in his memory.

"Both events resulted in people ceasing to question whether we could actually deliver the projects we tendered for. Actually, the same thing happened in 2004 when, in connection with the combination, we took in new capital to ensure that we were fully equipped to be able to bid on large projects – both now and in the future."

Svend Sigaard sees the combination itself as one of the most memorable events of his era.

"The decision and the timing were right. Naturally, I was quite worried about how we would manage to get two organisations of that size to work together, but I think we have done very well indeed. At the same time, I am sure that the rapid launch of a shared, competitive and customised product range has paid off in all kinds of ways."

Development has pushed back boundaries

In 1987, even the most enthusiastic supporter of wind farms would hardly have dared predict that turbines would grow in capacity from 75 kW to 4.5 MW. Nevertheless, that is what has actually happened. Naturally, the size of the turbines themselves is no guarantee of greater competitiveness, and it is the capacity of wind turbines to compete with other sources of energy that has been at the top of Svend Sigaard's agenda since 1987.

"Fundamentally, the idea was to ensure that customers got a good deal when they invested in wind turbines. Therefore, Johannes and I soon agreed that the kilowatt hour generated by a turbine had to be able to compete with that generated by a coal or oil-fired power station, for example. I think that I can say with a clear conscience that this goal has been achieved today," says Svend Sigaard, who is convinced that wind power will become even more competitive in the years to come.

"Vestas has pushed back the boundaries time and time again over the years. With the largest Technology function in the industry, I do not doubt for a moment that in future, Vestas will produce new solutions that make a direct contribution to making wind power an important source of energy."

More headwind than following wind

The three years that Svend Sigaard has spent as President and CEO have been marked more by headwind than following wind, but he is quick to stress that he knew what he was letting himself in for.

"The increase in competition has been developing for years. Of course, it was a difficult situation to work with, but that is what running a business is all about. Even though we have not quite achieved our goals in some areas, Vestas has remained in the black and turned a good profit."

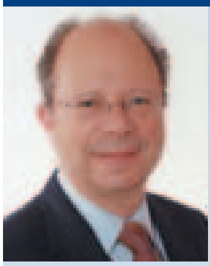
Svend Sigaard has wrestled long and hard with the question of whether to step down.

"The entire industry – and, as a result, Vestas itself – is now entering a period that will be just as exciting as the one we have just been through. Therefore, I think that this is the perfect time for me to step aside and let a new man take the wheel," says Svend Sigaard, who will be handing over to Ditlev Engel on 1 May 2005.

The real cost of fossil fuels

The risk of fuel price rises means that electricity from fossil fuels costs more than is generally acknowledged, argues a prominent economist. This is good news for wind energy, but making best use of wind power will require changes to the grid and to electricity marketing mechanisms.

Man with a mission



Dr. Shimon Awerbuch is a financial economist who specialises in utility regulation, energy and the economics of innovation and new technology. Currently Tyndall Centre Visiting Fellow at SPRU, University of Sussex, UK, he has previously been a Senior Advisor for Energy Economics, Finance and Technology with the International Energy Agency in Paris, Chief, Economic and Policy Studies at the Utility Intervention Office of the New York State Executive Department, and a consultant with Ernst & Young.

Awerbuch has 30 years of experience in regulatory and energy economics, advising Fortune 100 multinationals, energy ministries, the European Commission, the UN, the World Bank and environmental advocacy groups. He is Editor of Elsevier Topics in Global Energy Economics, Regulation and Policy. His current research focuses on portfolio approaches for enhancing energy security and valuing renewables.

www.sussex.ac.uk/spru/profile154800.html

"Suppose you are making a fruit salad," says Dr. Shimon Awerbuch, a financial economist at SPRU, a research institute at the University of Sussex, UK. "You go to the market and you notice that strawberries are expensive today, so you know that if you want strawberries in your fruit salad, the salad will cost more."

"Now imagine you're planning the country's energy strategy. You look at the various generating technologies and fuel types, and you decide that electricity from wind is more expensive than electricity from natural gas. So adding wind power to the mix will increase the cost of electricity, right? Well, it isn't that simple."

The missing part of the puzzle, explains Awerbuch, is the risk attached to fuel prices. At the market, you know exactly how much you will pay for your apples and your strawberries. When you build a power station, many of the costs are much less clear. How much will natural gas cost in ten years' time, for instance? "No-one really knows the answer to that," says Awerbuch.

Companies and governments plan their investments using "discount rates" – nominal interest rates that allow today's money to be compared with future money. It is common to use the same arbitrary discount rate, often in the range 5 – 10 per cent, for every part of every energy project. That may have worked reasonably well for comparing similar fossil technologies a long time ago, Awerbuch says.

But traditional arbitrary discount rates do not apply where risk is an issue, as with the future cost of fossil fuels. Risk costs money, as people who invest on the stock market well know. That is why risky bonds, which promise high annual returns, are often priced the same as "safe" government bonds with much lower interest rates.

"People want to minimise risk as well as maximise their income," says Awerbuch, "which is why most investment portfolios include 'safe' investments like government bonds, as well as higher-yielding but riskier investments. A portfolio like this is proven to perform better, on average, than a collection of high-risk stocks."

The true cost of risk

Like stock market investments, says Awerbuch, power generation benefits from a portfolio approach that allows for risk when seeking to minimise cost.

It is not as if these risks are small. Volatility in fuel prices costs governments dearly, he says, through their effects on economic growth and jobs, especially when high oil prices coincide with, and aggravate, economic depression. The 1973 oil crisis is estimated to have cost the US economy $350 billion; other sources suggest that fuel price volatility has cost an average of $33 billion a year over the last 30 years. Whatever the exact figures, they are far greater than the costs of changing to renewable sources.

Even if renewable energy costs a little more than fossil power – and even this is debatable, Awerbuch says – its costs are more certain. "To put it another way, fossil power becomes much more expensive if we allow for risk." Conventional analysis of US power costs typically assesses electricity from natural gas at around $0.03/kWh, against wind power at $0.04/kWh. Allowing for risk, he says, the true price of power from gas should be much higher, at $0.05-0.07/kWh.

Awerbuch says that though risk-based portfolio management techniques have been used for decades by financial economists, they have not been widely adopted in energy policy. "Other industries consider many of the models used in the energy industry to be out-of-date, and abandoned them," he claims.

Power portfolios

In a 2003 study of energy use in developing countries carried out for REEEP (Renewable Energy and Energy Efficiency Partnership), the United Nations Environment Programme and the British Foreign Office, Awerbuch found that increasing the share of wind and other renewables significantly lowered overall generating costs. One of the countries examined in the study was Mexico. The "business as usual" energy scenario projects that by 2010 Mexico's electricity would be supplied 75 per cent by fossil fuels, with nuclear power making up most of the balance, and would have an average cost of $0.05/kWh. Lowering the fossil share to 60 per cent, increasing geothermal generation to 11 per cent and wind power to 9 per cent would cut real energy costs by almost a third, to $0.036/kWh, Awerbuch claims. This is despite a higher assumed generating cost for wind: $0.05/kWh as compared to $0.036/kWh for gas.

In the UK, the government's plan to reduce carbon emissions from power generation involves a shift towards natural gas – a relatively risky fuel – as well as an increase in wind power. The current target is 11 per cent of electricity from wind by 2010. Awerbuch's calculations show that the UK could reduce generating costs by 17 per cent,

without increasing risk, by using three times as much wind (31 per cent). Using five times as much wind (54 per cent) would cost no more than the current plan, but would considerably reduce risk – as well as being better for the environment.

In the USA, the current policy of increasing gas use raises risk considerably while providing only a small reduction in cost, Awerbuch says. A mix containing 18 per cent of wind power would reduce risk by 23 per cent without increasing costs, even when wind power is assumed to cost 70 per cent more than gas.

The intelligent grid

The spread of renewable energy could be helped by new ways of distributing and marketing electricity, Awerbuch continues. "Wind is the lowest-cost electricity source for the foreseeable future, and it could provide half our electricity. But the existing grid is 100 years old, and new energy technologies need new support systems," he says.

Sources of renewable power tend to be distributed: they are more widely scattered than conventional power stations, and smaller in scale. Some renewable sources, notably wind power, are also intermittent: they are not available at all times. "Making the best use of wind depends on how much electricity demand can be shifted away from periods when the wind is not blowing, and how much information can successfully be transmitted and processed by the grid," says Awerbuch.

The traditional view of the grid as a bulk transport system is not helpful in the new world of distributed energy sources, he says: "We treat electricity as a single, mass-produced product, when really it's subject to millions of separate transactions." Instead, trading arrangements need to recognise that power is worth different amounts to different customers at different times: "Someone who wants to watch an important football game will pay more for electricity than a guy who's just mowing the lawn."

"Right now we're asking intermittent technologies to supply wholesale power, but they weren't designed to do that. Instead, we should match intermittent generation with intermittent loads, like pumping water or running refrigerators – if the wind dies down, these jobs can wait for a few hours. We need an intelligent or 'informated' grid to accommodate this."

Some liberalised electricity regimes already give customers more control over where their power comes from, but even these do not go far enough, Awerbuch claims: "Here in the UK, I can contract with a wind farm to buy electricity. You would think there were just two parties in the contract, but that's not so, because if the wind stops blowing, the grid will still supply me with electricity from another source.

"I'd like a system where if the wind stops, I must either obtain my power on a separate backup contract, or go without. That way I could run my computer on conventional power, and use cheaper wind energy for less-critical jobs." Letting electricity users make informed choices is the future, Awerbuch says – and that is good news for wind energy.

Power with responsibility

As the proportion of electricity generated from wind continues to rise, the rules governing how wind turbines connect to the grid are changing.

Across the world, the technical rules specifying how wind turbines interact with electricity transmission grids are changing. The reason is simple: wind energy is now a significant part of many countries' energy mix, and grid controllers can no longer afford to ignore it. As a result, new "grid codes" – the technical specifications to which generators must respect to be allowed to connect to the grid – are appearing in many of the world's leading wind power nations, including Germany, Denmark, Ireland, Spain, the UK, Australia, the USA and Canada.

One of the most important changes in the new grid codes is a requirement for wind turbines to keep generating electricity in the event of a grid fault. Before this, wind was not seen as a primary energy source. Whenever there was a problem on the grid, wind turbines would be disconnected and engineers would rely on conventional power stations – coal, gas and nuclear – to restore stability. Once the grid was running smoothly again, wind energy was allowed back.

"A few years back, the electricity authorities were cautious about connecting wind power to the grid. That was quite reasonable, because early wind turbines were relatively small in scale and their grid quality control was rather basic," says Søren Plagborg, Technical Support Manager at Vestas. "So in the event of a fault, wind turbines had to instantly disconnect from the grid – whether or not they had caused the problem in the first place."

But when wind power plants account for a sizeable share of many countries' generating capacity, shutting them down without a good reason is no longer sensible. A fault that causes the loss of even several hundred megawatts can usually be handled without cutting off the supply to customers, thanks to spare generating capacity, known as "spinning reserve," that can be called up at short notice. Shutting down large amounts of wind power at the same time, however, could cause blackouts for several hours.

The example of the UK shows how wind power can quickly become a resource that is too important to do without. The country's spinning reserve of 1.3 GW, equivalent to a medium-sized fossil-fuel power station, is currently greater than the UK's entire installed wind capacity, but the situation is changing fast. By 2010 the UK plans to get around up to 3 GW of power from wind, while the spinning reserve will remain at 1.3 GW. In countries such as Denmark that already have a much larger share of wind power, the need to avoid needless disconnections is even more acute.

New realities, new rules

Grid faults can result from lightning, trees falling onto overhead lines, cables struck by road-mending machinery, failure of equipment such as transformers and circuit breakers, and unplanned shutdowns at generating plants.

"When there is a fault on a power line, things happen quickly," says Plagborg. At the location of the fault, the grid voltage falls to zero almost instantaneously and a "wave" of low voltage starts to spread out across the network. Less than one-fifth of a second later, monitoring equipment has detected the voltage drop and contained the wave by temporarily isolating that section of the grid. Just three seconds after that, a typical transient grid fault has been cleared and the system is back to normal.

Unfortunately, a voltage dip lasting just a few tenths of a second is enough to shut down a wind power station. Although under the old-style grid codes this is exactly what is supposed to happen, the basic problem is that first-generation wind turbines have little option but to stop generating in the event of a grid fault. This in turn is because the non-synchronous generators used by wind turbines behave differently from the synchronous machines found in large power stations. As long as the fault is cleared quickly, synchronous generators will continue to run, but non-synchronous generators are less forgiving.

If no changes were made to the design criteria for future wind power plants, the likelihood of blackouts would increase as more wind capacity is built. The problem is most acute in countries that depend heavily on wind power, such as Denmark and Germany, and islands such as the UK and Ireland, which have relatively weak grid connections to neighbouring countries. Across the world, however, the companies who run the transmission grids realised that it was time for wind generators to be subject to the same rules as conventional power stations, which have to keep working while a fault is cleared – a process known as "fault ride-through."

Ireland was the first country to introduce a new grid code requiring wind energy plants larger than 5 MW to have fault ride-through, in August 2004. Other countries soon followed; in Great Britain, for instance, the new grid code is expected to come into force in April 2005.

Technology makes it possible

Fortunately for all concerned, the technology to make fault ride-through possible was already well in hand. The generators themselves will not change greatly: most wind turbines continue to use non-synchronous generators because they are simple in design, highly reliable and have other characteristics that are well-suited to wind power. However, many modern wind turbines also incorporate electronic power converters and control systems that make fault ride-through easier to implement.

Power converters were originally designed not for fault ride-through but to make wind turbines more flexible. Simple wind turbines use non-synchronous generators connected directly to the grid and running at essentially fixed speeds. In strong winds, speed is controlled by varying the pitch of the turbine blades. Pitch control takes several seconds to act, however, and in gusty conditions it cannot always keep up with changes in wind speed. To reduce mechanical stress on the drive train, manufacturers therefore sought other ways to vary generator speed by taking advantage of the characteristics of non-synchronous generators.

An example of such a system is OptiSpeed®, which allows the speed of Vestas generators to vary within a range of approximately 60 per cent with little loss of efficiency. Such a wide speed range not only acts as an effective shock absorber in gusty winds, but also increases power output at low wind speeds. The generator produces alternating current with a frequency that depends on the speed, though, so it cannot be connected directly to the grid, which requires a fixed frequency. As a result, variable-speed wind turbines rely on electronic converters to match the frequency of the generator output to that of the grid.

A useful side-effect of electronic power converters is their ability to provide active support to maintain stability on the grid. The converters control the voltage and frequency of the electricity they deliver, and they are also able to continuously adjust the power factor – the phase relationship between voltage and current. The ability to control power factor is important in maintaining stability in the event of a fault that causes the external grid voltage to vary from the desired value.
If a voltage problem starts to develop on the high-voltage transmission grid, a regional grid command centre instantly notifies the wind energy plant's central control system (SCADA system) over a dedicated data link. The SCADA system then adjusts the power factor, so that the wind power plant becomes an active partner in helping to maintain a stable voltage profile. Large wind power plants have an even more important role in grid stability, providing frequency support as well as power factor control.
To comply fully with the new grid codes, Vestas has had to modify its power converters and SCADA systems, and also to increase the size of it generators slightly. "The extra cost in doing this is the negative aspect of the new codes," says Plagborg. "But it applies to every wind turbine manufacturer, and the fact that we now have to play by the same rules as conventional generators shows that wind power has come of age."

Peak performance

Mountains and deserts are difficult places to build and operate wind turbines – but the effort pays off.

Snow, ice, rain and wind: mountains can be a hostile environment for human beings. Mountains are a challenging environment for wind turbines too, but one in which Vestas engineers excel, explains Henrik Kanstrup Jørgensen, Vice President, Technical Support.

Mountain winds are typically strong, turbulent and hard to predict. Wind speeds of over 25 metres per second are a problem in themselves, since they require turbines to shut down so as to avoid damage. Rapid changes in wind speed are also undesirable: mountain winds that jump from 6 to 25 metres per second in a couple of seconds impose large structural loads, which shorten turbine life and can increase the risk of unplanned shutdowns.

One measure of the variability of wind speed is turbulence, which engineers define as the standard deviation of the wind speed, measured over ten minutes, divided by the mean speed. Turbulence in mountain areas is often 15–20 per cent higher than at sea level, says Jørgensen. That may not sound a lot, but the resulting increased load can reduce the design lifetime of a wind turbine to a half or less. "Just imagine what this means for a poorly-designed turbine," he says.

Wind blowing up a slope creates uneven forces on the turbine blades, while the horizontal angle of inflow can veer suddenly as the wind funnels from one valley to the next. Two turbines just 100 metres apart can see a difference of 30 per cent in the amount of power they generate over a year, or a similar difference in structural load for the same electricity production.

Meeting the challenges

So why bother with mountains? For two good reasons, says Jørgensen. First, mountains often have useful amounts of wind in parts of the world that are not otherwise very promising for wind power, such as those outside the trade winds. Second, mountains provide building space that may be in short supply elsewhere.

Although Vestas' home country of Denmark is rather flat, any company aiming for a global presence in wind power must get to grips with hilly terrain. "50–60 per cent of the world market for wind energy is in mountainous areas," says Jørgensen. "That includes places like Italy and north Africa, where there is little wind at ground level but plenty in the mountains, and countries such as Japan, where there simply isn't much flat land available for wind power plants."

And, of course, those strong winds mean extra power for the taking. Some mountain sites have average wind speeds as high as 13.5 metres per second, says Jørgensen, which means 50 per cent more power than from a typical high-wind onshore or offshore site where winds average 9 metres per second. Harnessing this extra power has been a speciality of Vestas ever since the 1980s, when the company began supplying turbines for

Las Lomas, Spain

mountain sites in the USA. “In those days a lot of the design was done by rules of thumb, so we had to be quite conservative,” says Jørgensen. “If you were to scale up these early designs, without the advances we have made since then, they would weigh three or four times as much as today’s turbines.”

Modern design techniques have allowed Vestas to create turbines that are powerful yet lightweight. This means they can be installed using relatively small cranes and foundations, which is especially important in mountainous areas where access and working conditions are often difficult, and to have long service lives even in areas of high wind speed and turbulence. “These machines need planned maintenance only twice a year, and we’re now aiming for once a year,” says Jørgensen. “Twice a year is every 4000 running hours – your car, by comparison, is probably serviced every 500 hours.”

The use of water-cooled generators, as for the V90 turbine, improves performance under extreme conditions and reduces the physical size of the turbine. In some areas of the USA and Australia, ambient temperatures can go from –20°C to 35°C or higher. The wide range means lubricants must be chosen carefully, and high summer temperatures make cooling difficult – especially at high altitudes, where the air is thinner. Water cooling means that the nacelles need less external ventilation, which in turn improves resistance to corrosion. “Salt in the air can be a problem at sites near the coast,” says Jørgensen. “At temperatures below 11°C, our new turbines don’t need any air cooling at all. This makes them more reliable and increases their protection against corrosion.”

Modern techniques of data collection and mathematical modelling also help make sense of the unpredictability of mountain winds. “Standard wind measurements don’t tell us enough about the shape of the time-dependent wind profile, but we have developed measurement techniques to overcome this,” says Jørgensen.

“We are continually developing our design techniques – for instance, we are increasingly using computational fluid dynamics (CFD) to model wind conditions and predict the best turbine sites.”

“Designing a wind power plant for complex terrain is a matter of judgment and experience as well as the ability to do complex calculations,” Jørgensen concludes. “Vestas has a proven track record in building and erecting wind turbines for challenging conditions.”

Growing support for wind in China

With its booming economy and concern about pollution, the Chinese government is aiming for 10 per cent power generation from renewables in 2020.

China is booming and needs more energy. With a growth rate of 9.5 per cent during the last quarter of 2004, the Chinese economy is one of the world's fastest growing. Due to its rapid economic growth, China's focus on its long-term energy security is increasing for many reasons. Among others, the country's growing need for energy, the world's unstable energy prices and supplies, and finally, the current and probable future environmental impact of coal firing and car emissions in China.

Against this background, the huge potential for renewable energy in China is becoming increasingly relevant. The Chinese Government has set the target of meeting 10 per cent of the country's power generation from renewables by 2020. A significant share of this amount is expected to come from wind energy.

In May 2004, a report called "Wind Force 12 – China" released by the European Wind Energy Association (EWEA), the Chinese Renewable Energy Industries Association (CREIA), and Greenpeace showed that China is capable of installing 170 GW of wind power by 2020. The optimistic scenario they describe entails the following:

- The installation of 170,000 MW of wind power which would generate 417 TWh of electricity
- A total investment of EUR 105 billion
- The creation of 382,000 jobs
- An annual reduction of 325 million tonnes CO_2

Though optimistic, this scenario is not impossible. According to CREIA, China has abundant wind resources due to its large land mass and long coastline. According to The China Meteorology Research Institute, China's exploitable land-based wind resources have a potential power generation capacity of 253 GW, while its ocean-based wind resources have a potential of about 750 GW, a total capacity of approximately 1,000 GW. According to the Institute, the richest areas are located along the southeast coast and nearby islands and in Inner Mongolia, Zinjiang, Gansu Province's Hexi Corridor and the Qinghai-Tibetan Plateau.

At present the reality is quite different. China's installed wind energy capacity was approximately 800 MW at the end of 2004[1], having risen from only 20 MW in 1990.

New renewable energy law

China's increased focus on renewables is reflected in a new law that was passed by the National People's Congress (NPC) on 28 February, 2005. The law which was drafted by various Chinese ministries is called China's Renewable Energy Promotional Act and requires the mandatory use of renewables. Li Junfeng, Secretary General of CREIA says, "We believe that this law can start a renewable energy revolution in China." The law will make it easier to finance renewable energy projects, including wind energy, and it will therefore encourage the development and utilization of renewable energy and encourage market forces and the injection of capital into the industry. The law will come into effect from 1 January, 2006.

Kang Ping site, Liaoning, China

State concession projects

At present, the National Development and Reform Commission (NDRC) is planning to establish 20 concession projects each consisting of 100 MW before 2010. The first two concession projects have been offered and Vestas won the supply contract for the second one. The order was from the Chinese company Jiangsu Unipower Wind Power Co. Ltd. and is for 50 V80-2.0 MW wind turbines for the Rudong Wind Power Concession project. It is the first Vestas order for MW turbines in China and it comprises the delivery of the turbines plus the remote control system as well as a service and maintenance agreement. The project will be installed in Jiangsu province and is expected to be commissioned in late 2006. Svend Sigaard, President and CEO of Vestas Wind Systems A/S said about the order, "China has a huge demand for electrical energy, and wind power plants can be established quickly, which is a big advantage compared to other energy sources. Wind energy is expected to play an increasing role in the general energy supply in China, and Vestas has great expectations to the Chinese market."

In addition to the 20 concession projects, the NDRC expects a total of 500,000 MW of new generating capacity to be installed in China by 2020.

Local manufacturing

One of the conditions of the Chinese government's concession projects is that a significant part of the components used in the wind power projects must be manufactured locally. In the Vestas order mentioned above, the requirement is that 50 per cent of the components used must be of Chinese origin. In projects tendered starting in 2005, 70 per cent of the components used must be manufactured locally. To meet this requirement, Vestas is building a blade factory in China.

In addition, Vestas opened a Strategic Purchasing Office in Shanghai in February 2005 to source the purchase of both raw materials and components from Chinese suppliers for the Vestas Group and also for present and future wind projects in China.

Transition time in China

In connection with all this activity, VestasGlobal spoke to Jens Olsen, Vestas' Chief Representative in China about developments there. According to Olsen, who has been working in China for 14 years, the general transition in China from a state-controlled to a socialist market economy is really opening

up the market. In addition, Olsen considers Chinas' new Renewable Energy Promotional Act to be a very hopeful sign. "The new law will mean government recognition of renewable energy and will give renewables a significant place in China's supply energy mix," says Olsen. " It will also mean that our business is being taken more seriously than ever before."

Olsen continues, "Since Vestas expects to receive orders for a significant number of concession projects in the next few years, we are building a blade factory with the capacity to support the needs of these projects. The establishment of production facilities is also an expansion of Vestas' US dollar-related manufacturing base. In addition to this, we have opened a Strategic Purchasing Office in Shanghai. The new office will be in charge of strategic purchasing and aim to improve and do our sourcing in China. This should also improve our supply chain in dollar currency."

In addition to the state-controlled concession projects, the Independent Power Producers (IPP) in China are also offering a number of projects based on imported equipment. Vestas, says Olsen, is successful with these projects. "At the moment we are installing two projects," he reports. The first is in Ningxia and comprises 36 V52 wind turbines. The second is in Chifeng and also comprises 36 V52 wind turbines.

"We are negotiating a number of other projects at the moment."

The future

When asked about the future, Olsen had this to say: "China needs electricity, so energy supply is now getting a high priority. At Vestas, we see our future not just as manufacturers of wind turbines, but also as turnkey suppliers of windpower plants. Moreover, we believe that the wind industry, including Vestas, can create a lot of new job opportunities for the Chinese, which is another very important aspect in these developments. In addition, there is another important reason why wind energy is so much in focus now – it presents a new opportunity to diversify the energy supply, which today is mainly based on coal-fired power plants. There is also a major concern about the increase in pollution among the Chinese.

So again, clean wind energy is becoming a known, attractive alternative, which enjoys increasing support among the Chinese. And with the Olympic Games coming up in Beijing in 2008, the whole city is being cleaned up so who knows what role renewable energy can play here?"

Source:
1. BTM Consult

Good collaboration and proud traditions in New Zealand

The Te Apiti project in New Zealand is a shining example of how good collaboration, local backing and observance of local traditions can overcome obstacles and make everything fall into place.

In 2004, Vestas installed and commissioned fifty-five NM72-1650 kW turbines at the Te Apiti site in New Zealand. The site, which has a total capacity of 90.75 MW, is located on the North Island in the Ruahine Range – a part of the mountain chain that runs through the whole of New Zealand. The turbines were installed from May to October 2004 and following commissioning and testing, the project was handed over to the customer – Meridian Energy – on 8 December 2004, one week ahead of schedule. Te Apiti is the first wind farm in New Zealand that involves megawatt-class turbines and delivers power to the national electricity grid.

Storm and flood

During the installation period, a number of major challenges were encountered. For example, new roads had to be established, a project complicated by the mountain location of the site. The weather, too, constituted a particular challenge. In the first phase of the project, the area was hit by a torrential deluge accompanied by a storm. This flooded the entire area and destroyed a bridge that was essential for access to the site. At the same time, the erection work was hindered by the wind, which was often very strong. The weather-related challenges caused the loss of many working days, but on account of good planning and excellent collaboration between Vestas, the customer and the other partners at the site, the team succeeded in making up for this lost time.

The nacelles and hubs were made in Denmark, the blades on the Isle of Wight and the towers in Vietnam. All the turbine components were shipped to New Zealand and landed at the town of Napier on the eastern side of the North Island. From here, the turbines were driven approximately 150 kilometres to the site. “On the way, we stopped off at a number of schools, which had called us in advance to ask us to visit so that the pupils could see

the turbine components," related Carsten Brink, Project Manager for the Te Apiti project. "This gave them a first-hand view of the giant dimensions of a modern megawatt-class turbine, and they were particularly fascinated by the size of the blades," he continues.

Great local backing

The project was generally very well received by the local population, who are both pleased and proud to have the wind farm as their neighbour. "Before approval for the project was granted, a hearing was held to allow the local residents to voice their concerns. The project owner received some comments, but, unusually, more than half of them were in *favour* of the wind farm rather than against it. In fact, one of the respondents wanted the turbines located closer to his home," recalls Carsten Brinck. He continues: "Generally speaking, the project attracted great attention from the media and the reporting was always positive in both the local and the national press. At the same time, the two closest neighbouring towns were competing for 'ownership' of the farm, and they are both using wind turbines as a kind of hallmark for the area. Many of the locals followed the progress of the project at first hand and their positive attitude and pride were remarkable."

Tourist attraction

The Te Apiti wind farm has also proved to be a major benefit for the area by attracting large numbers of tourists. In fact, so many people – both local residents and tourists – are interested in the farm that the project owner has set up a public viewing area by one of the turbines. Here, anyone interested has the opportunity to take a closer look at the impressive constructions and to read information boards to find out about the project and wind power in general. The area also provided front row seats for viewing the installation work itself. In the second week of October 2004 alone, a traffic counter installed at the site registered more than 1,400 visiting cars[1].

Respect for Maori traditions

The project was completed in close collaboration with the Maoris, the indigenous people of New Zealand. Before the project was started, places sacred to the Maoris in the area were identified and measures were introduced to ensure that no turbines would be located on these sites[2]. The name of the wind farm (Te Apiti) was also chosen in consultation with the Maori people. "Before the project was started, the Maoris held a ceremony to bless the site, to call down the approval of the spirits and to recognise that the area was to be used for positive purposes," explains Carsten Brinck, who continues: "The Maori people were involved throughout the project and also attended the official opening of the wind farm, where they dressed in traditional costumes and performed a war dance in line with their traditions and culture." The Te Apiti wind farm was officially opened on 9 December 2004 by Helen Clark, Prime Minister of New Zealand.

"The project shows just how far you can go on the strength of good collaboration between the parties involved, appropriate attention and local backing. The fact that we succeeded in delivering the project to the customer a week ahead of schedule – despite the problems we experienced and the number of working days we lost – can be attributed to good planning and extraordinary collaboration between all the parties involved in the project. It is a shining example of the fact that positive vibrations can encourage people to go the extra mile," concludes Carsten Brinck.

Sources:
1. "Southern hemisphere's biggest wind farm now delivering full power," 1 November 2004, *www.meridianenergy.co.nz*
2. The Meridian Report, Spring 2004

The largest turbine in Greece to date

Greece is one of the markets on which wind energy is developing very positively. Vestas is currently working on a project to install twelve V90-3.0 MW turbines in the Peloponese in the south of the country. The turbines are being erected on Mount Didima, which stands in a delightful area of countryside close to Naphlion, the first capital of modern Greece. Standing at an altitude of 900 metres, the site provides a magnificent view over the Aegean Sea, and the area is dotted with traditional Greek villages and islands. The V90 turbines are the largest wind turbines ever to be installed in Greece. The installation work started in February and is scheduled for completion in June 2005.

A regional success story in Australia

The Lake Bonney wind farm in Australia has attracted both jobs and tourism to the area.

In December 2004, forty-six V66-1.75 MW turbines were commissioned at the Lake Bonney wind farm, a site stretching over 8 km and located in a remote area near Mount Gambier in South Australia. Lake Bonney is currently the largest wind farm operating in Australia.

A challenging project

Setting up the Lake Bonney wind farm was something of a challenge on account of the terrain itself, which is hilly and sandy. This terrain gave rise to a range of problems with the transportation of the nacelles, towers and blades, but all operations were completed successfully thanks to the painstaking planning done before the turbine components reached the site. For example, work was carried out to make the approach roads as reliable as possible before the heavy components started to arrive, and towing assistance was kept on standby throughout the erection phase. The management of the site itself was also challenging, as its sheer size made it difficult to monitor.

Benefits for the local area

The Lake Bonney wind farm is a resounding success in the local area for a number of reasons. Firstly, not only has it started to supply the region with clean, sustainable energy, but it has also brought jobs to the area – which is one of the reasons why the local attitude to the wind farm is generally very positive. Robert Boyle, a Project Assistant at Lake Bonney, relates: "I have met a lot of different people from the nearby town on a number of occasions, and I have heard a great deal of positive comments about the project – both from people I have spoken to myself and from conversations I have overheard."

Secondly, the wind farm has made a positive contribution to the area by attracting tourists. The number of wind farms in Australia is still limited, which makes them a natural choice of destination for tourists looking to satisfy their curiosity. The Lake Bonney wind farm is no exception, and Robert Boyle says that it is attracting plenty of interest. "You simply cannot drive up to the site without seeing a couple of cars passing through the area to take a look at the turbines. A local entrepreneur has even invested in a coach and started running guided tours of the site," he says. "These give tourists the chance to study the giant constructions right up close and experience the sheer size of the wind farm for themselves. Although the coach trips sometimes include visits to other local tourist attractions, the wind farm is still the main draw."

The Lake Bonney wind farm is expected to generate approximately 225 gigawatt hours per year.

Contacts

Regions

Vestas Northern Europe
+45 97 30 00 00
Sales and service in UK, Ireland, Scandinavia, Poland, the Baltic area and offshore

Vestas Central Europe
+49 4841 9710
Sales and service in Germany, Austria, Benelux, Russia and Eastern Europe

Vestas Mediterranean West
+34 902 41 98 00
Sales and service in France, Spain, Portugal and the rest of the western Mediterranean area

Vestas Mediterranean East
+39 099 4 606 111
Sales and service in Italy, Greece, the Middle East and the rest of the eastern Mediterranean area

Vestas Asia Pacific
+45 97 30 00 00
Sales and service in Australia, New Zealand, China, Japan, India and the rest of Asia

Vestas Americas
+1 503 327 2000
Sales and service in North, Central and South America

For more information about Vestas sales and service business units, go to the menu at www.vestas.com and click on Contacts.

Vestas Wind Systems A/S
Alsvej 21
DK-8900 Randers
Denmark
Tel. +45 97 30 00 00
Fax +45 97 30 00 01
vestas@vestas.com
www.vestas.com