ENERGY'S WIND OF CHANGE

Birger T. Madsen

Wind energy is rapidly developing as an environmentally sound and cost-effective option for power generation. Here, one of its champions describes an industry with wind in its sales

It takes a stiff upper lip not to smile when Don Quixote almost falls off his horse in fright after mistaking a windmill for a giant.But perhaps the unlikely hero of Cervantes'literary masterpiece can be credited with foresight. Today's windmills, dubbed wind turbines, dwarf their predecessors, as their steely arms slice through the air at heights of up to 100 metres. More and more of these giants sprout on land and at sea, and they are gaining new ground in the marketplace. And while at present wind power provides just 0.15 per cent of the world's total electricity, it has become the fastest growing form of energy production.

The basic principles of wind energy have been known for many centuries. The earliest references to windmills date back to 7thcentury Persia, but for many the image most closely associated with wind power is that which gave Don Quixote such a fright: a picturesque timber tower supporting four long cloth-covered sails rotating in the wind. Today's wind turbine consists of a giant propeller fixed on top of a tall metal pole. When it rotates, the propeller drives a generator which churns out electricity that can either supply nearby users,possibly in an isolated rural community, or alternatively be sent down a cable hooked up to a central energy grid. One problem is that no way has yet been found of storing electricity to enable the wind's "ups and downs" to be evened out. The trend is for wind farms to move offshore, where their appearance and the sound of whirring propellers won't bother local communities, and strong and steady sea winds will keep the turbines turning at full force.

For the past 25 years, manufacturers have been streamlining components and installing on-board computers to tilt the propeller blades, for example, to suit particular wind conditions. In the early 1980s, the average turbine was 20 metres high with a 26-kilowatt (kW) generator and a rotor diameter of 10.5 metres. A typical turbine today may be perched 55 metres high, have rotors with a diameter of around 50-60 metres and a capacity of up to 1,650 kW. The amount of energy it can produce is equivalent to that consumed by about 350 European households.

Since 1992, more commercial wind farms have been installed in more countries than ever before. There are now 40,000 turbines in 40 countries, and the world's wind energy capacity is growing at nearly 27 per cent annually. In 1998, it topped 10,000 megawatts (MW), about the total energy producing capacity of a country like Denmark. The 1999 figures are not all in, but we know that 1998 was a boom year for the wind power industry. Equipment sales topped $2 billion and there were 35,000 jobs in the sector worldwide. Growth is expected to continue at about 25 per cent a year.

The prime motors of expansion are increasing environmental awareness and political commitments to reduce greenhouse gas emissions made under the Kyoto Protocol of 1997. Wind is free and supplies of it are inexhaustible, and when it produces energy it doesn't release heat or greenhouse gases.

The prime motors of expansion are increasing environmental awareness and political commitments to reduce greenhouse gas emissions made under the Kyoto Protocol of 1997. Wind is free and supplies of it are inexhaustible, and when it produces energy it doesn't release heat or greenhouse gases.

The European Union has taken the lead in rolling out the "green carpet" by introducing tax breaks and investment plans aimed at developing renewable energy sources such as wind power. There are plans to install 40,000 megawatts by the year 2010. Denmark, the wind energy pioneer, covers 10 per cent of its electricity consumption from wind power, delivered from an installed capacity of some 1,700 MW. Germany is quickly catching up, and is now the wind sector's fastest growing market (see article page 11). Spain, with its ample grazing lands and steady winds, is also soon likely to be attracting investment.

Rolling out a green carpet

The climate in the U.S. has been more volatile. Every two years, a congressional battle erupts around the renewal of an important tax credit to spur the industry. The same tumult rattles state legislatures that have their own credit schemes. According to U.S.energy secretary Bill Richardson, wind power should provide five per cent of the nation's electricity demands by the year 2020, compared to the current 0.1 per cent.

For the up and coming energy giants, notably India and China, interest in wind power has less to do with environmental awareness than with economics. These countries where broad swathes of the rural population are without electricity are keen to take advantage of wind investment plans offered by Denmark, Germany and the Netherlands. With nearly 850 MW installed capacity, India ranks first among developing countries and fourth in the world after Germany in the wind power league table. About 600 turbines are churning out 260 MW in China.

Asia and the Pacific used to be considered the coming hot spot for wind power. ▶

Managing Director of BTM Consult Aps (Denmark), a leading consultancy group specializing in wind power

However, the region's financial crisis of 1998 knocked many energy investment plans off course, with the notable exception of New Zealand's Tararua Wind Farm—the largest in the southern hemisphere with a capacity of 12 MW.

Turbines are few and far between in South America, aside from a few installations in Costa Rica, Argentina and Brazil. Danish manufacturers are making some inroads into North Africa: Morocco recently installed 50 MW and Egypt 30 MW. The rest of the continent is in the doldrums, an unfortunate state of affairs given the tremendous need for renewable energy, especially in rural areas.

While the world's richest wind resources are found in North America, China and the former Soviet states, particularly those in Central Asia, we believe that wind power could provide at least 20 per cent of every continent's energy needs. There is enough wind to provide twice the expected global electricity demand for 2020. Even if only 10 per cent of energy needs were met by wind power, the world would be spared about 10 billion tons of carbon emissions (out of a total of 60-70 billion tons). To achieve this goal, 120 times more wind capacity would have to be installed than there is today. The initial investment required would be very high, but operation and maintenance costs would be marginal.

There is enough wind to provide twice the expected global electricity demand for 2020

Manufacturers today are building bigger and better turbines, and as a result wind-power prices have been falling at about 20 per cent over the past four years. In Denmark, for example, electricity generated by wind power cost almost 17 cents per kilowatt hour (kWh) in the early 1980s. The figure, which covers all costs (equipment, labour, interest on loans, operation and maintenance) fell to 6.15 cents by 1995 and has since dropped to about 4.6 cents. Meanwhile, electricity produced by the installation of a new coal-fired power plant would cost 5 to 6.4 cents kWh, 4 and 5.7 cents kWh in the case of a gas-fired plant, and 4.6 to 6.5 cents kWh in a nuclear facility, according to calculations by UNIPEDE, the European Utility Association.

But while the cost of wind-powered electricity will continue to fall in the future, competitive prices are not enough—there must be a political will to develop the market. Developing countries often find it difficult to raise the capital to cover the steep start-up costs of installing wind turbines. This is the downside of wind power. The initial costs of installing coal-fired plants, for example, are relatively cheap but fuel then has to be imported and in the long run this carbon-based energy will cost more than wind energy. If these countries are to develop an environmentally sound energy sector using wind power, they will need help in finding the initial investment.

© Jay Ullal/Stern/Studio X, Limours

On a wind farm near Muppandal, Tamil Nadu (India) women dry their saris in the breeze.

The situation is radically different in North America and Western Europe, both of which have enough installed energy capacity to meet demand. In these countries the market for wind energy is driven by environmental considerations rather than economics. If governments do not adopt "green policies" requiring utility companies to close down classical power plants and switch over to renewable energy sources, the market for wind power will not be very dynamic.

Green parties are stepping up the pressure on governments to promote clean energies by helping to fund R&D costs, for example. Other measures that could be taken include subsidizing electricity payments or offering tax credits and low-interest loans for manufacturers. The "polluter pays" principle might also be applied, with a special tax being levied on carbon-emitting energy producers, as opposed to a clean energy source such as wind.

A 'doped' market

Some argue that a truly promising energy source should not require government support. Others maintain that subsidies will do more harm than good by distorting the energy market and artificially boosting what remains an unpromising alternative. I would argue the contrary—that gas, coal, oil and nuclear energy have been "doped" on state subsidies from the start.

Many power companies using these fuels

began as state monopolies protected by national legislation. They control the power grids. Often they bar new energy producers from the grids or impose rules which oblige newcomers to sell their energy at unfair prices. The development of wind power has also been hurt by the absence of legislation. For example, the UK has the best wind resources in Europe, but commercial attempts to set up wind farms in the last three years were stymied when local authorities failed to issue permits for turbine construction. Had the national government set up guidelines and policies inciting local authorities to co-operate, there might be more wind farms in Britain today.

The two notable champions of wind power are Denmark and Germany. Ferociously anti-nuclear, the public in both these countries studied their energy options before giving wind a "green light". Their diligence is now paying off at home and abroad, as their turbines blow a fresh breeze into global energy production. ■

GERMANY: TILTING AT WINDMILLS

Hartmut Wewetzer

Germany is the world's top producer of energy from wind power. But whether more wind farms should be built is sparking fierce debate

The north German plain is looking different these days. Where once fields, meadows and forests stretched as far as the eye could see, today the landscape is dotted with spectacular windmills, some of which tower 100 metres or more above the ground.

The further north you go, the more there are. In East Friesland (Lower Saxony) and on the west coast of Schleswig-Holstein (where windmills crowd the horizon) thousands of small businesspeople (Germany's association of wind energy producers has more than 6,000 members) have built huge wind farms to produce electricity for the national grid.

Since 1997, Germany has overtaken the United States as the world's leading producer of wind energy. It accounted for 700 of the 2,035 megawatts (MW) of new wind energy capacity installed worldwide in 1998 (the equivalent of the output of two large nuclear power plants). Each year, new records are set. In the first quarter of 1999 alone, 228 new wind turbines were hooked up to the national grid. The number of turbines in Germany rose from about 6,200 in January 1999 to 7,200 by the end of that year (3,750 MW).

But so far these devices produce only 1.3 per cent of Germany's electricity. The rest comes largely from fossil fuels (58 per cent), nuclear plants (36 per cent) and hydropower (5 per cent). The wind energy association predicts that by 2020 about 25,000 wind turbines will be installed, producing 30 per cent of the country's electricity. Government sources say that some 30 billion Deutschmarks ($1.8 billion) will be spent on strengthening the sector.

Wind power's success in Germany is partly based on public and media approval. Germany is the only Western country where nuclear power has, since the 1970s, met almost unanimous and often violent opposition. The anti-nuclear movement led to the birth of the Green party, which has been in government with the Social Democrats since the end of 1998. This coalition wants a rapid shut-down of nuclear power stations, although it has not yet reached an agreement with the energy distributors. If they fail to agree, a law may be passed to restrict the life of nuclear plants to 30 years, forcing the industry to close them one by one.

Global warming is another argument in favour of using wind power, a non-polluting energy source. Germany has pledged to reduce its greenhouse gas emissions by 21 per cent between 1990 and 2010. The public largely sees this as evidence of an "ecological revolution" and a new civilization where humans are at peace with nature.

Subsidized wind farming

The only problem—a big one—is that wind energy is very expensive. Extracting one kilowatt/hour of energy from the wind costs four times as much as using fossil fuels. So the political decision to develop renewable energy, taken by the previous government and reaffirmed by the present one,can only be applied if aid is available in the form of tax breaks for firms producing wind energy, low-interest bank loans, subsidies from the state and from provincial governments and favourable legislation. ▶

Berlin-based journalist

© Emile Lucier/Rapho, Paris

Wind power supplies these pyramid-shaped houses designed by architect Gerard Schouten at Huizen (The Netherlands).

The 1991 "integration law", which is the key to the present system, obliges the electricity distributors to buy wind energy at guaranteed prices (90 per cent of the price paid by consumers), and this enables the wind farmers to make a profit.

But the growth of wind energy seems to be threatened by the opening up of the energy market, which started in April 1998 and has sharpened competition and reduced the price of electricity paid by consumers. This trend worries wind energy firms because they sell their product at prices which are specifically tied to consumer prices. With their profitability in jeopardy, they want more subsidies to protect themselves against the ups and downs of the market.

Meanwhile, opposition to wind power is growing. A few years ago, it chiefly came from the electricity distributors, who campaigned to have the 1991 law declared unconstitutional. They failed but managed to get it amended to limit their obligation to buy wind energy, which now comprises a maximum 5 per cent of the electricity they purchase. But in some parts of northern Germany, this quota is not enough to absorb the output of wind energy, and producers are looking for other outlets. A proposed new law would be even more advantageous to renewable energy than its predecessor in that it would abolish the 5 per cent rule.

The fiercest opponent of wind energy, Prof. Otfried Wolfrum, from Darmstadt, thinks that to continue backing wind energy is "a disastrous stupidity for the environment, for human beings and the economy". The current policy, he says, will in the coming years produce a loss of about 30 billion Deutschmarks (around $15 billion),which consumers will pay for in the form of electricity costing more than it would if the distributors were not forced to buy wind energy. He says wind farms are simply "a licence to print money".

He and other economists argue that subsidized wind energy may be creating jobs now but will end up cutting down on them. (Unemployment in Germany is over 10 per cent.) If energy prices are not competitive in Germany, they say, some electricity firms will move their plants to countries where conditions are more favourable. On top of this, these "appalling machines" are a blot on the landscape in important tourist areas. Wolfrum, the founder of Germany's League to Protect the Countryside, has made himself spokesman for a citizens' movement that is growing fastest in areas where wind turbines are most common.

Wind energy has become the centre of a major battle in Germany. Wolfrum's strong attacks, contained in his book "Wind Energy, a False Alternative", have provoked an equally strong riposte. An influential member of the lower house of the German parliament, Hermann Scheer, a wind energy lobbyist who received the 1999 Right Livelihood Award, also known as the Alternative Nobel Prize, recently even accused Wolfrum of using "fascist" arguments, which gives a good idea of how heated the debate has become. Scheer, working with journalists and environmental campaigners, has published a reply to his opponent's book called *Windy Protest*.

The fiercest opponent of wind energy, Prof. Otfried Wolfrum, and other economists argue that subsidized wind energy may be creating jobs now but will end up cutting down on them. If energy prices are not competitive in Germany, they say, some electricity firms will move their plants to countries where conditions are more favourable.

Despite these polemics, the rapid development of wind energy seems set to continue. In case public anxiety about harm to the countryside increases, wind energy entrepreneurs are planning to build wind farms out at sea. The biggest is slated for a spot 35 km east of the Baltic island of Rügen and will comprise 200 turbines capable of generating 1,000 megawatts. This is roughly the output of a big nuclear power plant, says a spokesman for Winkra-Energy, the company concerned, "and from the shore, you won't be able to see a single windmill." ■