

INDUSTRY WHITE PAPER

April 2003

European Wind Power:

Thar she blows!

Executive Summary

In this report we investigate four emerging trends in the wind power industry: the continuing difficulty faced by wind turbine manufacturers; the increasing pace of concentration amongst wind power operators; developments within the spot market and finally the impact of legislation in the UK, Germany and Spain.

Market Performance

Wind Turbine manufacturers share prices have mirrored the decline in tech stocks, falling by 78% since their January 2001 peak.

Pressure is mounting for turbine manufacturers' to consolidate, driven by the need to implement process engineering, rising development costs and shorter life cycles of new turbines.

Industry Commercialising and Concentrating

The average cost of an installed Mega Watt (MW) of wind power has fallen from €1.7 million in 1996 to €1.0 million today.

More than half of Europe's wind energy is now generated by wind farms greater than 10MW in size.

Over 80% of Italian and 60% of UK wind assets are owned by the top three players in each market.

Wind farms are growing in size; the average size of a UK wind farm has increased from 7MW over the last eight years to an expected 50MW in the next four years.

Wind Energy and Electricity Trading

Electricity spot prices below those contracted on Power Purchase Agreements mean the cost of balancing the electricity load is lower than has been anticipated.

Exchange traded electricity is likely to grow in volume and volatility as the need to accommodate wind generated electricity becomes more prevalent.

Legislation

Subsidy regimes remain critical to the wind power industry, determining the financial viability and potential returns of projects.

Market uncertainty over subsidy regimes is hampering the rapid build out of wind power assets in selected markets.

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Turbines and Operators

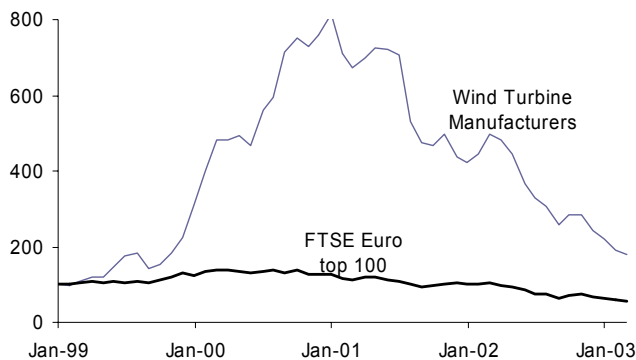
Turbine Manufacturers

Wind turbine manufacturers face a daunting prospect. While the wind energy industry continues to grow rapidly, the past efficiency gains that turbine manufacturers have been able to deliver through increasing size and reliability of turbines are diminishing. In the future, efficiency and hence competitive advantage, is going to be delivered through better process engineering and this will require investment the equity markets will be reluctant to deliver.

It is open to question whether the world needed another example of an industry which, like the railways and aviation industries, offered proof that widespread economic growth can go hand in hand with poor stock market performance. Between 1999 and 2001, turbine manufacturers were the darlings of the stock market. This phenomenal run up in value started as investors piled into just about anything that promised growth, in particular technology and media (TMT) stocks. In this great bonanza, wind turbine manufacturers enjoying the status as a side bet, offering helpful diversification aspects. Indeed the diversification element allowed wind turbine manufacturers to continue to enjoy significant investment through 2001.

Turbine
Manufacturers
difficulty in
generating
profits has hit
share values
hard

Wind Turbine Manufacturers¹ Share Prices (rebased)



Source: Yahoo, Augusta Finance

Installation Cost

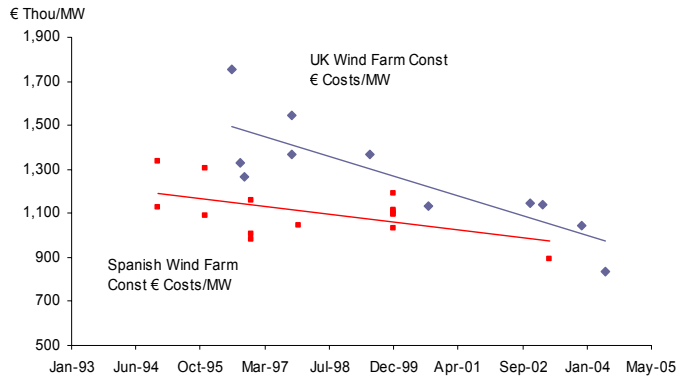
The cost per MW of wind generated electricity has fallen steadily over the last twenty years from €160 MW/h in 1985 to €5 MW/h today, leaving only gas as being generally less expensive. What is less studied has been the way in which the cost of installing each MW of wind electricity has also fallen. Obviously the cost of installation can vary widely, depending upon such factors as the proximity and cost of grid connections, as well as the cost and power output of the equipment installed. But examples from across Spain and the UK indicate that one million euros per

The installed
cost of turbines
has fallen to €1
million per MW

¹ NEG Micon, Vestas, Nordex, Gamesa and RePower – equally weighted, Enron /GE wind energy excluded from calculations.

installed MW is at present a reasonable benchmark figure for onshore wind power.

European Wind Power Construction Costs



Source: Wind power Monthly, Augusta Finance

In examining why costs per installed MW have fallen, two factors stand out: technology and scale, that is larger turbines and bigger wind farms. While cost reductions per installed MW are likely to continue to fall as process engineering allows turbine manufacturers to produce ever more efficient machines at a lower price, the incremental gains are unlikely to be as significant in future as they have been in past. On shore turbines, at 2.5MW, may well be approaching maximum size. The very large cranes needed in construction are expensive and in short supply, and this alone means turbines can not be produced much larger. In addition moving ever larger blades to the desired location is also proving to be a significant constraint. Offshore still has potential to employ larger machines and in time offshore wind farms may well exceed onshore in number or turbines.

Operation of Wind Farms

The operation of wind power assets across Europe is undergoing rapid change. Fast fading are the days where wind farms were small scale operations with a disparate collection of often local owners. This is the Danish model and although Denmark has been at the forefront of exploiting wind energy, we do not believe this to be the model for the future. The last three years have demonstrated that not only are wind farms growing in size, but that individual farms are increasingly being grouped together by ever larger operating companies. Indeed it seems likely that a diverse and overly localised ownership pattern will prove an impediment in the future, as diffuse holdings deny both economies of scale and make replacing older turbines with more efficient and powerful new models more difficult.

Augusta Finance has researched the size of wind farms across Europe. Our view is that wind farms above 10MW are generally going to be of interest to larger scale operators. The UK, with the best potential wind sites in Europe, has seen a slow increase in the size of wind farms over the past decade, but a real breakthrough is likely in the next few years, as evidenced by the development

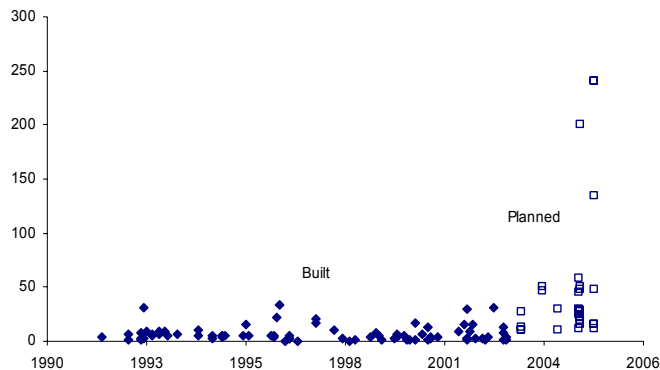
Increased unit cost of turbines...

larger wind farms ...

mean larger and more powerful developers

pipeline, where the average size of wind farm is increasing from 7MW over the last eight years to 50MW over the next four years.

Development of UK Wind Farms, over time, by size



Source: BWEA, Windpower Monthly, Augusta Finance

Larger wind farms can ...
 supply more of a utilities renewable requirement...
 gain direct access to capital markets ...
 and enjoy economies of scale in O&M

The cost inherent in construction, as well as the economies of scale available to larger scale operators, all point to an ongoing concentration of ownership amongst wind assets. Augusta Finance believes that as wind farms become more commercial, this will place additional pressure for the market to become increasingly dominated by large operators – either specialists, or divisions of major utilities. Augusta Finance believes that larger wind farms groupings have three immediate advantages:

- The ability to be able to supply significant portions of a utilities legally required renewable energy target means better PPA terms should be obtained;
- Larger wind farms are able to gain direct access to capital markets, lowering the cost of finance;
- Larger wind farms enjoy economies of scale in their operation and maintenance.

Electricity Prices

Spot electricity often sells at its marginal cost, making it less expensive than long term contract electricity

Renewable electricity enjoys a legislative mandate ensuring the drivers of demand are quite separate from that in the wider electricity market. That said, the prevailing price of electricity, both spot and longer term contract Power Purchase Agreement (PPA), does matter to wind power generators.

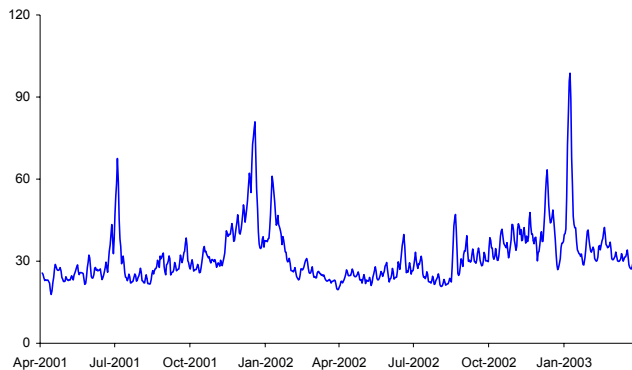
Most electricity is sold through contractual Power Purchase Agreements (PPA's), with less than 10% of electricity being bought 'spot'. However the spot price is a useful indicator of supply, demand and capacity constraints. It should be stressed that so long as there is spare capacity, as is the case in much of Europe, spot price is the marginal price for electricity production. Thus it does not include fixed costs, which have to be paid in any case. Moreover spot prices take advantage of the cost of shutting a generation facility down, which itself is partly influenced by expectations of the duration of low demand. Because of these

Excess capacity has meant low spot prices, which lower the cost of balancing electricity loads

factors the spot price can differ significantly from the price paid under PPA's. Even in Europe's largest exchange, Scandinavia's Nordpool, the volume of spot electricity is only between 4-7% of total power generation, although France's PowerNext has hopes of up to 10% of all electricity being traded in the near future.

Augusta Finance has averaged electricity prices from the Scandinavian, Dutch, German, UK, French and Spanish spot electricity exchanges. The average price over the past two years has been €31.9 per MWh, although the standard deviation has been €10, there have also been considerable spikes. Highs of €258 MWh have been seen in Amsterdam and €240 MWh in the highly liquid German market, reflecting that inelastic electricity demand can, in the very short term, be very expensive to supply.

European Spot Electricity Prices (€/MWh)



Source: Nordpool, AMX, UKPX, LRX, OMEL, Powernext, Augusta Finance

One of the drawbacks of wind power is that alternative power sources must be prepared to step in and supply electricity in the event the wind does not blow. This unreliability would normally mean that wind would not be the preferred electricity source. However legislative requirements for renewably generated electricity mean that the balancing pressure is taken exclusively by other forms of generation, primarily gas. The fact that this balancing load uses electricity which sells for less than that generally available through a PPA means that so long as there is spare capacity within the system, the cost of balancing is less than might be thought.

Emissions Schemes

Europe

While it can be argued that wind energy is now efficient enough to compete without subsidy and the cost of utilities balancing electricity loads is not as high as might have been feared, wind energy developers and operators still expect and enjoy both beneficial legislative regimes and a variety of subsidies.

The European Union has devised a scheme for tradable Renewable Emissions Certificates, (RECS) set to begin in January 2005. In brief the scheme will work as follows: electricity generators will be set a target level for their emissions and issued with tradable

permits equal to that level. The target can be met either through: reducing emissions to the target level; reducing emissions below the target level and selling the extra certificates; or if unable to meet the target reductions, buying sufficient certificates in order meet obligations. For every MW hour of renewable energy produced, a RECS certificate will be issued. The owner of a certificate can redeem it to advertise its environmental performances, or to fulfill a purpose specific to that country or region (e.g. renewable obligation, tax exemption, etc). For the UK, by 2007, it is envisaged that the present arrangement will be merged into the Europe-wide scheme.

Integrating this European scheme into various national regimes is at times fraught with uncertainty. The UK has put forward a structure designed to last for the next decade. Spain's Royal Decree is renewed annually. While the US Production Tax Credit, lasts for ten years for those projects that reach commercial operation before the expiry deadline, (currently 31 December 2003), the problem is that there is no prescribed process for extending this deadline and in the past the extensions have been irregular and impossible to predict. Such short time horizons allow politicians to keep a close eye on the rapidly changing market for wind energy, including the need for subsidy at all. But constant changes to the regulatory regime do add a degree of uncertainty which makes it difficult for the market to grow, particularly as future development is more and more dependant upon large projects with complex financing, and these financings incorporate prevailing subsidy regimes in their calculations of returns and hence the viability of any particular project.

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