WIND ENERGY: KEEPING THE LIGHTS ON

The UK is currently facing an enormous energy opportunity. Over the next 10–20 years around 30% of our conventional, climate-damaging electricity generation capacity is scheduled to close. Whilst energy efficiency measures can reduce our overall energy demand, a significant proportion of production capacity will need to be replaced. If we seize this opportunity, this windswept country – already the site of the world's largest offshore wind farm in development, the London Array – could reap huge benefits from the fastest growing renewable technology, particularly in offshore wind.

Appropriately and sensitively sited wind power could provide much of our electricity in the UK, and at the same time develop a highly-skilled manufacturing sector, providing employment for thousands of people. Wind power can be brought online very quickly – within the timeframe required to reduce carbon emissions. It is a simple, proven, zero-carbon technology with a bright future.

The pressing need to avert catastrophic climate change and maintain energy security is driving a remarkable global transformation in the way we produce energy. Support for, and investment in, a much greater role for renewables is now a reality in all the world's large and developed economies, including the European Union, India, the USA and China[1]. In 2008, according to the UN, more was invested in renewable than conventional energy production worldwide at $155 billion. Wind power attracted the highest new investment of any energy technology at $51.8 billion.[2]

The pressure on the UK to move rapidly towards renewable energy comes from many quarters. The UK committed itself, as part of a legally binding EU agreement, to produce 15% of its energy from renewable sources by 2020 in order to tackle climate change. This is likely to mean that 32–40% of our electricity will have to come from renewable sources by 2020, with the majority of this being supplied by wind generating capacity. The UK Climate Change Act 2008 also requires the UK to reduce its carbon emissions by at least 80% by 2050. The independent government advisory body, the Committee on Climate Change, has called for the electricity sector to be almost totally decarbonised by 2030, so renewables will play an even larger role in the future.

However, concerns are raised by in some analyses about variability of wind supply. Put simply, they argue that since the wind does not blow constantly, the power produced by it cannot be constant either. The result, they claim, is that a reliance on wind power would either mean 'the lights going out' when the wind stops blowing or that wind farms would need to be backed up heavily by additional conventional sources, thus defeating the object of reducing emissions. Furthermore, they suggest that the national grid would not cope with variability, and that managing it would make wind power a lot more expensive than conventional power supplies.

But in reality the extra costs of managing wind variability are not very significant at all. They are only a small fraction of other costs associated with energy production including fluctuating fuel prices, costs of generation, transmission and distribution, metering, and the cost of CO_2 emissions through the European Emissions Trading Scheme.

This paper summarises the findings of prominent energy analyst David Milborrow. His review, Managing Variability, found evidence, and a consensus of expert opinion, that demonstrates:

- **Wind power can significantly reduce our climate damaging carbon emissions**
- **Fluctuations in wind strength can be managed technically and at modest and declining cost.**
- **High proportions[3] of wind power in our energy mix are feasible, and are already successfully integrated in other countries.**
- **A range of technological developments already underway could allow for a steadily increasing use of wind power and the phasing out of conventional carbon-based fuels as a backup technology.**

This summary also draws out key conclusions and recommendations that would remove barriers, including barriers to investment, that prevent a rapid shift to large amounts of wind power in our energy mix.

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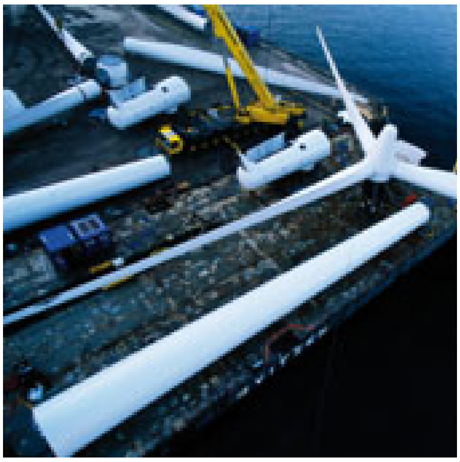
SUMMARY OF KEY FINDINGS

Managing Variability, by energy analyst David Milborrow
June 2009



1. Wind power does not need large amounts of extra conventional energy backup to stop the lights going out

It is sometimes claimed that every wind farm in the UK needs equivalent amounts of fossil-fuelled backup supplies, to kick in when the wind stops blowing. This is not the case.

A common, large pool of backup generation capacity called 'short term reserve' is used to step in when coal, gas and nuclear power stations stop generating at short notice. They can and do 'trip' without warning, leading to the instantaneous loss of large chunks of UK generation – as occurred on 27 May 2008, with the Sizewell B nuclear power station.[4] Whilst the instant loss of a large conventional power station through tripping is a real risk, it is extremely unlikely that the equivalent amount of wind will disappear instantaneously.

This is because wind power is a nationwide technology – wind farms all over the country are adding power to the grid at once. While wind may drop at some sites, the wind very rarely stops blowing everywhere at once, so wind power does not need to be backed up, megawatt for megawatt. In fact, wind power is less likely to suddenly fail than other energy options.

Even in the often cited cold still snap in January 2009, when energy demand was high and wind power output would have been minimal, the existing pool of backup power would have been more than sufficient to keep the lights on, even though coincidentally nearly 50% of Britain's nuclear output was not available at that time. In addition, peak consumer demand is mostly likely to coincide with windy times due to wind chill.

Because backup electricity capacity already exists from flexible energy sources, it will be possible to use it for large amounts of wind power as well as for other electricity sources. In any case, the system never assumes peak capacity of all wind farms at once and operates on an average capacity carried by all of the wind farms. Furthermore, by the time wind power is producing 20% of our electricity (a more than ten fold increase from today), the additional backup it will need will be less than 10% of the peak level of wind production.

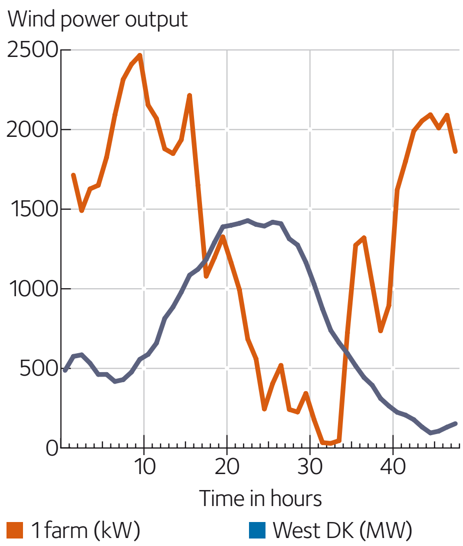
Finally, it is worth noting that new storage and distribution technologies, and other options currently in development, will increasingly reduce the need for conventionally fuelled backup for wind power even further.

2. The national grid is able to manage variable input from wind power: the electricity system is already designed to manage fluctuations in supply and demand

Critics of wind energy often cite the fluctuation in input caused by changing wind patterns as a reason not to pursue the technology. But the amount of variation in wind power is often exaggerated. The variations in wind are actually considerably less than the variations in consumer demand for electricity, which varies on an hourly

Left: Danish company Skykon recently acquired the Vestas plant near Campbeltown, a declining industrial area of Scotland, bringing long term job security to the 100-strong workforce. ©Davison/Greenpeace
Middle: Offshore wind farm construction in Denmark. ©Zenit/Greenpeace
Right: Coal-fired power stations must be phased out if we are to avoid catastrophic climate change. ©Morgan/Greenpeace
Opposite: China's wind energy capacity has doubled in each of the past three years, and is forecast to be the biggest in the world by the end of 2009. China is aiming for a 20% renewable target by 2020. ©Canxiong/Greenpeace

Figure 1: Wind output in Denmark, over two days, compared to variable output from an individual wind farm, shows how supply is stabilised across the country.



and daily basis according to the weather, rush hour and even the scheduling of East Enders. The grid is already organised to manage significant fluctuations in both supply and demand.

Moreover, changes in wind strength are actually increasingly predictable on an hour-by-hour basis, and so are relatively easy to manage. When aggregated over a whole country, the peaks and troughs of individual wind farm production are smoothed out. For example, across western Denmark, where wind power is widely used, the fluctuations are only a quarter of those measured on a single typical wind farm (see figure 1).

Backup power station capacity and hydro-electric energy stores are already available in Britain to respond to short-term mismatches in supply and demand. In Denmark, the very occasional rapid shifts in wind power have been successfully managed in this way.

3. Widespread use of wind power leads to a significant reduction in carbon emissions

It is sometimes claimed that the need for backup power for wind farms means that coal or gas power stations would have to be built anyway, so overall emissions would not be reduced. As explained above, however, only a very limited amount of additional backup is required. This backup is not always on and is only used when necessary. Numerous authoritative studies have shown that the introduction of wind energy does mean a reduction in the amount of conventional power stations needed to provide reliable supplies of electricity and a reduction in carbon emissions.

4. Variability in wind supply does not mean that the cost of wind-powered electricity will be substantially higher. Wind power will also provide significant skilled job opportunities

Government projections of how the UK can meet its legally-binding EU renewable energy targets currently propose that wind should provide 32% of our electricity by 2020. At this level, variability costs would increase the domestic electricity price by about 2% or around 0.2 pence on an average 10 pence per unit of electricity. Further increases in the share of wind in the energy mix beyond that point are both feasible and affordable, and do not necessarily have to rely on the introduction of new technology. At 40% of our electricity generation, managing the variability of wind would add 5.5% or 0.55 pence to an average unit of electricity.

Wind power also generates proportionally more high quality skilled jobs than other energy sectors. Skills are transferrable from other fragile sectors such as car manufacturing, and jobs will be provided across Britain, often in areas of most need.[5] There are already 400,000 people working in the wind-energy sector worldwide and this could reach one million by the end of the decade.

5. New technologies are set to reduce both the costs of wind variability and the need for fossil fuel backup

Technologies already exist which can help to manage the variability of wind energy and reduce associated costs. More accurate wind forecasting is a proven approach, enabling supply and demand to be balanced more effectively by system operators. If used to its full potential, this could reduce the costs associated with wind variability by as much as 30%.

At the same time, new approaches are being developed to improve the efficiency of our energy use. These include measures such as smart meters, to help match the use of power in homes and business to the availability of power in the system. The installation of more international transmission links between Britain and Europe will help absorb the variability of wind power by connecting up the national grid with energy networks across the continent. Plans to investigate and fund such connections are already being discussed across the EU.

Finally, the introduction of more electric cars could provide opportunities to absorb any surplus wind energy produced at periods of high wind power production and low electricity demand – for example at night – making wind energy more cost effective. Taken together, these technologies provide a great opportunity to create intelligent power networks alongside expanding renewable generation capacity, suggesting a bright future for zero carbon power.

CONCLUSIONS

The benefits for Britain of generating a significant proportion of our power from appropriately sited wind developments – on and offshore – are huge in relation to limiting climate damaging carbon emissions, securing energy supplies, protecting against fossil fuel price hikes and also creating skilled engineering jobs. Although the variability of energy supply from wind has been given great prominence, the costs associated with variability are in fact only a fraction of the overall costs faced by the energy sector.

Independent energy analyst David Milborrow's study 'Managing Variability' demonstrates that:

- There is no technical barrier to accommodating large amounts of wind power in our energy mix. We can keep the lights on.
- Even at relatively high levels of wind in the energy mix, the need for backup capacity is modest, with most backup needs being met by the existing pool which supports all forms of power generation.
- The costs associated with managing the variable nature of wind power are modest and can be expected to decline as new technologies including a supergid, smart grid and improved energy storage are developed.
- As other variable renewable technologies are developed, it is expected that these too would be suited to displace conventional power stations.
- Other European countries are already using large proportions of wind power in their energy mix and see no technical barriers to increasing to higher levels.

RECOMMENDATIONS

As there is no technical barrier to further wind development, action is now needed from the government. To facilitate the rapid development of a strong, sustainable wind industry in Britain as part of a strategy to support and expand renewable energy generation to limit global warming, the UK government must:

- Ensure that the energy market is able to deliver a massive expansion of renewables. This must include ensuring that energy regulator's main task is to cut climate change emissions by prioritising renewables and energy efficiency.
- Grant priority access to the energy market and electricity grid system for renewables ahead of conventional dirty power
- Deploy continued and substantially increased financial support and regulatory incentives for renewable energy beyond 2020
- Secure attractive grants and green loans for energy efficiency measures and research and development for renewable technologies.
- Enable better planning for renewables, including spatially based approaches to ensure timely delivery and facilitate appropriate siting.
- Create an industrial strategy that will establish skills and manufacturing capacity in the UK, addressing shortages in the supply chain for renewables and boosting UK jobs and the economy.

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