The proposed Allt Duine scheme near Kincraig is one of 11 wind farms consented or planned near or on the edge of the Cairngorms National Park and is going to be a test case

Chris Townsend

WILD AT HEART

The case for protecting Scotland's remote, uninhabited areas. By **CAMERON McNEISH**

Relentless campaigning against the disappearance of our planet's most precious and limited resources will not have gone unnoticed by many. It is surprising, therefore, how little has been said about the plight of Scotland's wild land until very recently; an asset that any country would be proud to boast of, but one that we, as a nation, are leaving exposed to continual and increasing harm.

Having spent the past 40 years or so climbing, backpacking and trekking in some of the world's wildest places, I have a great familiarity with wild land - a concept which refers to those places of a certain character, uninhabited and often remote, where it is hard to see the influence of human activity. Such places, untouched by human hands, form some (if not most) of our country's most spectacular landscapes.

Generally comprising the four main qualities of perceived naturalness, ruggedness, remoteness and absence of modern human artefacts, the importance of wild land extends far beyond its visual aspect. Wild land also provides us with clean air and water, helps to regulate the climate and – as an undeniable attraction to tourists – provides a vital contribution to our economy. Indeed, a Scottish Natural Heritage (SNH) study found that wild land provides more financial benefit to our country than agriculture and forestry combined. Not only this, but it is difficult to overlook the intrinsic societal value that is fundamental to ideas of Scottish identity and culture – associated with these stunning landscapes. A new survey, conducted jointly by Loch Lomond & The Trossachs National Park Authority, the Cairngorms National Park Authority and SNH, has also revealed widespread public support for action to protect wild land.

"The status quo provides completely inadequate protection for the great Scottish outdoors"

For many of us, the enjoyment of wild land can be inspirational. It links us to the physical elements of the natural world that are so far removed from our modern lives, and allows us to find solitude and spiritual refreshment. For me, it is the attempt to try and form a 'connection' with the wild landscape that I treasure the most. But our ability to enjoy and benefit from this great part of our national heritage is increasingly under threat.

This precious, limited resource is disappearing at a startling rate and – unless better protection is provided soon – we will lose the remaining areas as well. It is baffling, but developments continue to surface on these celebrated landscapes, irrespective of the damage they are causing. The Government appears not yet to have recognised that the visual impact of building upon wild land is both devastating and irreversible; under current

regulation, inappropriate developments on wild land can be opposed through the planning process but there is no guarantee – and often little hope of success.

The loss of our country's impressive scenery is not a potential fear, or something that will happen in the distant future. Scotland's wild land is being eradicated as we speak; despite the fact that over 90 per cent of respondents to an SNH study agreed that Scotland's areas of wild land should be protected. Although some areas are safe, sadly, they are in the minority. In England and Wales very little wild land is at risk, thanks to national landscape designation, but in Scotland, only about a third of these landscapes enjoy such safeguarding.

It is a crime that areas so plainly unsuitable for development have not yet been given statutory protection. Leading wild land charity, the John Muir Trust, suggests that a wild land designation would be a clear marker to developers that proposals in that area would be unlikely to be granted permission. SNH, however, feels that such a designation method would lead to confusion, and favours a complementary approach that would involve National Scenic Area designation and other national and local planning policies.

The proposed Allt Duine scheme near Kincraig is one of 11 wind farms consented or planned near or on the edge of the Cairngorms National Park in an area of wild land and is going to be a test case for its protection. The scheme is subject to a public inquiry with a recommendation from the Reporter due in the spring. If the Allt Duine proposal is granted permission, the landscape, visual and wild land impacts will be devastating.

Whichever route we go down, it is clear that the status quo provides completely inadequate protection for the great Scottish outdoors. It is also clear, furthermore, that we need to take significant steps if we are to have any hope of retaining the beauty of our countryside. The issue in both cases is how, and how quickly, we are going to make these changes happen – because time is something we don't have.

WAKE UP CALL

How to address the 'democratic deficit' around wind farm siting

By Christopher R Jones

"It seems extraordinary to have allowed [wind farms] to be peppered around the country without due regard for the interests of the local community or their wishes."
(Rt. Hon. John Hayes MP, 30 October 2012)

A The comments made by John Hayes MP during the recent RenewableUK conference in Glasgow have reignited debates about the future of onshore wind farm development in the UK. However, are the interests and wishes of local communities as roundly objectionable as the above statement would suggest or does this statement reflect the amplified opinion of a particularly vocal minority?

Attitude surveys typically reveal that the majority of people in the UK like wind power; thus, the low rates of planning success for specific wind farms is something of a paradox. This so called 'social gap' (Bell, Gray & Haggett, 2005) is often linked to the apparently high levels of local opposition that develop in 'host' communities when projects are announced. Such opposition is often seen to be the product of selfishness (i.e., Not in My Backyard-ism or NIMBYism), where it is assumed that an 'individual gap' exists in people's attitudes towards development at local (negative) vs. general (positive) level, one that is motivated by personal interest (e.g., fear over house prices). However, while the presence of a large number of 'NIMBYs' could help to explain the emergence of the 'social gap', a growing literature now questions the status of NIMBY as a sole, or even major, explanation of such local opposition (Jones & Eiser, 2009). Some even question whether the 'social gap' need necessarily hinge upon an 'individual gap' in general vs. local attitudes (Bell et al., 2005).

In relation to the first point, it has been argued that in some instances, opposition might not be directed at the wind farm per se (i.e., people still like wind farms) but rather at the developers for their use of exclusive, 'top down' development strategies (i.e., where host communities are largely excluded from the decision-making process). Thus, what might appear to be NIMBY is, in fact, localised resistance rooted in concerns about procedural justice. In accordance with this suggestion, there is evidence that more inclusive, 'bottom-up' strategies (i.e., where developers more readily engage and involve host communities) tend to be associated with reduced opposition (Walker & Devine-Wright, 2008).

In relation to the second point, it has been argued that while it may appear that the number of people objecting to a wind farm is greater than should be anticipated from general attitude surveys, this might be an 'illusion' resulting from differences in the relative activity of supporters and opponents. That is, while still constituting a minority, opponents tend to be more active than their supportive counterparts, and thus exert a disproportionate influence over wind farm permitting decisions. Part of the reason for this could be differences in the respective goals of proponents and opponents, with the focal goal held by opponents (i.e., prevent wind farm) being more directive of action than the global goal held by proponents (i.e., prevent climate change) (Jones, Rennie & Woolley, 2010). Thus, what might appear to be NIMBY is, in fact, a disproportionate amplification of local oppositional opinion relative to views of local supporters.

In reality, it is likely that a combination of the abovementioned (and other) reasons are behind the emergence of the 'social gap'. From a democratic perspective, though, the latter possibility is troublesome since it asserts that, within the context of local wind farm development, the views of a supportive but quiescent majority are being trumped by an active minority. If this 'democratic deficit' hypothesis (Bell et al., 2005) holds true, then one might assume that by 'waking the silent majority' one could take steps towards addressing the 'social gap'. However, while the concept of motivating the supportive majority is attractive to developers, how best to achieve this aim remains unclear. It is this question that we are seeking to address at the University of Sheffield.

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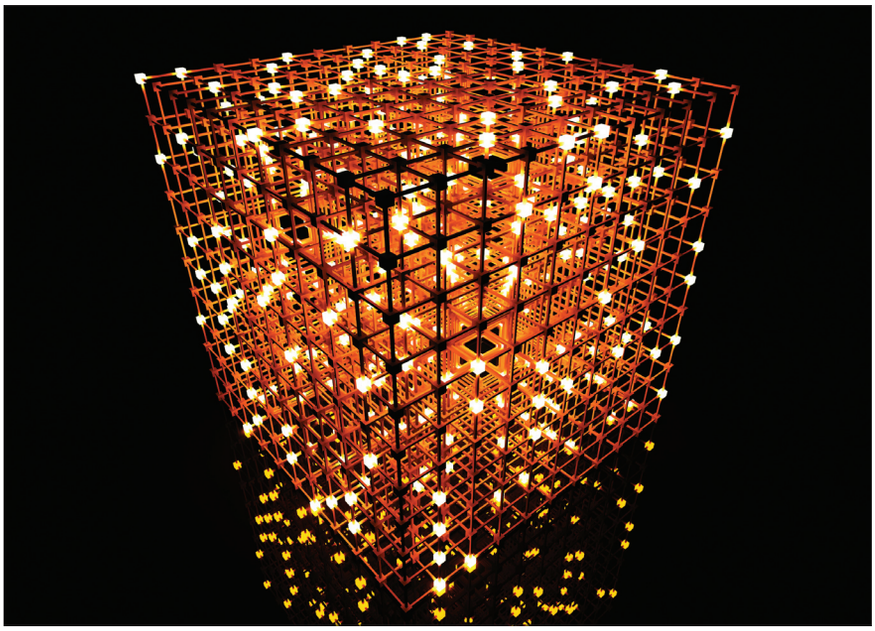

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PURE BASE LOAD

Co-locating wind generation with energy storage

By Theodore Holtom

Critics cruelly label wind energy as 'intermittent' and 'unpredictable', highlighting problems for grid management. And they do have a point. This article describes energy storage solutions to this problem, energy security and environmental benefits, and multiple new revenue streams which are available to wind farm owners.

Government policies aim to reduce carbon dioxide emissions due to the risk of climate change. Cheap fossil fuel and uranium supplies will not last forever whereas wind energy is abundant in Scotland, therefore, work is under way to accommodate more and more renewable energy on the grid. Renewable energy generators produced approximately 9.4 per cent of UK electricity during 2011, around 4.2 per cent being wind energy. Wind projects currently in construction and already approved by the planning process suggest that by 2020 there could be four times as much UK installed wind capacity as at present, both onshore and offshore. The sector continues to grow strongly despite the global economic downturn.

The grid system operator has to continually balance supply and demand. Electricity trading prices adjust accordingly. Tools employed for grid management range from huge hydroelectric generators, ready to ramp up their power output within seconds, to demand side management where large industrial electricity users reduce their demand for a period.

The variability of wind power can be managed given the correct tools. The problem is that electricity grids have been constructed during a time when there were no wind generators to speak of. So-called 'base load' generators such as coal plants and nuclear power stations were (usually) reliable and predictable.

What tools are being put in place to manage increasing variable wind output? In recent years, wind farms have received instructions from the grid to limit their output, typically when windy during night time. A 'curtailment' instruction or export limit is transmitted to the wind farm and the wind turbines are controlled such that the wind farm as a whole does not export more energy than the limit. Effectively, the control system deliberately makes the wind turbines lose efficiency to ensure the curtailment limit is not exceeded, even though the wind conditions may be sufficient to generate much more wind power.

Over the course of a year, it is possible for some wind farms to dump around five per cent of their output through curtailment. But it could get much worse. The magnitude of curtailment has been steadily increasing over recent years. The present mechanisms encourage the wasteful dumping of free renewable energy instead of utilising it and reducing the corresponding fossil fuel consumption and emissions.

"What can government do to assist strategic progress in energy storage?"

If this curtailment is allowed to continue then one can envisage a situation where the huge offshore wind farms of the grid in 2020 will be ordered to regularly dump city-scale wind power when the wind picks up. The presently increasing wind curtailment is a warning sign.

There are also significant market risks for wind energy as installed wind capacity continues increasing. As wind capacity rises beyond ten, twenty or thirty per cent of overall grid generation capacity then market forces can result in electricity prices plummeting, exactly when wind farms are most productive. When the wind picks up, there can be a glut of wind power on the supply side of the grid and unless there is increased demand for that power, the electricity price will tend to fall. This means there is a risk of decreased revenue for wind farms when they are most productive. Such a risk needs to be mitigated in order to protect investment in renewable energy for purposes of energy security, reducing pollution and reducing carbon dioxide emissions. It is also possible for a lull in wind power to last for an extended weather period. The mitigation method is the ultimate smart grid tool – energy storage.

Happily, these problems are not beyond the wit of humankind. They provide new opportunities in business, innovation, sustainability and energy security. There is a fundamental strategic solution which is energy storage co-located with variable generators. Independent pumped storage units on the grid are helpful for grid management and can be profitable for the pumped storage owners, especially when little competition implies that high prices can be obtained in order to 'keep the lights on'. But this is not very helpful for those wind farm owners who do not own energy storage facilities. Such owners would benefit from installing their own co-located energy storage. There are also energy security advantages in having energy storage co-located with renewable generators since this forms a naturally distributed system rather than a small number of large targets.

By connecting an energy storage unit within the grid connection point of a wind farm, it is possible to curtail the output to limits specified by the markets and for grid management, whilst storing excess wind energy instead of dumping it. The wind farm output becomes predictable. The variability of wind energy is no longer a problem. Wind farms will be in a position to deliver their wind energy when it is most needed by the market in order to balance supply and demand. We will have attained pure renewable base load generation.

By utilising energy storage, a wind farm owner can benefit from multiple new revenue streams. Upon curtailment, wind farms can meet their contracted obligations to the market, assisting grid management as instructed, and continue to get paid accordingly. But stored curtailment energy can be sold

to the market at a later date. A second revenue stream arises from energy trading. Since electricity price variations occur continually, energy storage allows wind energy to be stored when prices are low and the energy is less needed and delivered at a time when the energy is more needed and prices are higher. Energy storage also eliminates the price penalties associated with wind farms delivering less energy than promised to market. Most significantly, energy storage guards against the risk of damagingly low prices on a future grid with huge installed wind capacity, where electricity prices fall as the wind picks up.

Future pumped hydro energy storage need not adhere to the high cost status quo. A map of Scotland can easily be studied to find that many wind farms are in hilly areas, providing the typical 300-metre height difference between upper and lower reservoirs. Man-made reservoirs can be constructed and excavated to a suitable size. Pipes can run down the hillside, avoiding the need for costly tunnelling. A non-traditional low cost approach to hydroelectric energy storage allows wind farm owners to benefit from new revenue streams and guard against the risk of low wind energy prices.

Rather than signing up to long-term power purchase agreements (PPAs) with big utility companies, it could also be possible to actively enter the energy trading market via an in-house trading team or by working with a third party energy trader. New hydroelectric energy storage would provide many engineering and construction jobs.

So what can government do to assist strategic progress in energy storage? Certainly it would be good to identify and reduce barriers to entry within the energy storage market and energy trading, enabling renewable generators of all sizes to balance their output. There are methods to incentivise energy storage and encourage new market entrants now. This would be preferable to a delayed reactive response to huge scale wasteful curtailment and damagingly low wind power prices.

Scotland and the rest of the UK is investing massively in wind power including offshore wind. This means there is huge gearing advantage to be obtained by investing also in energy storage. Innovative technology and new industry in energy storage can be a great form of economic stimulus and job creation. Government can encourage relevant research, both theoretical and practical.

And what should the wind industry be doing? Forward thinking wind farm owners and wind industry financiers will be commissioning cost-benefit feasibility analyses now in preparation for changes in our future energy system. They will be studying the topography around their existing and future wind farms. They will be assessing what are the break-even cost points for introducing energy storage and they will be considering the investment case for adding in matching pumped hydro or possibly other methods of energy storage such as electrolysers for the export of green hydrogen.

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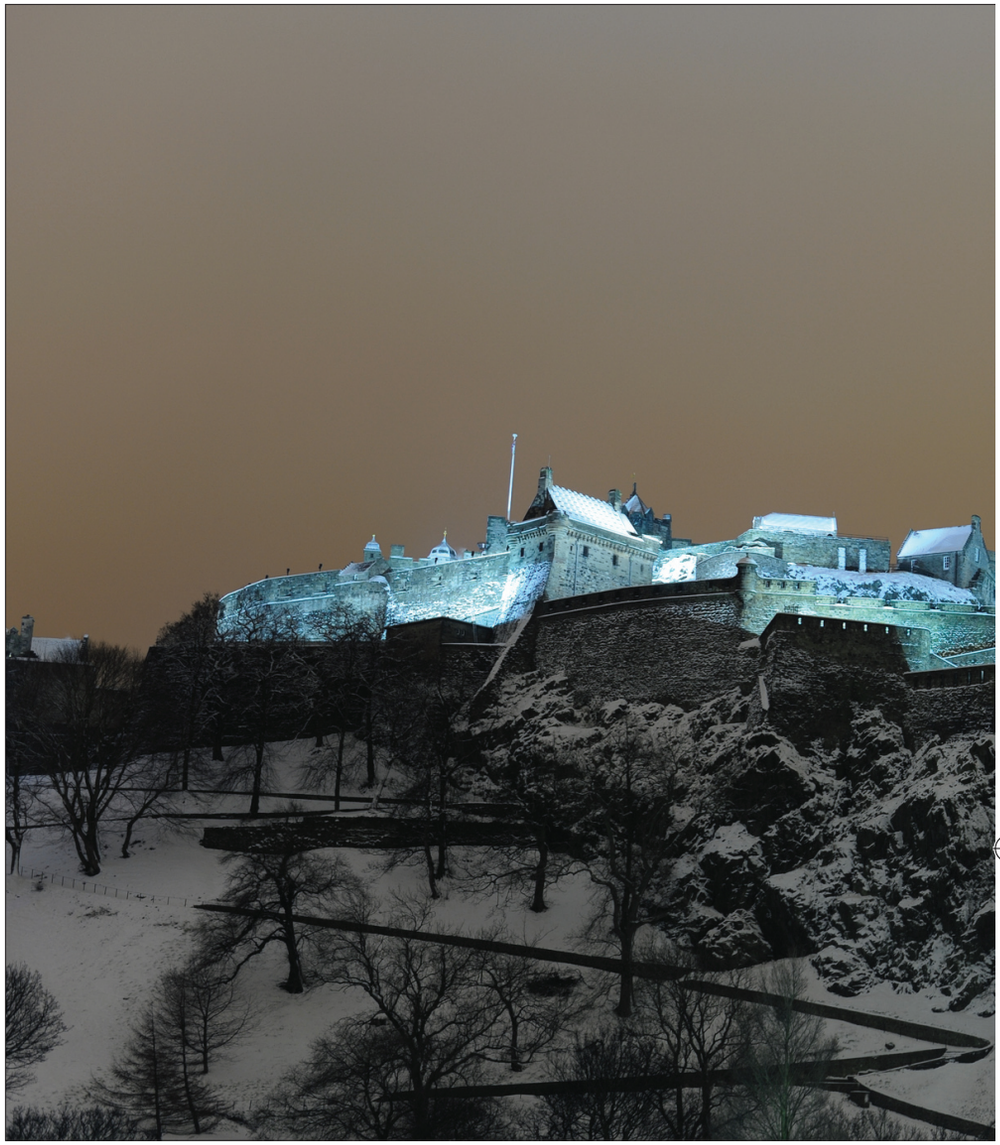

Balancing supply and demand becomes a critical challenge

By Tobi Kellner

Scotland's target to produce 100 per cent of its electricity from renewable sources by 2020 ranks among the most ambitious renewable energy targets of any nation on the planet. Yet electricity only accounts for around a quarter of our final energy consumption, much of the remaining 75 per cent is gas and oil used for heating and transport. For a sustainable energy future, we need to be able to supply 100 per cent of our total energy needs from renewable sources, and climate scientists tell us we need to get to zero greenhouse emissions as soon as possible.

At the Centre for Alternative Technology, the Zero Carbon Britain 2030 research project explores what a country powered exclusively by renewable energy would look like. In our scenarios, we explore combinations of drastic energy demand reduction, through refurbishment of the building stock and electrification of heating (through heat pumps) and transport, and large amounts of renewable electricity-generating capacity. Offshore wind power forms the backbone of our energy models, with between 100 and 200GW of capacity from fixed and possibly floating wind turbines spread around the British Isles. But with so much of the total energy demand now dependent on a highly variable source of electricity, balancing supply and demand becomes a critical challenge.

To show that our model can meet this challenge, we have defined more than 50 zones for potential future offshore wind farms. For each zone, wind speed data for every hour of the last decade is obtained from NASA's Modern-Era Retrospective

VARIABLE RATE

On cold winter days, the UK's demand for heat is often six times as high as the electricity demand

Analysis (MERRA) dataset, which draws on a wide range of data sources to compute hourly wind speed data for offshore locations far away from any met mast. Together with hourly data on heat and electricity demand for the last ten years, this allows us to simulate hour-by-hour flows of supply and demand in future energy systems, based on observed past weather data and demand patterns.

One important finding from our research is that even with a fleet of offshore wind farms evenly dispersed all around Britain, from the Hebrides to the English Channel, variability will remain a serious challenge. For example, our data indicates that under the wind speeds experienced on the morning of 28 December 2009, most offshore wind farms in our model would have been producing at less than 10 per cent of their rated capacity during a time of high energy demand, even though wind speeds were quite good the evening before. This illustrates that a future with a large amount of renewable energy from variable sources will also have a large requirement for flexible dispatchable backup generation, for example, gas turbines which burn biogas or synthetic natural gas produced using excess wind electricity in a process known as methanation.

The December 2009 example is also a useful reminder of the central role heat will play in future energy scenarios. On cold winter days, the UK's demand for heat is currently often six times as high as the electricity demand. In a future where most space heating is electrified, this creates a challenge: even if we assume good heat pump efficiencies and dramatic improvements to our building stock, winter electricity demand will still double. This obviously creates challenges, but there are also opportunities: heat can be stored fairly easily for a few hours or days, either in domestic hot water tanks or in large underground stores as part of heat networks with centralised heat pumps. Stockholm, Sweden, is already supplied by a heat network incorporating heat stores and large heat pumps which extract heat from sea water. Our research suggests that installing similar systems in the UK could play an important role in integrating large amounts of variable wind power in our energy system and ensure a sustainable and reliable heat supply. For a cold and windy island, this is good news!

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