centre for sustainable energy

Common concerns about wind power (2nd edn)

Chapter 10
Siting wind farms on ecologically sensitive land

This is one of a series of chapters of evidence-based analysis drawing on peer-reviewed academic research and publicly funded studies.

For other chapters, see
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The first edition of Common Concerns about Wind Power was published in 2011 to provide factual information about wind energy, in part to counter the many myths and misconceptions surrounding this technology.

Since 2011, much has changed in the legal and economic sphere, and a second edition became necessary. Research has been carried out for this edition since 2014. Therefore, this edition is formatted as a series of individual chapters available for download at www.cse.org.uk/concerns-wind-power-2017

All chapters written and researched by Iain Cox.

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The Centre for Sustainable Energy is a national charity committed to ending the misery of cold homes and fighting climate change.

We share our knowledge and practical experience to empower people to change the way they think and act about energy.

We are based in Bristol although most of our work has relevance and impact across the UK. Our clients and funders include national, regional and local government agencies, energy companies and charitable sources.

Chapter 10

Siting wind farms on ecologically sensitive land

Summary

Although many environmental drivers, both natural and man-made, have historically had more far-reaching impacts on sensitive environments than wind farms are likely to, the addition of any intensive renewable energy development on such land creates an additional pressure. Therefore, it is necessary to consider these impacts in the context of vulnerable habitats, especially so for wind power since by its nature many of the most viable wind resource sites in the British Isles coincide with areas of unique ecological and cultural value. Nowhere is this more evident than the upland fens and bogs that are characterised by peaty soils, which not only support habitats of international importance due to their rarity across Europe, but also sequester significant quantities of carbon in the soil itself. In all cases, the strategic importance of renewable energy developments must be weighed against the potential stress such developments can place on sensitive or overburdened ecosystems.

Existing windfarms in upland areas, particularly in Scotland and Ireland, have shed some light on how good practices can ameliorate the negative effects that infrastructure and turbine construction can have on upland habitats. In some cases, windfarm developments can be successfully combined with peatland reclamation due to the requirement that commercial conifer stands are cleared in the proximity of turbines, although these associated forestry operations can themselves have short-term effects on ecosystem function, such as streamwater nutrient flows. In addition, disruption of upland habitats can exclude some bird populations during wind turbine construction. Despite evidence that some species numbers recover post-construction, this is not the case for several species of waders; thus, careful site assessment is needed to ensure important species are not permanently displaced.

What is this based on?

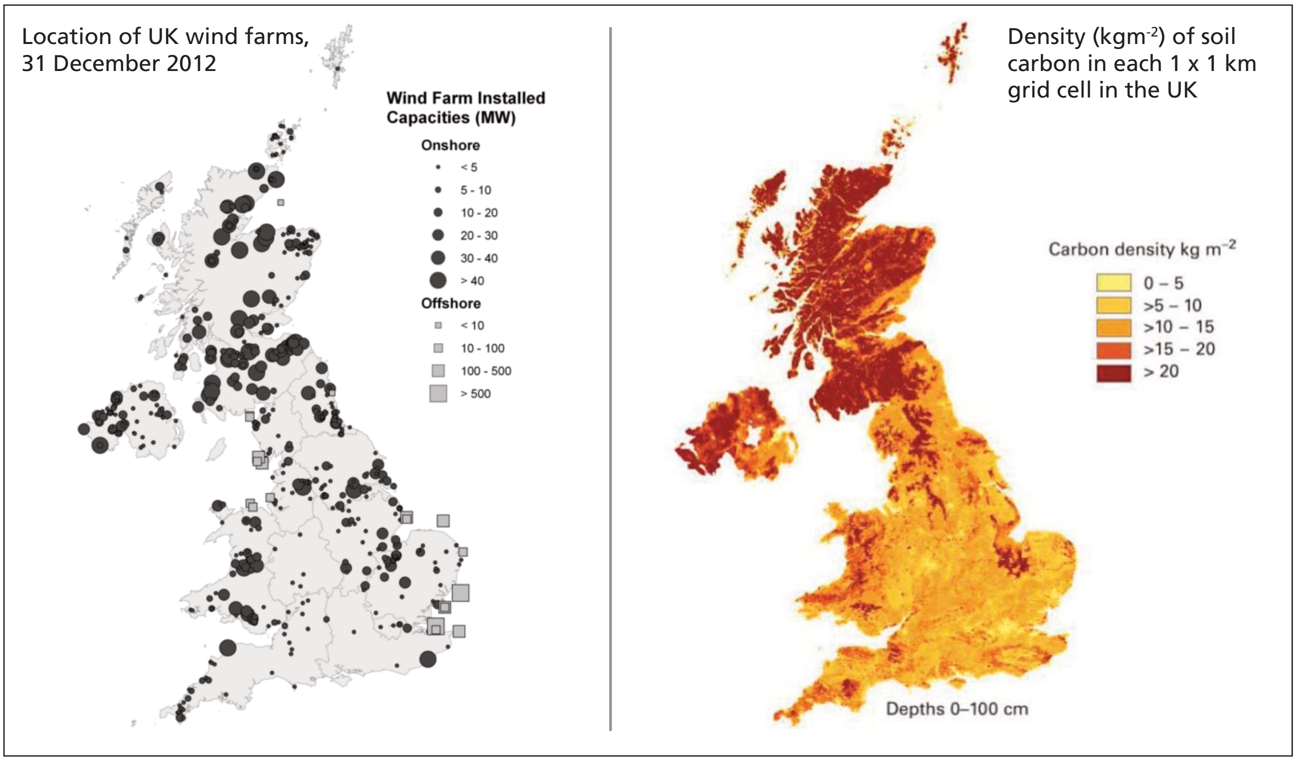
As with any infrastructure development, wind farms require the construction of site facilities and associated transport structures to enable the connection, maintenance and operation of turbines so that they can supply electricity to the national power system. Because of the nature of the wind resource across the British and Irish Isles, many of the best sites for wind farms fall within areas of peatland.[1,2] Upland areas have higher average wind speeds and thus offer the best returns in terms of renewable electricity and financial reward. The negative perception of local wind farm developments, which has been particularly strong in the UK in comparison with many other European countries where community ownership is more common, also means that developers are often keen to site turbines further away from the more settled lowland areas.[3,4] These same upland areas, however, are characterised by high rainfall, high water tables and low agricultural productivity; consequently, a large proportion of the UK's upland areas are covered by heather-dominated moorland, fens and bogs.[5]

Due to their disappearance across many areas of Europe, upland habitats in Britain and Ireland are of international importance, particularly the fens and bogs.[1,5] The wet conditions and cool temperatures that are prevalent allows the formation of peaty soils, which are very high in organic content and act as a major carbon 'sink'. The flux of carbon in habitats with peaty soils is generally in the direction of sequestering carbon in the soil fraction, rather than releasing carbon (in the form of CO_2) back into the atmosphere, so these peatland areas represent an important resource with regards to mitigating carbon emissions.[5] Indeed, such is the density of carbon in peaty soils that Scotland alone, where there is a preponderance of upland habitats, holds nearly half of all the UK's soil carbon,* even though Scotland makes up less than one-third of the UK's total land area.[6] A significant proportion of the UK's major existing and planned wind farms are sited in upland areas (see Figure 11.1).[7]

Although most existing wind farms are sited on the fringes of core habitats, growing numbers of these developments means that there will be increasing pressure on sensitive ecological areas in the UK, in particular those dominated by moorland, fens and bogs.[5] At the end of 2013, Scotland contained 61% of the UK's total installed onshore wind capacity, which illustrates the general trend for wind farms to be within

* The actual figure for Scotland is 48%. For comparison, England accounts for 38% of the UK's total soil carbon, even though it makes up more than half (54%) of the UK's land area.

Figure 10.1 The preponderance of wind farms situated in upland areas that coincide with peaty, high-carbon soils. (Maps from ref. 6 and 7, with permission.)



potentially sensitive and important habitat areas.[8] With careful planning and attention to restorative works following construction, it is possible to minimise the negative impact of wind developments on sensitive habitats whilst benefiting from the positive contribution made by the supply of renewable electricity. However, failure to follow good practices in areas with carbon-dense soils (mainly peat, but woodland areas too) can negate much of the carbon emission savings, resulting in only small reductions at the cost of disrupting important ecosystems.[2]

What is the current evidence?

Experience with extensive wind farm developments on peatland areas in Scotland and Ireland has hastened a range of guidelines and legislation to inform developers during the construction period, and also restorative work that must be undertaken afterwards.[1,9] In particular, a notable landslide in a blanket bog area in Ireland in 2003 following the installation of a 60 MW wind farm led to the formulation of extensive guidelines to monitor and mitigate 'peat slide'.[1] In the UK, this led the Scottish Executive to establish clear guidelines and requirements for any energy-related development in peatland areas.[10] These requirements include surveying to reveal deep peat soils where developments should be avoided altogether.

The major impact on upland areas is soil disturbance caused by construction of the turbines themselves and also related forestry operations.[9] For peaty soils, these disturbances can significantly affect streamwater chemistry, meaning that the flow of nutrients and organic compounds (the latter primarily made up of carbon), is perturbed in the local catchment area.[11] For peaty soils, with their ability to sequester large amounts of carbon thanks to the prevailing temperate and wet conditions, the increasing flow of organic matter out of the area can be a problem if this leads to excessive export of stored carbon.[2]

The forestry operations are carried out for several purposes. In addition to the trees cleared to site the turbines themselves, sometimes it is necessary to clear an area to reduce turbulence and improve wind flow to maximise the output of the wind farm. Furthermore, trees can be harvested around the area of a wind farm as part of a habitat management plan, often carried out to increase the area of blanket bog to compensate for vegetation lost to the turbine siting and provide alternative foraging grounds for native wildlife.[12] It should be remembered that the major cause of habitat loss in UK upland areas in the post-war years is due to more intensive grazing of marginal lands, commercial forestry plantations and the deposition of airborne pollutants.[†][5,13] As such, restoration of traditional peat bogs is a priority for the UK Biodiversity Action Plan, and also benefits the national climate change mitigation strategy by increasing soil carbon storage; thus, habitat management plans can be considered an enhancement in some cases, not just a compensatory measure.[5,12]

Several major wind farms in Scotland can be found situated in upland areas of mixed commercial forestry plantations and bog habitats. Several of these sites have been the subject of extensive surveys since the planning stage, resulting in, for example, decisions to reroute access roads across peat areas that were already degraded due to forestry instead of disturbing pristine undrained soils.[12] However, disturbances are inevitable, and existing developments have provided useful demonstrations in how wind farm developments can temporarily alter habitats in sensitive areas at all stages, including post-construction. It has revealed the importance of monitoring nutrient flows out of the catchment area before and after development, and the importance of accurately tracing the source of nutrients, such as whether they are from fractions of differing ages stored in the soil, or from excess atmospheric deposition.[11] It is also clear that associated forestry operations are a major cause for the increases in the level of carbon and phosphorous export observed in streamwaters of a wind farm development, although the same study also found that access tracks and their associated features (e.g. settlement ponds and ditch blocking) could, conversely, reduce the export of organic matter.[9] One feature of forestry clearfelling and habitat restoration that requires careful balancing is the use of 'brash mulching' to protect the exposed peaty soils after trees are harvested; even though this helps speed up the process of bog restoration, this technique can significantly increase nutrient run-off into surrounding waters (brash is the leftover residue from felled trees that is not suitable for the timber trade, like small stems and conifer leaves, and it has a high nutrient content). Solutions may involve the phased application of brash mulching to even out the flow of nutrients into streamwater, removing some of the excess brash material and using it for biomass energy, or immediate seeding of cleared areas with fast-growing grass species.[9]

For any renewable energy project, calculating the carbon emissions created by developing a previously undeveloped area, especially where the soil is carbon-dense, and setting these against the carbon emissions saved through the generation of renewable electricity is paramount.[2] There are many nuances to this, such as accounting for the natural flux of carbon emissions from peatlands – for example, undrained peat soils will effectively sequester CO_2 but they do emit higher levels of CH_4 (methane, another greenhouse gas) than drained soils. A very comprehensive lifecycle assessment of a large Scottish wind farm development suggests that best practices can mean carbon emissions from development can be as little as 9% of the emissions saved (i.e. savings are still significant); without proper management of the site the emissions savings may be reduced by as much as 34%; and if the site selection is poor in combination with minimal habitat management and restoration, then the carbon savings may be cancelled out almost entirely.[2] The key to best practice is careful site selection to avoid excessive drainage of undisturbed peatland, combined with prompt and carefully managed habitat restoration to mitigate disturbances caused by turbine construction and access roads.

One final consideration is the impact a development may have on wildlife.‡ Several species of birds of conservation importance are located in upland habitats, although major developments for wind farms tend to fall outside those areas where bird populations are most sensitive.[14] Monitoring of bird populations during and after construction of wind turbines has shown that many species are not seriously affected overall, with the most acute disruption occurring during the construction phase.[15,16] However, although many displaced bird populations do return to the vicinity of developed areas once construction is over, numbers may take a some time to reach pre-construction levels. Furthermore, some species, such as snipe and curlew, show a strong aversion to wind turbines and do not repopulate in developed areas.[16] It is vital that steps are taken to prevent further displacement of particularly vulnerable species.

Conclusion

Any construction works or installation that encroaches on the natural or semi-natural landscape must be subject to an Environmental Impact Assessment (EIA), as prescribed by EU law.[17] The upland areas of the UK, which are typically further from settled areas, less agriculturally productive and more exposed, offer the best wind resources in the country. These same conditions are also largely responsible for the formation and maintenance of upland heaths, fens and bogs containing peaty soils – the rarity of these across Europe means that such habitats in the British Isles are of special conservation importance. Due to the ability of peaty soils to store large amounts of carbon and act as a carbon sink, UK peatlands also represent an important strategic resource in relation to climate change mitigation. Thus, although the principles of the EIA and good practices apply to any site where a wind farm is to be developed, the UK upland areas are of particular consequence as they are where key climate change and conservation interests converge.

Given their nutrient-dense soils and high water tables, disturbances to undrained peatland habitats represent the biggest potential for ecological impact when

† In addition to acidification caused by airborne pollutants, which has declined since the 1980s, major disruption to upland habitats is caused by active nitrogen compounds being deposited at relatively high levels, creating imbalances in the nutrient cycle that adversely affect native plant species in sensitive ecosystems like upland heaths and bogs. This nitrogen deposition is an ongoing problem.

‡ The effect of wind farms on wildlife is discussed in further detail in chapter 11

constructing wind farms. The EIA can identify where siting is appropriate and what measures can be taken to minimise or mitigate these impacts. In many instances, peatland that has already been degraded by commercial forestry or intensive grazing can be used with minimal adverse effects, and careful habitat management planning can even improve the status of valuable bog habitats due to the requirements for commercial forest clearing. Once construction is complete, the resulting 'footprint' of an operating wind turbine array is relatively small in relation to the total area encompassed by the wind farm, although developers should take into account the impact of drainage and the potential to fragment pristine habitat areas. In addition, the impact on important avian species is expected to be minimal based on evidence from existing and planned wind farm sites, but there are a few individual species of waders that appear to be vulnerable to disruption. Measures such as mobile screening, no-go areas and prohibiting construction activities during breeding seasons may go some way towards mitigating the impact on these species, although more observations are necessary to confirm whether these will be effective.

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