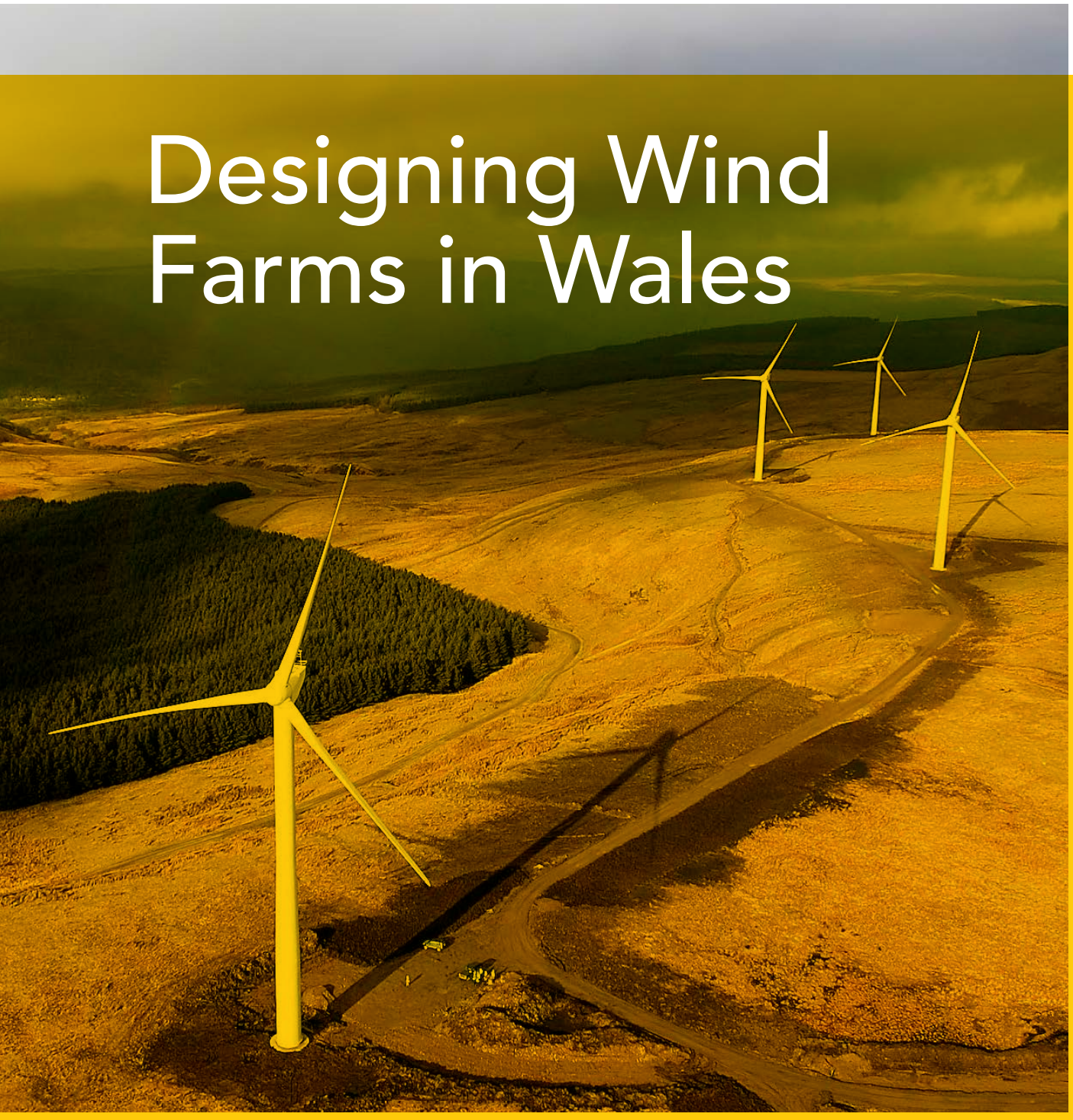
DESIGN
COMMISSION
FOR WALES
COMISIWN
DYLUNIO
CYMRU

Designing Wind Farms in Wales



Updated 2014

ARUP

Designing Wind Farms in Wales

Table of contents

Foreword

The purpose of this document is to set out the design objectives and considerations for the sensitive development of large scale wind farms and ancillary development in Wales. Both will assist in achieving developments which respond well to their context while helping to meet Welsh Government aspirations for low carbon energy generation.

It is anticipated that this guidance will be used by Local Authorities in their approach to reviewing and influencing wind farm applications, and provide signposting to developers bringing forward nationally significant projects on appropriate guidance available. The document will also inform communities of wind farm development within the Welsh landscape.

The Design Commission for Wales is the national champion adviser on design quality for the built environment and its impact on the natural environment. As an independent expert body, established by and working closely with the Welsh Government, we play a significant role in both national policy project proposals in Wales.

As a body reporting to the Welsh Government Minister for Environment and Sustainable Development, we are mindful of key policy and other requirements relating to large scale energy projects including renewables and nuclear, and to the commitment to reducing carbon emissions and making Wales more self-sufficient in energy production. We are also keenly aware of implications of associated development for such projects and the need for careful design consideration.

Through our team of independent experts we provide early, strategic consultation on all nationally significant infrastructure projects as they come forward in Wales, free of charge. We hold significant expertise in the relevant areas in relation to energy matters and associated enabling development, as well as major infrastructure projects and ports. Our commitment is regarded as authoritative by local authorities, the Planning Inspectorate, and many fellow professionals and developers.

It is important that we have access to proposals at an early stage of the design process, i.e. at the early pre-application stage, while there is still sufficient flexibility to allow developers to respond positively to our comments or recommendations and to realize the full potential and benefits of well-designed energy and infrastructure projects.

For further information please contact:
connect@dcfw.org
029 2045 1964

1 Introduction

Good design and siting principles for wind farms are becoming established following more than a decade of wind farm development in Wales. Design is a material consideration in the planning process. Good siting and design of wind farms is significant in helping to produce development which is appropriate to a landscape whilst delivering Wales's renewable targets.

This guidance document relates in the main to Nationally Significant Infrastructure Projects (NSIPs), Planning Appeals, and Called-In Planning Applications (PINS) (>50MW). It is not primarily aimed at small to medium scale wind developments. Knowledge and understanding in this area is evolving quickly. It is expected that this guidance will need to be reviewed and updated to reflect this. There are different consenting processes depending on the size of the wind farm development. The Planning Inspectorate makes consenting decisions on wind farms over 50MW, for projects submitted prior to the 2008 Planning Act (under Section 36 of the Electricity Act). Since the 2008 Act, the Planning Inspectorate is responsible for processing the applications, but the decision making responsibility for wind farms over 50MW lies with the UK Secretary of State. For wind farm developments under 50MW, the developer will need to apply for planning permission from the local planning authority (LPA).

Onshore wind farm development plays a significant role in the Welsh economy. Figures indicate that onshore wind alone could be worth more than £2bn to the Welsh economy, but this can be realised if industry and government work side by side to develop potential[1].

Wales is legally bound to national and European targets on energy and climate change, for instance, 15% of total energy should come from renewables by 2020 as implemented by the Renewable Energy Directive (2009)[2]. The Welsh Government has an ambition to make low carbon energy a reality in Wales. Welsh Government's energy policy and aspirations are set out in "A Low Carbon Revolution" which identifies Wales' sustainable renewable energy potential to 2020/2025. The Welsh Government is committed to pursuing these aspirations and promoting all forms of renewable energy with onshore wind as currently the most viable technology. The Welsh Government will achieve this situation by the following objectives[3]:

— Welsh Government will maximise energy savings and energy efficiency in order to make producing the energy we need from low carbon sources more feasible and less costly;

— Energy needs must be met from low carbon sources and move to a resilient low carbon energy production via indigenous and thus secure renewable energy, on both a centralised and localised basis; and

— Welsh Government will ensure that this transition to a low carbon maximises the economic renewal opportunities for practical jobs and skills.

Annually, the Welsh Government aims to double renewable electricity production by 2025 in comparison to 2010. By 2050, at the latest, to be in a position where all local energy needs can be met by low carbon electricity production[4].

Experience has shown that there are opportunities to achieve community benefits through major wind farm developments. Some benefits can be justified as mitigation of development impacts through the planning process e.g. highway infrastructure improvements and wildlife habitats creation or management. In addition, developers may offer benefits not directed relating to the planning process, e.g. an annual financial payment to the community or a commitment from the developer to use local labour wherever possible.

2 Strategic and Criteria-based Planning of Wind Farm Developments

This section provides guidance in the main to Local Authorities. It does not replace or override the policies stated in Planning Policy Wales (PPW) (Edition 4, February 2011)[5], Technical Advice Note (TAN) 8: Renewable Energy[6] and TAN 12: Design, but seeks to compliment and expand upon the landscape and visual considerations as identified in PPW.

PPW (Edition 4, February 2011) sets out the land use planning policies of the Welsh Government and is supplemented by a series of Technical Advice Notes (TANs). It provides the strategic policy framework for the effective preparation of local planning authorities' development plans. PPW updated Chapter 12, Infrastructure and Services, also provides guidance to Local Authorities about renewable energy developments. The new approach to Infrastructure will be needed in light of the consequences of climate change. One of the objectives of Chapter 12 is to promote the generation and use of energy from renewable and low carbon energy sources at all scales and promote energy efficiency, especially as a means to secure zero or low carbon developments.

PPW (Edition 4, February 2011) requires local planning authorities to set out a planning framework for the consideration of wind farm proposals. It allows some flexibility for development of wind farms within the Welsh landscape. TAN 8 which is referenced within PPW allocates 7 Strategic Search Areas (SSAs) across Wales within which most large wind farms (over 25MW) would be located. TAN 8 identifies areas where proposals are likely to be supported, areas to be afforded significant protection from wind farm development, and the criteria to be followed in the remainder of the area. TAN 8's approach is to generally limit the development of large scale wind farms to the areas of Wales which were independently and empirically assessed to be the most suitable.

TAN 12 requires local planning authorities in Wales to appraise the 'character' of the topography; landscape character, field patterns and land use patterns, distinctive views (in and out of the site), skylines and vistas, prevailing uses and plan forms, boundary treatments, etc. Furthermore, TAN 12 outlines that the appraisal of the landscape should focus on its quality in terms of geology and geomorphology, vegetation and habitats, visual and sensory quality and historic and cultural quality.

Landscape considerations, natural heritage, ecological issues and other constraints need to be taken into account when developing a robust and coherent planning framework. Good strategic planning can help to avoid wind farms diminishing landscape diversity within Wales by ensuring that wind farms are sited within areas which are able to accommodate them.

Landscape resources, such as 'LANDMAP'[7], can help to inform and identify where development would be preferable in landscape terms. LANDMAP is one method of assessment which has the potential to provide a framework and information base from which good design and management can be developed[8].

The planning framework in Wales advocates the use of LANDMAP as an information source. At the strategic level, landscape character analysis can help in identifying those landscape types best suited to large scale and multiple wind farm development.

Scottish Natural Heritage[9] (SNH) guidance developed three possible landscape objectives in judging whether or not an area should be kept free of wind farm impacts. These are landscape protection, landscape accommodation, and landscape change as set out below.

Landscape Protection

PPW (Edition 4, February 2011) aims to maintain the integrity and quality of the landscape within the National Parks, Area of Outstanding Natural Beauty (AONB), Natura 2000 Habitat Directive Sites, National Nature Reserves, the Dyfi Valley Biosphere site and World Heritage Sites. The highest levels of nature conservation and heritage designations, such as National Parks and AONB, are all excluded from SSAs.

Landscape Accommodation

Landscape accommodation aims to retain the overall character of the landscape, yet accepting that development may be allowed which will have an impact locally; that it fits within the landscape and does not change its character on a large scale.

SSAs have been reviewed as 'technically feasible areas' to accommodate large scale wind farms[10]. The following factors which are reviewed in order to identify 'technically feasible areas'; wind speed/topography, cultural heritage, land ownership and forestry, existing wind turbines and consented developments, nature conservation and landscape value. The highest levels of nature conservation and heritage designations, such as National Parks and AONB, are all excluded from SSAs.

Landscape Change

Within (and immediately adjacent) to the SSAs, the implicit objective is to accept landscape change i.e. a significant change in landscape character from wind turbine development[11]. Where it is accepted that the area is one whose landscape character may be allowed to change, DCfW considers that good landscape design principles still need to be followed to ensure that the development is still appropriate for the scale and character of the landscape.

Identifying capacity and limits to development

Within the aspirations set out in "A Low Carbon Revolution", Wales has the potential to provide 2 Gigawatts of onshore wind capacity. The potential estimated in the Low Carbon Revolution Energy Policy Statement was based on the maximum capacities that were considered appropriate for the SSAs in TAN 8 (2005).

Within areas identified as being suitable for multiple wind farms there may still be a limit on the number or extent of wind farms which can reasonably be accommodated. Within SSA's Local Authorities are encouraged to complete a landscape capacity study to determine how much development can be accommodated and what the critical factors might be that will define an eventual limit to development. The critical factors will be specific to the landscape involved, but could include the following key factors opposite. These key factors were developed in response to a need identified in Scottish Planning Policy (SPP) 6[12].

Cumulative Impacts

In developing planning policies and wind farm guidance, local authorities and developers should consider identifying areas that should be afforded protection in order to reduce the potential for further cumulative impacts. These areas may be required between very large individual wind farms, clusters of wind farms, and SSAs. Renewable assessments undertaken by the local authority would identify these areas. The "Renewable and Low Carbon Energy – A Toolkit for Planners" document provides guidance on how to undertake a renewable assessment to identify opportunities and provide the evidence base for their Local Development Plan's. It is acknowledged that the delivery of any protected areas may be challenging and will rely on a constructive dialogue between all parties.

— Effects on landscape designations – landscape value
Effects of additional development on the qualities, integrity and objectives of any relevant landscape designation should be analysed and described.

— Effects on landscape character
The effect of development on existing landscape character should be described. It is likely that as more wind farms are developed, and/or at closer distances to each other, they will begin to be perceived as a key landscape characteristic and will therefore change landscape character.

— Effects on sense of scale
Tall structures are likely to dominate and alter the perception of vertical scale in the landscape. This will be the case particularly when larger turbines are seen in comparison with developments using smaller turbines or when proposed turbines are viewed in comparison with other landscape features.

— Effects on sense of distances
Effects on distance may be distorted with additional wind farm development. For example, if larger turbines are located in the foreground of smaller turbines or vice versa.

— Effects on existing focal points in the landscape
An existing wind farm development may act as a focal point in the landscape and the effects of other wind farm development on this should be considered.

— Effects of skylining
A viewer's eye tends to be drawn towards the skyline. Where an existing wind farm is already prominent on a skyline the introduction of additional structures along the horizon may result in development that is proportionally dominant. The ratio of developed to non-developed skyline is therefore an important landscape consideration.

— Effects on sense of remoteness or wildness
The existing experience of remoteness and wildness should be assessed, and the effects of development on it analysed.

— Effects on other landscape interests
Effects of additional development on other interests in the landscape should be considered. For example, this may include consideration of the effects on the landscape setting of settlement or other cultural interests and associations with the landscape.

3 Siting and Design of Wind Farms

This section deals with siting and designing wind farms within the landscape. It applies design principles and develops them further in relation to landscape and visual effects. Experience has shown that the application of these principles will have an important influence on reducing the overall landscape and visual impacts of a wind farm. The following section has the same format as SNH[13] guidance for '*Siting and Design of windfarms in the landscape*', however this section is in context of the landscape in Wales.

Siting of Wind Farms

This section highlights the appropriate specific aspects of siting wind farms within the landscape.

Landscape and Visual Impact Assessment (LVIA) is an iterative process for examining the landscape and visual impacts of a development[14]. Alternative wind farms sites and design are proposed, assessed and mitigated. The first step to carrying out the Landscape Impact Assessment (LIA) section of a wind farm LVIA is typically to assess the landscape character of the study area to identify the key characteristics relevant to wind farm development.

Landscape Character

Underlying geology, landform, soils, vegetation, land use and settlement make places have different 'landscape character'. Taken together these qualities contribute to regional distinctiveness and a local 'sense of place'. Understanding a landscape's key characteristics and features is vital in considering how new development will affect it or, with appropriate design, contribute to it. LANDMAP, the key landscape guidance and landscape resource for Wales, has five layers of information that promotes sustainable landscape decision-making; Geological Landscape, Landscape Habitats, Visual and Sensory, Historic Landscape and Cultural Landscape.

Large scale deployment of wind power can change the character of a landscape and as such Technical Advice Note (TAN) 8: Renewable Energy (2005) has identified seven Strategic Search Areas (SSAs) where landscape change is likely to be acceptable. It is important to note that these areas do not preclude the erection of wind turbines in other parts of Wales but large scale development of multiple wind farms maybe less likely outside of these areas.

As defined in TAN 8, SSA's typically display the following characteristics:

— extensive areas with a good wind resource (typically in excess of 7 metres per second);

— upland areas (typically over 300m above ordnance datum) which contain a dominant landform that is flat (plateau) rather than a series of ridges;

— generally sparsely populated;

— dominated by conifer plantation and/or improved/ impoverished moorland;

— has a general absence of nature conservation or historic landscape designations;

— of sufficient area to accommodate developments over 25MW, to achieve at least 70MW installed capacity and to meet the target capacity;

— largely unaffected by broadcast transmission, radar, MoD Mid Wales Tactical Training Area (TTA) and other constraints.

Landscape and Scenic Value

A landscape may be valued for many reasons, such as for its specific landscape quality, scenic beauty, tranquillity or wildness, recreation opportunities, nature conservation or historic and cultural associations. A wind farm will not necessarily be incompatible with valued qualities of a landscape; this will depend on the nature of the development and the nature of the landscape qualities that are valued.

In Wales, a significant proportion of landscape is protected, for instance, 20% of the land mass in Wales have designated National Parks[15]. National Parks in Wales are areas of great natural beauty and have high scenic value due to their sense of place, tranquillity, wildness and/or openness, and integrity and diversity of landscape. Planning Policy Wales (2011) sets out the Welsh Government's framework for development control within the special protected landscapes of the Welsh National Parks. PPW makes it clear that major developments should not take place in the Parks save in exceptional circumstances.

In addition, 14% of Wales' landscape is covered by woodland[16]. Wooded landscapes in Wales offer a high cultural value as people and communities enjoy it in different ways – ranging from mountain biking, motor rallies, training and enterprise to simply walking a dog. In many cases wind farms can be entirely compatible with leisure use of the countryside and woodland.

Wales has a large expanse of coastal landscape. CCW using LANDMAP have mapped the land-sea intervisibility of Wales and characterised a resulting suite of 'seascape units', with major coastal headlands acting as division points. The assessment of Welsh seascapes is at a regional scale but provides relevant additional contextual baseline information. It characterises the Welsh coast into 50 regional seascape units detailing the character and qualities of each unit.

Many coastal habitats are designated as special areas of conservation under the EC Habitats Directive, including saltmarshes and mudflats, maritime cliffs etc.[17]. The coastal landscape within Wales has a high scenic value with a concentration of people choosing to live on the coast. In addition, the coastal landscape in Wales has a high cultural value, for instance, residents and visitors carry out recreational activities such as walking, cycling, surfing and sailing etc.

Experiencing wind farms in the landscape

The impact of a wind farm will depend on how and where it is experienced; for example, from within a settlement, while moving along a road, or from the top of a mountain range. The LVIA takes into account the sensitivity of the landscape and visual resource, and those people that will be affected by the development. LVIA includes assessment of impacts upon the key users of the landscape, including residents, motorists, workers, those partaking in recreation and tourists.

Different groups of people will experience different visual impacts. For example, residents will experience a wind farm from different locations, at different times of the day, usually for longer periods of time, and in different seasons. In contrast, visitors and tourists experience a short term visual impact but their sensitivity to landscape change is regarded as higher because their purpose is specifically to enjoy their surroundings.

Since June 2012, there are 37 operational and 14 consented onshore wind farms in Wales[18], therefore it is necessary to consider the cumulative visual effects from main transport and recreational routes. Of particular importance are: how these developments relate to each other in design and relationship to their settings; their frequency as one moves through the landscape; and their visual separation to allow experience of the character of the landscape inbetween.

Wind farm siting and design in relation to landscape and visual characteristics

The most distinctive characteristics of a wind farm are typically its collection of tall, often uniformly spaced turbines, each with moving blades that change orientation according to wind direction. Amongst the main factors that influence the siting of wind farms are:

— exposed places that are open, high and relatively prominent;

— land ownership;

— access;

— grid connection;

— site topography;

— location in relation to other natural or cultural heritage interests and/or statutory designations;

— aviation constraints;

— proximity to settlement; and

— to avoid excessive turbulence.

Landform

Landform is a key characteristic of many landscape character types, affecting whether it is rugged, flat, undulating or rolling, and upland or lowland. In flat landscapes, physical relief tends to become accentuated so that even low hills appear substantial. A large proportion of the Welsh landscape is rural and of upland nature.

Wind farms on undulating moorland or hills can present a confusing image because wind farms would be seen from different directions at varying elevations and spacing, against varying backdrops. It is generally preferable for wind farms to be grouped upon the most level part of the site so the development appears to be more cohesive.

It is also important that the scale and extent of a wind farm does not seem to overwhelm the distinctive character of the landform.

Landscape Scale

Developments should typically be designed to relate to landscape pattern where this contributes to landscape character and visual composition. The distinctive character of some landscapes relies on strong contrasts of pattern, for example an intricate arrangement of fields and regular spacing of rural houses seen against a simple moorland hill backcloth. In these locations, best practice suggests it is important that the addition of a wind farm neither compromises the simplicity of the backcloth hills, or the hierarchy or pattern of the lowland landscape below

Perspective

Careful consideration is needed in the siting and design of wind farms, and between wind farms, to avoid confusing the sense of perspective. The introduction of turbines into a landscape can confuse this sense of perspective.

Land Use

Land use is also an aspect of landscape character, reflecting the past and current activity of an area. Land use can influence pattern, texture, colour, foci and the framework of these elements within an area, which may be simple or complex and affect the condition of a landscape and the perception of its value e.g. whether it seems neglected or well-maintained.

Landscape and Visual Pattern

Strongly influenced by land use and physical features, landscape and visual pattern relates to the configuration of key elements. It is a product of the arrangement of repeated or corresponding features, be they a network of stone hedgebanks, hedgerows, shelter-belts, drainage channels, the distribution of drumlins along a valley, or repeated rock formations.

Focal Features

Mountain peaks, ridges, rock outcrops, or clumps of trees; or man-made structures like hill-forts, etc. are natural focal features. Wind farms are man-made focal features, sometimes the introduction of a wind farm as a focal feature may have beneficial effect helping to distract from negative prominent features.

Settlements and urban/industrial landscapes

Settlements and buildings within a landscape tend to be sensitive to the development of a wind farm for three main reasons:

Ffynnon Oer Windfarm Access, UK © Arup

— by being places from which people will view a wind farm and within which a key quality may be the provision of shelter and a sense of refuge that may seem impinged upon by the movement and proximity of a wind turbine;

— because buildings act as a size indicator in views that may emphasise the much greater scale of wind turbines in comparison; and

— because the settlement itself often forms a focal feature / landscape pattern to which a development would need to relate.

Larger single wind turbines are sometimes accommodated near to or within urban and industrial locations more so than a group of large wind turbines.

Coast

Wales has a great diversity of coastal landscapes, ranging from low-lying beaches with dunes, to craggy intricate cliffs and headlands. LANDMAP characterised the Welsh coast into 50 regional seascape units detailing the character and qualities of each unit[19].

Simple, open, flat coastal areas can probably better accommodate wind farms than complex coastal landscapes, such as those with inlets and islands. It is important that wind farms do not detract from existing landmarks, such as historical or navigational features, or coastal settlement and areas valued for recreation. Cumulative impacts may occur between onshore and offshore wind energy developments.

Woodland

Trees can act as a scale indicator if wind farms are sited immediately adjacent to, or within woodland areas. Trees can have a screening effect if they occur in the fore or midground of views looking towards turbines in the distance. This screening effect may change or be lost as via moving through the landscape.

If a wind farm is located within a forest, the clearance of trees can create a pattern of spaces, lines and shapes which could cause changes to distant views.

Wind farm extensions and 'repowering'

Recent wind farm developments have included numerous extensions and upgrades (repowering) to existing wind farm developments. Layout and site design objectives and principles should echo those of the original wind farm. Scale, colour, form and rotation speed should be compatible with the existing wind turbines. If the upgrade of a wind farm involves a replacement of all existing turbines with turbines of a different colour, scale and form, then it is imperative that throughout the design stage the design and layout principles are carried out.

Wind Farms © Arup

Wind Turbine Design and Layout

The landscape and visual impacts of a wind farm are strongly influenced by the design and layout of wind turbines. Impacts also result from infrastructure serving the development, such as access tracks and borrow pits, anemometers. Design and siting of this ancillary infrastructure are also referred to in this section.

The landscape and visual impacts of a wind turbine vary not only with its size, but also with the make and model of the turbine proposed. Turbines of the same height may have varying visual appearances due to their different design and technical characteristics.

A wind turbine comprises a tower that supports a nacelle, that is the main shell containing the electric generator and to which the turbine blades attach via a hub.

The nacelle has an anemometer attached so that the direction in which the blades face can be altered to maximise wind capture.

Turbine Colour

Experience has shown that it is important to choose a colour that will relate positively to a range of backdrops seen within different views and in different weather conditions. If wind turbine components are of different colour it can create a more complex image and means the visibility of different sections varies.

A light grey colour generally achieves the best balance between minimising visibility and visual impacts when seen against the sky. For multiple wind farm groups or wind farm extensions, the colour of turbines should generally be consistent. Light grey will relate positively to a range of backdrops seen within different views of and in different weather conditions.

Turbine Lighting

In some locations it may be necessary to light wind turbines for reasons of civil or military aviation safety. Lighting on top of the turbine may be inappropriate in predominately unlit rural areas. Therefore it is necessary to design lighting in order to minimise landscape and visual impacts whilst satisfying health and safety or navigation requirements.

Turbine Size and Scale

Longer blades will result in a greater rotor area and likely extend upwards into higher wind velocities. Currently wind turbines consists of 60 -100 meters high towers with blades of 40-50 meters or more, so their overall height to blade tip is typically 100 -150 meters. Larger wind turbines may appear out of scale or visually dominant in

Whitelee Wind Farm, Eaglesham, East Renfrewshire, UK © Paul White Photography

lowland, settled, or smallerscale landscapes. Commercial wind turbines, over 60m in height, may seem to dominate elements of the landscape pattern.

It is necessary to note that the relationship between visual impact and turbine size is not directionally proportional due to two reasons:

— a wind farm is viewed within a surrounding context which varies; and

— the actual size of a wind turbine is usually difficult to perceive.

Ancillary infrastructure

The siting and design of ancillary infrastructure needs to relate to the key characteristics of the landscape. Careful siting of the substations, transmission lines, access tracks and control buildings will help to enhance a wind farm design.

In addition, landscape and visual impacts associated with widening of roads, access tracks and corners to enable the delivery of large turbine components should be taken into account when designing and siting a wind farm.

Turbine layout

The layout of a wind farm should relate to the specific characteristics of the landscape. The layout of large scale wind farms generally comprises a grid of wind turbines often taken as the starting point with the turbines spaced at minimum separation distances to avoid turbulence, often equating to 4-5 rotor diameters. Throughout the design process, the wind turbines may be moved or removed due to an array of physical and environmental constraints.

Design and Access Statement

A Design and Access Statement (DAS) is a key document which accompanies a planning application and a developer should aim to create a wind farm with a cohesive design that relates to the surrounding landscape. A DAS should explain the design principles and concepts that have been applied to particular aspects of the proposal. The DAS should demonstrate how the local context has influenced the design of the development.

The 'access to the development' component of the statement should explain how the design ensures that all users including disabled people, older people and very young children, will have equal and convenient access to the development.

Where EIA of an application is required, as will be the case for significant wind energy development, this should include, where appropriate, an assessment of, among other things, the proposed transport route for the movement of turbines and associated equipment to the site. As part of that assessment, the local planning authority should consider what works and measures are likely to be required to secure the satisfactory operation of that route.

An Environmental Impact Assessment (EIA) also accompanies a planning application and informs the local authority, developer, statutory and non-statutory consultees of the likely effects of a new development on the environment. The next section, Section 4, provides more information on this process.

4 Environmental Considerations

EIA is a key procedure of informing the Local Authorities and statutory and non-statutory consultees of the likely effects of a new development on the environment. These impacts need to be fully understood and taken into account before the development is allowed to go ahead.

An EIA is only a statutory requirement for wind energy proposals where the proposal is likely to have significant effects on the environment, under the Town and County Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999. It is an integral component of the planning process for certain types of development and will be for all large wind farms (>25MW). The Schedule 2 criteria and applicable thresholds for the purpose of classifying wind farm developments as Schedule 2 is stated below[23].

Installations for the harnessing of wind power for energy production (wind farms):
(i) The development involves the installation of more than 2 turbines; or
(ii) The hub height of any turbine or height of any other structure exceeds 15 meters.

EIA considers all potential impacts of the development on the surrounding environment including ecology, ornithology, noise, visual, communications, shadow flicker and archaeology. EIA also considers any environmental benefits such as the reductions in emissions, and improvements to biodiversity or habitats.

Not only does EIA assess environmental impacts of the proposed development on the surrounding built and natural environment but also social and economic impacts. There is a possibility of a Habitat Regulations Assessments (HRA) being undertaken. The UK Government Guidance on Habitats Regulations Assessment (HRA) from the Department of Communities and Local Government (DCLG), August 2006, states that areas designated as globally important wetlands under the Ramsar Convention (1971) should also be given the same level of protection as Special Areas of Conservation (SAC) and Special Protection Areas (SPA) designations in the HRA process. HRA assesses the likely impacts of the possible effects of a plan's policies on the integrity of the Natura 2000 sites including cumulative impacts.

Land Use

Wind turbines take up very little land, only about 1% of the site where they are situated and the remaining land is still available for agricultural or amenity use. The potential effects on land use are generally minimal because the land may not be of a particularly high quality in terms of Agricultural Land Classification (ALC). For instance, uplands tend to have limited land use and may be of less marginal economic value to farmers. Land use will determine the layout, siting and size of a wind farm.



EIA support © Arup

Ecology

Certain species in Britain are in need of special protection, for reasons of dramatic decline, loss of habitats and rarity or restricted distribution. The flora and fauna listed below are protected via European and/or national legislation:

— Invertebrates;
— Bats;
— Amphibian and reptiles;
— Great Crested Newts;
— Water voles; and
— Key habitats (including plant species).

The design, layout and siting of a wind farm has to take into consideration of the surrounding protected species. If the wind farm layout design has the potential to cause ecological issues it is often possible to modify a wind farm site to minimise the effects upon protected flora and fauna species. Consultation with the Countryside Council for Wales early will assist this iterative process.

Ornithology

Poor design of wind farms could result in loss of bird habitat and feeding grounds, collision and interruption to flight paths and migratory routes. The EIA informs the design process so that site layouts are modified to accommodate bird movements in an iterative process prior to the planning application. As with ecological issues above, early consultation with the Countryside Council for Wales/RSPB will also assist this iterative process.

All wild birds are protected under the Wildlife and Countryside Act 1981 which prevents killing or injuring any bird or damaging or destroying nests and eggs. Certain species are specially listed under Schedule 1 of the Wildlife and Countryside Act 1981, which prevents disturbance of the species or its nest and/or eggs at any time, and are protected by special penalties.

Many species of bird will adapt to the presence of wind turbines. Radar studies of migratory flight paths show that many species of bird will fly around wind turbines. Other studies in the UK have shown that the effects of well-placed wind turbines are not significant on bird populations.

Ground feeding birds are normally least affected and may even increase in numbers. Raptors (birds of prey) could be affected by wind turbines due to the following reasons:
— Construction of wind farms on good hunting sites;
— Many raptor species are large soaring birds which require the lift of hills and ridges to remain airborne for long periods of time; and
— Interruption to regular flight paths.

All of these factors should be identified in the EIA which will result in a modification of turbine layout to minimise the risk.


EIA support © Arup


EIA support © Arup


EIA support © Arup

Noise

Two factors affect the perception of a particular sound; the level of background noise relative to the sound in question; and the tonal quality. If the noise emitted by the turbine is less than the background noise then it will be hard to discern the sound of the turbine.

In modern wind turbines the designers go to great lengths to avoid tonal noises from gearboxes and towers. The effect of noise from wind turbines forms an important part of the EIA. Most large wind developments will now use computer software to model the effects of terrain on the sound levels at critical places such as nearby houses. This information can then be used to change the layout of the wind farm to minimise the effects.

Visual Impact

Visual impacts of wind farms can determine the layout and siting of a wind farm.

Wind turbines are large structures that can be seen for great distances depending and considerable effort is made by developers to reduce the visual intrusion of wind turbines as part of the EIA process. There are various factors such as landform, landscape scale, focal features, turbine colour, turbine size and turbine lighting etc. which could accentuate visual impacts of a wind farm, see Chapter 3 for more information.

Shadow Flicker

Shadow flicker may occur under certain circumstances of geographical position and time of day, when the sun passes behind the rotors of a wind turbine and casts a shadow over neighbouring properties. As the blade rotates, the shadow flicks on and off, an effect known as shadow flicker.

Shadow flicker can be mitigated through the layout and siting of the wind farm, and/or operational controls.

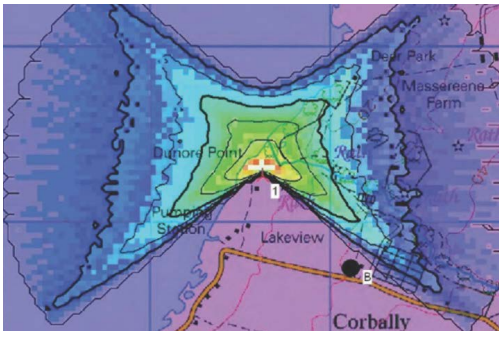
Archaeology

Construction of wind farms could affect visible or buried archaeological remains, such as non-designated features and designated features (Listed Buildings and Scheduled Ancient Monuments).

The siting and layout of a wind farm can reduce the adverse impacts on archaeology.

Hydrology

Wind farm development could create vulnerable changes to flood risk, ground water, surface water and drainage systems. The layout and siting of a wind farm can reduce the adverse impacts on hydrology.



EIA support © Arup

Telecommunications, Television, Aviation Systems

Large structures such as wind turbines have the potential to interfere with telecommunication links, television reception, radio communication and flight paths through physical obstruction or reflection of signals. The siting and layout of wind turbines can reduce these interferences.

Social considerations

Effective and early consultation with key stakeholders and the general public are important processes within the EIA and design process.

Socio-economic and tourism considerations

Wind farm developers can provide funds to communities living closest to their project. The level of benefits is usually calculated in terms of pounds per megawatt (MW) of installed capacity, to be paid per annum, with funds available for an array of community purposes.

Construction, operation and maintenance activities of the wind farm can create jobs for the local workforce creating indirect and direct economic benefits. However, operational and maintenance employment for onshore wind farms is generally low: a large 50MW wind farm may require no more than four technicians[20].

Local businesses may be economically directly and indirectly affected by wind farms, for example, as a result of construction workers using local Bed and Breakfast accommodation and shopping locally.

The potential exists for an effect on tourism and the perception of visitors caused by the proposed development – however the majority of studies carried out into this issue suggest effects are limited or negligible[21; 22]. Potential effects may vary from serving as a new attraction to visitors to the local area or acting as a deterrent if the turbines are perceived as affecting the natural landscape. The impact on tourism may have wider effects on the local economy and employment.

5 Designing in landscapes with multiple wind farms

The cumulative design objective is one of the most important design objectives with regards to designing multiple wind farms in landscapes as highlighted in the '*SNH Siting and Designing wind farms in the landscape guidance*'[23]. Multiple wind farms will result in different types of cumulative effects. For each wind farm or strategy concerning potential wind farms, the most appropriate cumulative design objectives should be established, while also taking into account existing developments.

Some landscape character types will be able to accommodate multiple wind farms, while this may be inappropriate others. Generally, it will be preferable for wind farm development to be limited in the range of landscape character types it covers within a particular area, to avoid reduction in the distinction between types.

In areas with multiple wind farms there is potential for the overall landscape character to be significantly changed. The presence of a number of wind farms could make them the dominant characteristic of the landscape such that it becomes a 'wind farm landscape'. It would generally be undesirable for multiple wind farm development to change distinctive skylines or occupy the major proportion of a skyline from key viewpoints or receptors.. A Landscape Character Assessment (LCA) can assist in designing development which best respects a location's distinctive character. Wind farms can be concentrated in SSAs due to a maximum generation capacity in relation to the size of each SSA. Therefore, a 'wind farm landscape' will be appropriate in SSA's although good wind farm design principles still need to be applied.

Separate wind farms should generally appear visually separated from each other – unless specifically designed to create the appearance of a single combined wind farm –and/or unless local planning authorities have policies to allow this to happen.

To ensure wind farm landscapes complement the landform in their positioning, extent and density, different forms of wind farm development should respond to different landscape character types, as stated in section 3 of this document.

An extension to a wind farm should relate to the area's landscape character in extent and scale and the new turbines should be compatible with the existing ones.

6 Glossary

AONB
Area of Outstanding Natural Beauty, an area of countryside considered to have significant value in England, Wales and Northern Ireland.

Ancillary infrastructure
The built element and structures of a windfarm, apart from the turbines, which serve the development, such as access tracks, borrow pits, the control building and substation.

Anemometer mast
A mast erected on a windfarm site, usually the same height as the turbine hubs, to monitor wind speed.

Capacity Study
Research which attempts to identify the acceptable limits to development in a given area.

Cumulative Impact
Additional changes caused by a proposed development in conjunction with other similar developments.

Design and Access Statement
A document which aims to create a development with a cohesive design that relates to the surrounding landscape and allows access to all users.

EIA
Environmental Impact Assessment, the process by which the key environmental and socio-economic impacts of a development are assessed to reduce likely negative effects during the

LIA
Landscape Impact Assessment, part of the LVIA process by which explores the potential effects on the landscape of a proposed development (see below).

LVIA
Landscape and Visual Impact Assessment – a standard process for examining the landscape and visual effects.

Megawatt (MW)
1,000 kilowatts

Strategic Search Area
These areas can accommodate large scale (over 25MW) onshore wind developments due to efficiency and environmental reasons amongst others.

7 Notes

1 Insider Media Limited (2012). Group to push for renewable gains. [online] Available at: < http://www.insidermedia.com/insider/wales/72642-group-push-renewable-gains/index.html > [Accessed on 29/06/2012]

2 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

3 A Low Carbon Revolution – The Welsh Assembly Government (2010), [online] Available at :< wales.gov.uk/topics/.../energy/.../policy/lowcarbonrevolution/> [Accessed on: 29/06/2012

4 Ibid

5 Welsh Government (2011), Planning Policy Wales Edition 4, [online] Available at:> http://wales.gov.uk/topics/planning/policy/ppw/?lang=en> [Accessed 29/06/2012]

6 Technical Advice Note 8: Renewable Energy (2005), Annex D

7 Countryside Council for Wales (2010), LANDMAP for Landscape and Visual Impacts Assessment of Onshore Wind Turbines, LANDMAP Information Guidance Note June 2010

8 Technical Advice Note (TAN) 12: Design (2009), [online] Available at:http://wales.gov.uk/topics/planning/policy/tans/tan12/?lang=en [Accessed 13/06/2012]

9 Scottish Natural Heritage (2009), Siting and Designing windfarms in the landscape, Version 1, December 2009

10 Technical Advice Note (TAN) 8: Renewable Energy (2005) [online] Available at: < http://wales.gov.uk/topics/planning/policy/tans/tan8/?lang=en> [Accessed on 13/07/2012]

11 Ibid.

12 Scottish Planning Policy: Renewable Energy, Scottish Executive 2007 – was superseded in 2010 by a new consolidated SPP, paragraph 3, Annex A – Cumulative Impacts

13 Scottish Natural Heritage (2009), Siting and Designing windfarms in the landscape, Version 1, December 2009

14 The guidelines for this are set out in the 'Guidelines for Landscape and Visual Assessment' (GLVIA), produced by the Landscape Institute and the Institute of Environmental Management Assessment

15 Welsh Government (2007) Policy Statement for the National Parks and National Park Authorities in Wales, March 2007, [online] Available at http://wales.gov.uk/topics/environmentcountryside/consmanagement/countrysidecoastalaccess/npwales/policystatement/?lang=en [Accessed on 26/06/2012]

16 Welsh Government (2009) Heritage, Landscape and the Cultural Value of Welsh Woodlands and Trees: The National Assembly for Wales's strategy for trees and woodlands. Forestry Commission, March 2009

17 Hadley., D (2009). Land Use Policy, Land use and the coastal zone, Science Direct, 26: S198 – S203

18 BWEA, [online], Available at:http://www.bwea.com/statistics/ Accessed on: 29/06/2012

19 Countryside Council for Wales (2010), LANDMAP for Landscape and Visual Impacts Assessment of Onshore Wind Turbines, LANDMAP Information Guidance Note June 2010

20 Munday, M., Bristow, G., and Cowell, R. (2011) 'Wind farms in rural areas: how far do community benefits from wind farms represent a local economic development opportunity?' Journal of Rural Studies 27, 1–12

21 The Tourism Company (2012), The Impact of Wind Turbines on Tourism – A Literature Review, [online] Available at: www.tpnw.org, [Accessed on 16/07/2012]

22 The Scottish Government (2008), [online] Available at:http://www.scotland.gov.uk/Publications/2008/03/07113554/0 [Accessed on 16/07/2012]

23 Scottish Natural Heritage (2009), Siting and Designing windfarms in the landscape, Version 1, December 2009

Contact details

— Comisiwn Dylunio Cymru / Design Commission for Wales
4th Floor, Cambrian Buildings
Mount Stuart Square, Cardiff, CF10 5FL

— +44 (0) 29 2045 1964
— connect@dcfw.org
— www.dcfw.org

ARUP

— www.arup.com

DESIGN
COMMISSION
FOR WALES
COMISIWN
DYLUNIO
CYMRU

ARUP