Scottish Natural Heritage

Siting and Designing windfarms in the landscape

Version 1

December 2009

Contents

Part 1

Introduction

1.1 Good design principles for windfarms are becoming established following more than a decade of windfarm development in Scotland and with more than fifty windfarms constructed and operating. Design is a material consideration in the planning process and SNH believes that good siting and design of windfarms is important for all parties involved, helping to produce development which is appropriate to a landscape whilst delivering Scottish renewables targets.

1.2 In 2001, SNH published '*Guidelines on the Environmental Impacts of Windfarms and Small Scale Hydroelectric Schemes*', which included guidance on the siting and design of windfarms. Since this time, however, our understanding of the effects of windfarm siting and design has developed further and some new issues have come to the forefront, such as the cumulative impacts of multiple developments. This guidance, which supersedes the landscape sections of the original guidelines, reflects this advance in our understanding of the key landscape and visual issues relevant to windfarm development. Nevertheless knowledge and understanding in this area is evolving quickly and it is expected that this guidance will need to be regularly reviewed and updated to reflect this.

1.3 This is guidance on landscape issues, building upon areas of SNH renewables policy. It does not refer to wider technical design considerations (such as wind speed, access to grid) or to other natural heritage issues (such as impacts on birds, other wildlife and habitats) which are also of importance in relation to both siting and design. A range of other considerations such as noise, archaeology, access and transport are also relevant to the design of windfarms and guidance on these topics is available elsewhere. It should be used alongside other SNH guidance, including our *Strategic Locational Guidance for Onshore Windfarms* (2002, updated March 2009), *Cumulative Effects of Windfarms* (2005), and *Visual Representation of Windfarms Good Practice Guidance* (2006), available on the SNH website.

1.4 Developers and those involved in windfarm design should also refer to the Spatial Frameworks for Windfarms being developed by Local Authorities in response to Scottish Planning Policy (SPP) 6[1]. This guidance has been written during the period that Local Authorities are developing their Spatial Frameworks, with a view to providing guiding principles at a strategic level. However, when considering an individual application, the adopted development plan and supplementary planning guidance as well as SPP6 provide the framework within which the application should be considered.

1.5 The guidance is structured in two parts. Part 1 provides siting and design guidance for windfarms. Part 2 provides guidance on strategic siting and design considerations for windfarms in relation to the requirements of SPP6.

1.6 This guidance is being written at a time of change, not least the proposed revision of currently separate SPPs into a single document. It is intended to review the guidance periodically so this document, Version 1, will gradually benefit from subsequent updates and amendments. Comments will be sought via the SNH website.

1 Scottish Planning Policy 6: Renewable Energy, Scottish Executive 2007 – to be superseded in 2010 by a new consolidated SPP.

1.7 The views expressed in this document are drawn from the experience of SNH staff who have advised on windfarm applications across Scotland in many different landscape settings and at many different scales of development. They have also been informed by a public consultation exercise and a workshop held at Battleby in March 2009.

Background

1.8 SNH supports the adoption of renewable energy technologies, including windfarms, to address the effects of climate change and supports the Scottish Government's adopted policy in SPP6[2]. Windfarms have an important role to play, taking advantage of the good wind resource in Scotland. However, our support for renewables has to be balanced with the Scottish Government's commitments and aspirations to conserve and enhance the natural heritage, including the quality and diversity of Scotland's landscapes. The purpose of this guidance is to help guide windfarms towards those landscapes best able to accommodate them and to advise on how windfarms can be designed to best relate to their setting and minimise landscape and visual impacts.

1.9 Scotland is renowned, at home and internationally, for its diversity and quality of landscape and scenery, particularly its distinctive coast, mountains and lochs. This contributes to the overall quality of life for all who live in or visit Scotland, and provides a setting for our economic activity, including tourism. It also means that landscape is the basis for many of our social, community and cultural values. The European Landscape Convention applies to all landscapes, and recognises landscape character assessment as a way of informing decisions. The Convention promotes integrated policies for landscape protection, management and planning, and encourages the involvement of the public in developing these. SNH's Landscape Policy Framework (2005) recognises both the importance of landscape to Scotland's natural heritage and people's lives, while acknowledging that this relationship will change as landscapes evolve.

1.10 Wind turbines are generally large structures with the potential to have significant landscape and visual impacts. The development of windfarms, including associated infrastructure such as tracks, power-lines and ancillary buildings, has already had a major impact on many of Scotland's landscapes – arguably the biggest change since that resulting in some parts of Scotland from commercial afforestation in the 1970s and 80s. Thus far most of this change has occurred in landscapes considered more suitable for windfarm development. This guidance aims to learn from current experience to inform the future siting and design of windfarms.

1.11 It is therefore important that care continues to be taken to ensure that further windfarms are sited and designed so that adverse effects on landscape and visual amenity are minimised, and that areas which are highly valued for their landscapes and scenery are given due protection. If windfarms are sited and designed well, the capacity of our landscape to incorporate this type of development will be maximised. Conversely, if they are poorly located and designed the scope for further development in the future will be greatly reduced.

2 SNH Policy Statement 01/02 SNH's Policy on Renewable Energy.

2

Landscape and Visual Assessment of Windfarms

What is Landscape and Visual Impact Assessment?

2.1 Landscape and Visual Impact Assessment (LVIA) is a standard process for examining the landscape and visual impacts of a development. The methodology for this is set out in the 'Guidelines for Landscape and Visual Assessment' (GLVIA), produced by the Landscape Institute and the Institute of Environmental Management and Assessment[1].

2.2 LVIA follows an iterative process by which alternative sites and designs for a development are proposed, assessed, and amended (a process often referred to as mitigation). Through this process, LVIA identifies the preferred siting and design option for a development, balancing different environmental issues as well as functional, technical and economic requirements. Ultimately, the final scheme is assessed for predicted residual impacts on the landscape and visual resource. LVIA is usually carried out by Chartered Landscape Architects who apply professional judgements in a structured and consistent way based on landscape design principles. The LVIA should assist decision makers, members of the public and other interested parties by providing a clear and common understanding of the predicted effects of windfarm proposals in an impartial and professional way.

Context for Landscape and Visual Impact Assessment

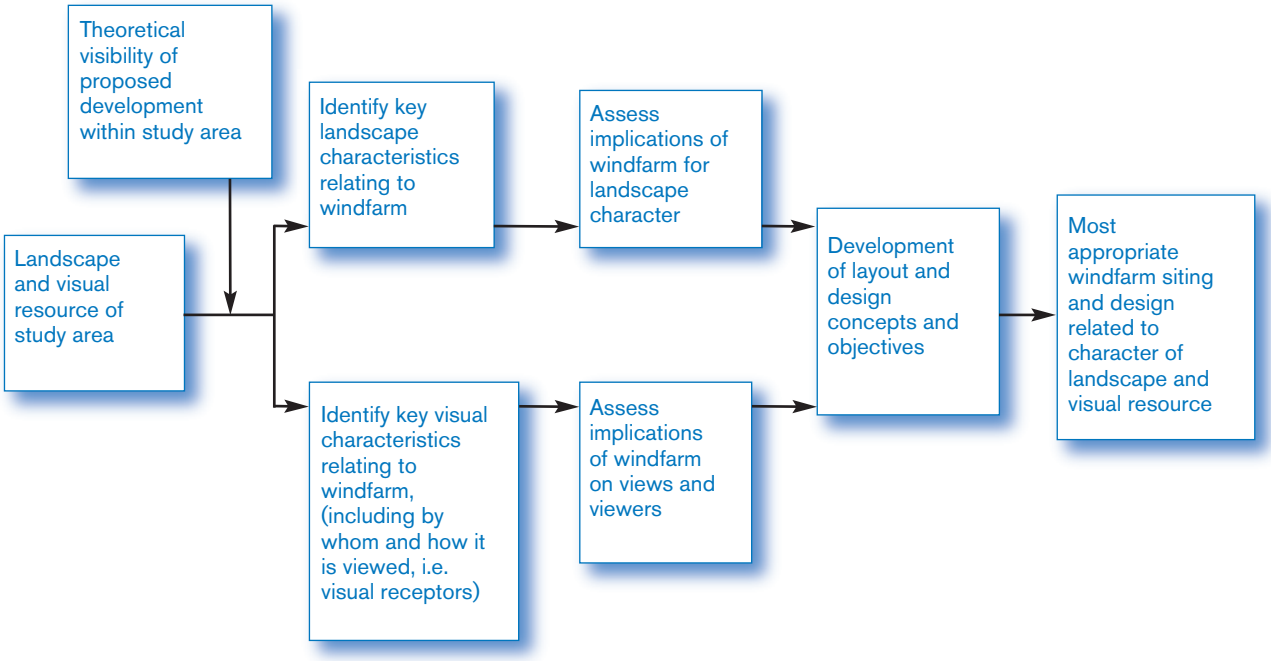
2.3 LVIA is a standard process of assessment that may be presented as a separate report or form one part of an Environmental Impact Assessment (EIA) within an Environmental Statement (ES). While a LVIA will usually be required for every windfarm proposal, an EIA is only a statutory requirement for wind energy proposals where the proposal is likely to have significant effects on the environment. Circular 8/2007[2] sets out when EIA may be required for windfarms.

Landscape and visual impacts of Windfarms

2.4 LVIA comprises two separate parts, Landscape Impact Assessment (LIA) and Visual Impact Assessment (VIA), although these are related processes as described within the GLVIA. LIA considers the effects of the proposal on the physical landscape, which may give rise to changes in its character, and how this is experienced. VIA considers potential changes that arise to available views in a landscape from a development proposal, the resultant effects on visual amenity and people's responses to the changes.

2.5 The flow diagram below indicates the process of LVIA, which commences with determining the key characteristics of the landscape and visual resource.

1 Guidelines for Landscape and Visual Impact Assessment, 2nd Edition, (Spon Press), Landscape Institute and Institute of Environmental Management and Assessment.
2 Scottish Planning Series Planning Circular 8-2007: The Environmental Impact Assessment (Scotland) Regulations 1999. Scottish Government.



2.6 Early in the LVIA process it can be determined which landscape and visual characteristics are particularly relevant or sensitive to the development proposal. Focussing on these, the designer can explore what the potential impact of a windfarm will be if it is sited and designed in different ways, and determine what the main design aims should be to create a windfarm that relates well to the landscape.

2.7 Clearly other technical and economic factors will also be important in the decision-making process, as will other environmental impacts such as effects on wildlife and habitats. Cumulative effects with other windfarms will also be a consideration[3].

Design Statements

2.8 Design Statements help communicate the issues, constraints and decision making processes behind development of a design. They document the design process of a development, whether it requires a LVIA and/or EIA or not, so they are not a wholly additional piece of work. Their relevance to windfarm or wind turbine applications is notable. A design statement need not be a lengthy or complex document and diagrams can be used to summarise the design process. They are a useful way for designers to explain why an application has a particular layout or appearance to consultation bodies, Local Authorities and the public. Further guidance on producing design statements is provided in PAN 68[4], and an example of a windfarm design statement for Clyde windfarm is included in Appendix 1.

2.9 Design Statements are also helpful in establishing design objectives. These may need to be referred to in the future if the scope of a scheme changes: for example for a windfarm extension, amendment of the type of wind turbines, or even for another windfarm nearby. Design objectives can help to

- maintain the integrity of a scheme in changing circumstances;
- explain the design background of windfarm extensions; and
- indicate how existing nearby windfarms or cumulative impacts have influenced the design and layout of a new proposal.

3 For further discussion on cumulative effects see 'Cumulative effect of windfarms', version 2, SNH 2005, available on the SNH website.

Presentation of information within landscape and visual impact assessment

2.10 A number of methods are used to illustrate the potential landscape and visual impacts of a proposal. In LVIA, illustrations are used by landscape and planning professionals in four main ways.

- To record site assessment, in the form of photographs and sketches, as an aide-memoire:
- To provide computer generated Zone of Theoretical Visibility maps (ZTVs) to show the area from which a proposal may be visible;
- To provide visualisations that show potential visibility from a specific viewpoint and aid an assessment of the magnitude of impact, typically in the form of computer-generated wireline diagrams and photomontages, and;
- To illustrate key concepts and design principles using line drawings and diagrams.

2.11 When used on site, these illustrative tools are typically sufficient to make judgements of predicted landscape and visual impact for the LVIA. However, in addition, other illustrative techniques may be useful, such as computer generated simulations, fly-throughs and video-montage. Further guidance on the selection, production methods and use of illustrative techniques is available in the 'Visual Representation of Windfarms: Good Practice Guidance' (2006)[5].

Small windfarms and the need for assessment

2.12 In addition to large windfarm developments, there continues to be interest in developing single turbines and small windfarms in Scotland, particularly in lowland settings, typically including between one and three turbines. If there are more than two turbines, or the turbines are more than 15m in height, they are Schedule 2 developments under the Environmental Assessment Regulations. It is then a matter for the Planning Authority to decide whether they are likely to have significant environmental effects and therefore require EIA.

2.13 Even if an EIA is not required, there is usually a need for submission of a LVIA in support of a planning application. This assessment should be carefully scoped so that it is appropriate to the size and scale of the development and the likelihood of significant landscape and visual impacts, including cumulative effects. SNH's guidance note on 'Natural Heritage assessment of small scale wind energy projects which do not require formal Environmental Impact Assessment'[6] provides advice on the level of landscape and visual assessment likely to be appropriate for different scales of turbines (although it is important to highlight that the landscape and visual impacts of turbines are not directly proportional to their size). SNH will be producing more detailed guidance on the installation of micro wind turbines (<50kw) later in 2009.

Duration of impacts and decommissioning

2.14 The expected lifetime of wind turbine generators is typically around 25 years, and planning permission is usually granted for this period. Decommissioning of the turbines at the end of this operational phase is often a specific condition of planning permission and is an important consideration when designing and assessing a windfarm.

2.15 Decommissioning commonly proposes that turbines and ancillary buildings are removed, leaving their foundations and access tracks in situ, but covered over and

4 Planning Advice Note 68: Design Statements (2003) The Scottish Government.
5 SNH, Scottish Society of Directors of Planning and Scottish Renewables Forum (2006) Visual Representation of Windfarms: Good Practice Guidance. Table 2, pp.36.
6 available at www.snh.org.uk

re-vegetated, thus reducing the need for further ground disturbance. There is therefore potential for some residual visible change to the landscape, even when restored, although this can be minimised through thoughtful design and consideration of how decommissioning will proceed at the project outset. The use of carefully worded legal agreements or planning conditions to ensure delivery of appropriate removals and restoration of site conditions at the end of a project's lifespan will also be of benefit. In some locations, however, it may be assessed that it is possible to remove foundations and access tracks without unacceptable environmental disturbance and this approach should be an aspiration in the design of any windfarm site.

Partial restoration of access tracks to grass

2.16 There is likely to be continued demand for renewable energy generation in Scotland for many decades ahead. Thus it is possible that existing well-designed windfarms may remain in use well beyond 25 years, with turbines either refurbished or replaced and a planning consent renewed. However, a time limited consent does provide the opportunity for decommissioning to be required should it be judged, for whatever reason, that the windfarm development was inappropriate.

3

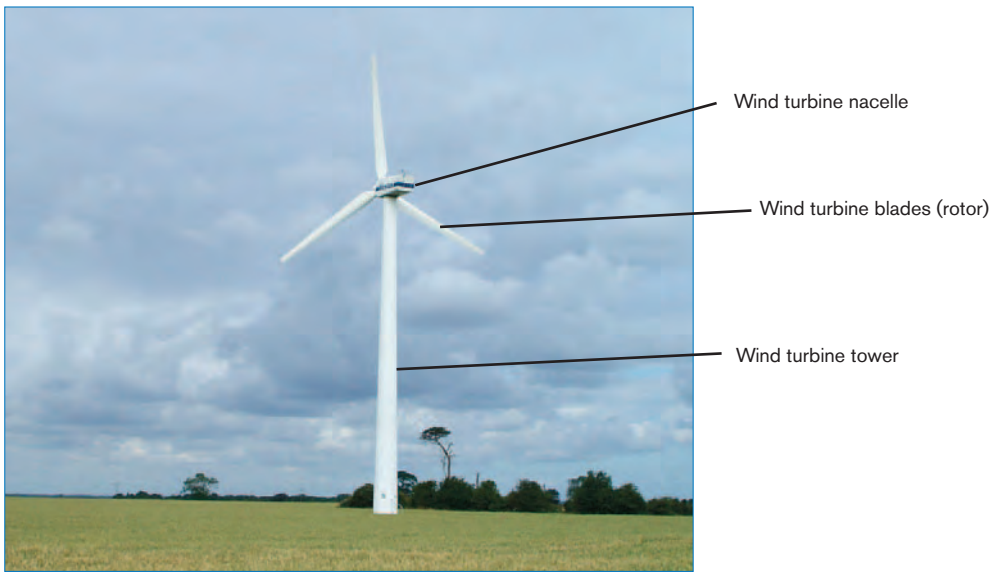
Wind Turbine Design and Layout

3.1 The landscape and visual impacts of a windfarm are strongly influenced by the design and layout of wind turbines. This section focuses upon the different types of wind turbine and their layout or array, while the following section considers how these principles relate to landscape and visual characteristics.

3.2 Impacts also result from infrastructure serving the development, such as access tracks and borrow pits, anemometers, control building, and substation (where necessary). Design and siting of this ancillary infrastructure are also referred to in this section.

Turbine form and design

3.3 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. Further guidance on wind turbines is available in Planning Advice Note 45[1].



3.4 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.

3.5 Windfarm developers are often reluctant to be specific as to the actual model of turbine to be used because market availability, costs, and turbine technology may

1 Planning Advice Note 45, Renewable Energy Technologies, Scottish Executive, 2002, www.scotland.gov.uk

change during the period between submitting an application and actual construction. However, they will usually have a shortlist of preferred models for consideration and applications should include details of these. The LVIA and EIA should assess, as far as is possible, impacts of the model within the shortlist that represents the 'worst case scenario'.

3.6 Turbine properties, in addition to height, colour and individual design, which may be important when choosing the most appropriate model for a particular site, are:

- the proportion of blade length to tower height; and
- the dynamic impact resulting from rotation of the turbine blades (larger, slow moving blades will have a very different impact from shorter, faster moving blades which may give the impression of increased clutter).

Alternative wind turbine proportion – these images show the contrast between blade length and tower height, which affects the overall visual range.

Turbine colour

3.7 Selecting the most appropriate colour for a turbine(s) is an important part of detailed windfarm design and mitigation. It has previously been assumed that wind turbines could be painted a colour that would camouflage them against their background. However, experience has shown that no single colour of wind turbine will consistently blend with its background and it is more important to choose a colour that will relate positively to a range of backdrops seen within different views and in different weather conditions.

3.8 When determining the most appropriate colour for wind turbines, key considerations are:

- the immediate landscape context and anticipated backcloth against which the turbines will be viewed predominantly (for example sky, heather moorland, woodland);
- the direction the turbines will most frequently be viewed from (including the angle of the sun and how it is likely to reflect on the wind turbines);
- the predominant weather conditions (which will dictate typical sky colour and will vary for different parts of the country);
- seasonal variation in landscape colours;

– the proposed design and layout of the windfarm; and other windfarms within the area.

Variable colouring of turbine bases typically does not correspond with the skyline from most viewpoints and increases contrast when seen against the sky. From some viewpoints, this effect can also make the turbines seem to 'float' above the land.

Different colour of wind turbine components creates a more complex image and means the visibility of different sections varies

White turbines will look bright in certain light conditions, but will tend to convey a positive image. This may be associated with cleanliness and existing white foci in our landscape such as white-washed cottages.

Grey wind turbines will appear less prominent when seen against a grey sky, although they will rarely match the shade. When visible, a grey colour may appear 'dirty' and be associated with an industrial, urban or military character

3.9 As a general rule for most rural areas of Scotland:

– A single colour of turbine is generally preferable;

– The use of graded colours at the turbine base should be avoided;

– A light grey colour generally achieves the best balance between minimising visibility and visual impacts when seen against the sky;

– The use of coloured turbines (such as greens, browns or ochres) in an attempt to disguise wind turbines against a landscape backcloth is usually unsuccessful;

– Paint reflection should be minimised;

– For multiple windfarm groups or windfarm extensions, the colour of turbines should generally be consistent; and

– Precise colour tone and the degree of paint reflectivity should be specified at the application stage.

Turbine transformer colour

3.10 It is preferable for wind turbine transformers to be housed within the turbine towers, to minimise the number of elements and visual complexity of a windfarm scheme. However, where transformers are housed separately near the base of turbines, the colour of their housing requires careful consideration. This should be site specific, relating to the surrounding land cover, not the wind turbines, as transformers are rarely viewed against the skyline. Such an approach ensures that their visibility is reduced, and they are seen as a separate element to the wind turbine so that they are less likely to detract from the simplicity of its form. Browns, khakis and 'earth' colours are generally the most successful colour choices for transformers, with greens often appearing too bright.

In variable light conditions and against different backgrounds, wind turbines of the same colour can appear to have contrasting visual effect

Turbine lighting

3.11 In some locations it may be necessary to light wind turbines for reasons of civil or military aviation safety. Such lighting, typically at the top of the tower of the wind turbine, may appear prominent in night views and may be incongruous in predominantly un-lit rural areas. Where lighting is necessary, this should be designed to minimise landscape and visual impacts whilst satisfying health and safety or navigation requirements. This may, for example, be achieved by incorporating shields so that the lights can only be seen from above.

3.12 As yet there has been little experience of lighting turbines in Scotland. However, it is likely to become more of an issue as more sites are being explored within flight paths. SNH is collating information to develop our understanding of these impacts with a view to developing further guidance in due course.

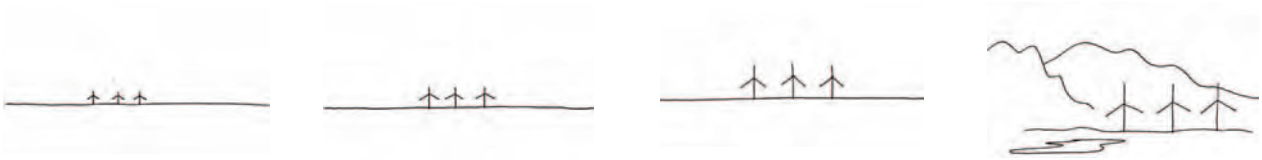
Turbine size

3.13 As wind energy technology has developed, larger wind turbines have become available. Currently machines typically consist of 60 – 100 metre high towers with blades of 40 metres or more, so their overall height to blade tip is typically 100 – 140 metres, although some higher turbines are now available. Longer blades result in a greater rotor area and, combined with the fact that they will likely extend upwards into higher wind velocities, their wind capture and energy production tends to be proportionally larger than smaller turbines.

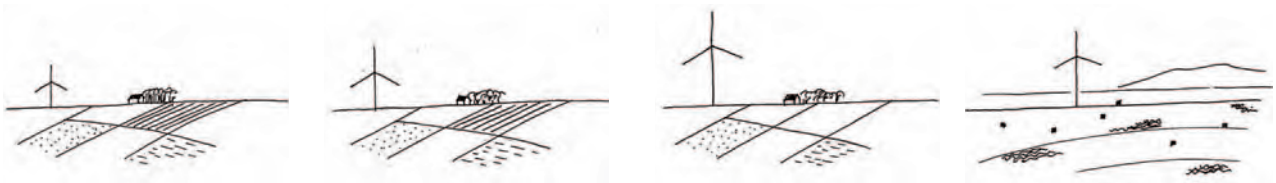
The size of these wind turbines is difficult to perceive, located in open moorland with no definite scale indicators

The buildings adjacent to this windfarm act as scale indicators, and emphasise the large scale of the wind turbines

3.14 Choice of turbine size is an integral part of the design process of a windfarm in relation to key landscape and visual characteristics. Identification of the key landscape characteristics, their sensitivity and capacity to accommodate change will inform this. Generally speaking, large wind turbines may appear out of scale and visually dominant in lowland, settled, or smaller-scale landscapes, often characterised by the relatively 'human scale' of buildings and features. On the other hand, the longer blades of larger turbines often have slower rotation speeds and this can be less visually distracting than the faster speeds of smaller blades.



Increase of wind turbine height is not very noticeable within moorland landscape, due to lack of size indicators; nevertheless, there may be a threshold at which larger wind turbines no longer seem to directly relate to the local area of moorland but, rather, relate more closely to the neighbouring high mountains



The size of wind turbines is clearer within a distinct landscape pattern that includes definite scale indicators. Although older/domestic wind turbines may relate to the scale of buildings, most commercial wind turbines commonly used now, over 60m in height, will seem to dominate elements of landscape pattern. There may be, however, a threshold in some landscapes at which a larger wind turbine would no longer seem associated with the underlying landscape pattern and seem 'elevated' above it, by appearing to relate to larger components.

3.15 Wind turbine size is also a key issue in upland landscapes that are viewed against or from landscapes which are more intricate in scale and pattern, or where it is otherwise difficult to discern scale and distance. By illustrating the scale of an upland landscape, wind turbines may seem to compromise the perceived expansive nature of some of these areas.

3.16 As the experience of different landscapes varies greatly, it is not appropriate to provide strict guidelines on turbine sizes that should be used for particular landscapes. Site-specific assessment and design is essential for each development proposal.

3.17 It is understood that procurement of 'smaller' turbines is becoming increasingly difficult as turbine manufacturers move towards larger models. However, some smaller models remain available and may be particularly appropriate near or adjacent to an existing development comprising of small turbines as well as in smaller scale landscapes. It is important to highlight that a 'one size fits all' approach will not respond to the great variation of landscape scale and windfarm requirements; thus it is important that a market for different sizes of wind turbines, including medium and small sizes, is maintained.

Turbine scale

3.18 Size comparisons between wind turbines and other tall structures may help people to be able to visualise how tall a proposed development would appear in the landscape. Table 1 shows the heights of some tall elements in the Scottish landscape that may provide useful scale comparisons. It is important to appreciate, when making comparisons of this sort, that wind turbines are typically not viewed in the same way as monuments or landmarks, which generally have much greater 'solidity'. In addition, although the visibility extent of turbines will obviously increase with their greater height, the relationship between visual impact and turbine size is not directly proportional. Principally, this is because a windfarm is viewed within a surrounding context, which varies; and also because the actual size of a wind turbine is usually difficult to perceive.

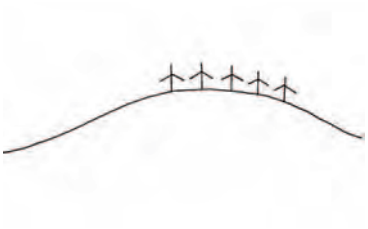
Electricity pylon acts as scale reference in relation to wind turbines

Table 1 Landscape elements which may be used as scale comparisons

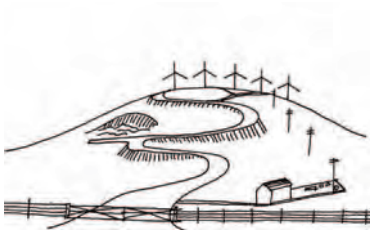
Landscape Element	Typical Height (in metres)
Metal Pylons	25 to 50
Telecommunications Masts	15 to 20
Television Transmission Masts	300
MoD Masts	70 to 80
Cockenzie Power Station Chimney	149
Inverkip Power Station Chimney	212
Forth Road Bridge Towers	150
Domestic Buildings (1.5–2 storey)	6–10
Mature Deciduous Trees (depending on species)	10–20

Ancillary infrastructure

3.19 Ancillary elements for a windfarm development should also be designed to relate to the key characteristics of a landscape. It is essential that these elements do not confuse the simplicity of the windfarm design, or act as a scale indicator for the turbines themselves. Undergrounding power lines within the windfarm, using transformers contained within tower bases (where possible), and careful siting of substations, connecting transmission lines, access tracks, control buildings and anemometer masts will all help to enhance a windfarm design. Simplicity of appearance and use of local, high quality materials will further enhance this.



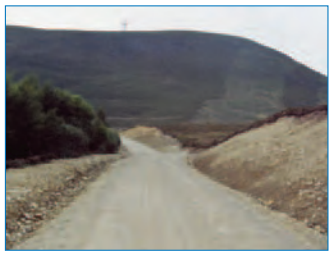
Windfarm creates simple image in the landscape



Insensitive siting and design of windfarm infrastructure creates complex image and conflicts with underlying landscape character

3.20 There may also be practical constraints in delivering large turbine components to site, because of, for example, the limitations of rural bridges, road junctions or corners. Additional landscape and visual impacts, associated with widening of roads, access tracks and corners in order to enable transport of long turbine blades, should be taken into account.

Small windfarm substation



Windfarm access track across slopes

Junction of windfarm access track and public road

3.21 Detailed advice on the siting and design of tracks can be found in the SNH publication 'Constructed tracks in the Scottish Uplands' (SNH Natural Heritage Management Series, 2006).

Turbine layout / array

3.22 Turbines can be arranged in many different layouts within a windfarm. The layout of a windfarm should relate to the specific characteristics of the landscape. This means that the most suitable layout for every development will be different. The development process for a windfarm typically begins with a layout that responds mainly to wind speed and wind turbine specification, sited within defined land ownership / tenure boundaries. For a small windfarm, this might comprise a single row of wind turbines along a ridge; while, for a larger development, a grid of wind turbines is often taken as the starting point, with the turbines spaced at minimum separation distances to avoid turbulence (often equating to 4–5 rotor diameters).

3.23 From this starting point, turbines will typically be moved or removed due to physical constraints, such as watercourses, areas of deep peat and steep slopes, and in response to sensitive habitat or wildlife species. During this process of modification, landscape and visual issues will also inform the layout. Although landscape and visual concerns – such as the need to avoid visibility from a particularly sensitive viewpoint - may present an absolute constraint, many

landscape and visual sensitivities can be addressed through good design in windfarm layout. This commonly involves a number of changes to create the most appropriate windfarm to fit the design objectives of the project.

3.24 There are a number of common types of layout, chiefly divided into regular or irregular formats. Generally, the fewer the number of wind turbines and the simplest of layout upon the most even of landform, the easier it is to create a positive feature - visually balanced, simple and consistent in image as it is viewed from various directions. This is most easy to achieve with a simple line upon level ground. As soon as there is deviation from this, the visual image becomes more complicated.

Single wind turbine forms point feature with simple and direct relationship to surrounding landscape

Single line of wind turbines. These posses a visual relationship to each other as well as to the landscape.

Double row of wind turbines. Wind turbines within each group have visual relationship to each other and landscape. The two groups also have a separate and collective visual relationship to each other and the landscape.

Grid layout reveals simple visual relationship when looking down rows, but appears more complex when looking across rows.

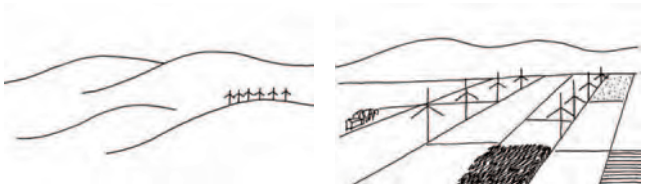
3.25 A regular shape, such as a double line, a triangle, or a grid can appear appropriate within a wide open and level space where there is a regular landscape pattern, such as within agricultural fields. However, as soon as you move through the landscape and see it from different directions and elevations, views of the grid change and reveal a variable effect, seeming ordered along some rows, but in others overlapping. In addition, the rationale of the position of turbines is confused if they appear at variable elevation.

Informal layout. However regular spacing between wind turbines and direct link to landscape pattern gives layout visible rationale and sense of order.

Informal layout with no obvious rationale. Creates chaotic image that contrasts with the underlying simplicity of the hills.

3.26 Irregular layouts can be more appropriate in landscapes of variable elevation and pattern, as is most common in Scotland. However, irregular forms pose an even greater challenge in terms of creating a simple image as the turbines will interact in varying ways with each other as well as with the underlying landscape. This can result in effects that do not correspond to good design principles, such as varying visual density of wind turbines, overlapping turbine rotors (often termed 'stacking up'), partial screening behind a skyline and turbine outliers separate from the main group.

Two different views of the same windfarm. The layout appears simple from one direction, but complex from another



A windfarm layout appears simplest where it relates directly to the underlying landscape characteristics

Where a landscape does not include any obvious elements or features to which a windfarm could relate directly, it may be most appropriate for a windfarm to form a distinct feature in its own right. However, for this approach to appear clear, it will usually require the windfarm to be surrounded by an area of open space.

Wind turbines relate to small scale undulations at a local level. However, if the key views are distant, these undulations would not be obvious and the wind turbines would alternatively appear in closest association with the broad scale landform

Alternatively, the windfarm can be designed to relate to the broad scale landform

3.27 Windfarms should directly relate to underlying landscape characteristics of a similar scale and/or prominence. This design principle also means that wind turbines may be able to be accommodated within areas of complex pattern. Odd numbers of turbines often present a more balanced composition than even numbers.

Micrositing

3.28 Micrositing is the movement of wind turbines by small distances within the overall windfarm layout, typically involving distances of up to 100m. The process is used at two main stages of windfarm development:

- Firstly, during the design stage to ensure that turbine layout is satisfactory from key viewpoints and achieves the design objectives. It can also be used to maximise the screening benefits of landform or landcover from key viewpoints.
- Secondly, during the construction phase of a project where previously unexpected conditions are encountered on site. This may happen, for example, where a turbine needs to be located away from an area of peat that is deeper than predicted on the initial survey.

3.29 Developers should seek to minimise the need for micrositing by conducting thorough site investigation during the design process.

3.30 Micrositing during construction can obviously have an effect on the nature and extent of the appearance of a windfarm as previously assessed and illustrated within an ES, especially those set out in regular patterns such as grids or evenly spaced lines. Any significant changes in layout should be assessed to ensure that the overall design objectives for the site are not compromised. Decision makers should also consider the extent of micrositing that it is appropriate to allow when consenting development. Where, for reasons of design coherence, there is a clear need to maintain turbine layout in accordance with submitted plans, then the permissible micrositing distances may need to be strictly limited. This is particularly important for sites of limited numbers of turbines, where there is a strongly formal layout or where micrositing may result in changing the altitude of turbines and therefore affect the windfarm's design relationship with surrounding topography.

A line of wind turbines, where slight alterations of position and elevation have disrupted the image of consistency and rhythm.

3.31 Planning permissions should therefore contain a condition limiting the distance that turbines can be microsited without requirement for further permission. It is important that such micrositing conditions are tailored to be specific to the nature and scale of the proposed developments, and have particular regard to the possible effects on design layout and the overall visual coherence of the scheme.

4

Windfarm Siting and Design

4.1 This section deals with siting and designing windfarms within the landscape. It applies similar design principles to those outlined in Section 3 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 windfarm.

4.2 The chapter begins with generic issues in relation to windfarm LVIA, and then highlights specific aspects of siting and design. It offers general guidance only and for any windfarm would need to be supplemented by more detailed design objectives, established through the LVIA process. Cumulative landscape and visual impacts, which also form part of LVIA, are addressed by section 5 of this Guidance.

4.3 Reference is made to generalised categories of windfarm size as listed below. This grouping is for the sake of simplification, and it should be noted that landscape and visual impacts are not directly proportional to wind turbine numbers.

Windfarm size	Number of Turbines
Small	1–3
Medium	3–20
Large	20–50
Very Large	50+

Landscape character

4.4 The first step to carrying out the Landscape Impact Assessment (LIA) section of a windfarm LVIA is typically to assess the landscape character of the study area to identify the key characteristics relevant to windfarm development. Different places have different 'landscape character', comprised of distinct and recognisable patterns of elements. These relate to underlying geology, landform, soils, vegetation, land use and settlement. 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.

4.5 Landscape Character Assessment (LCA) can assist in designing development which best respects a location's distinctive character. It is a tool to help understand what the landscape is like today, how it came to be like this and how it may change in the future. LCA helps to ensure that change and development does not undermine whatever is characteristic or valued about a particular landscape, and that ways of improving the character of a place can be considered.

4.6 At a regional scale, SNH Landscape Character Assessments may inform this assessment. SNH's National Programme of LCA comprises 27 studies and an

overview report[1]. These LCAs highlight key landscape characteristics across the country, and also identify the main forces for change in these landscapes and relevant guidance. It should be noted that many of the LCAs were produced during the 1990s and, although they remain relevant as descriptors of landscape character, do not necessarily address the sensitivity of particular landscape character types to windfarm development.

4.7 In addition to the broad-scale information offered by LCAs, LIA should include an assessment of local landscape characteristics, and how they are experienced, in relation to the specific proposal. There should also be an assessment of the extent and distribution of predicted visibility within relevant character areas.

Landscape and scenic value

4.8 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 windfarm 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.

4.9 LCAs do not place value on one landscape type over another, but they may point to the reasons why a landscape might be valued, because of special characteristics or the experience the landscape offers. In contrast, landscape and scenic value is recognised at national and local levels through development plan policies and designations such as National Parks, National Scenic Area (NSA) or local landscape designations including Areas of Great Landscape Value (AGLV). Designations are usually supported by legislation and associated with specific planning policies at a national and regional level. The lack of any designation does not imply that a landscape has no value[2]. Some landscapes are strongly linked to cultural heritage, for example, while others may be valued for their perceived lack of human influences. In line with the European Landscape Convention[3] SNH promotes an 'all-landscapes approach', founded on the recognition of value in all landscapes.

4.10 In addition to recognition of landscape and scenic value through an accolade, value may be placed on a landscape due to its rarity or novelty within a particular area. Although landscape assessments do not place value on the distribution or frequency of landscape character types, national or regional maps showing the occurrence of different types clearly indicate where this may be an important issue.

4.11 For the LVIA of windfarms, the key challenge with respect to landscape value is to ascertain for what a landscape is valued and by whom, and then to assess the predicted impacts of the proposed development on this valued landscape. Establishing the quality of a valued landscape is best informed by a clear description or citation, for example as provided for NSAs in 'Scotland's Scenic Heritage'[4], and for local landscape designations within many Local Authority Development Plans. However, for some valued areas, this information may not be available, and thus the LVIA needs to first establish the quality of the valued landscape through landscape and visual assessment of the baseline conditions and how it is used, for example through consultation, visitor information and user websites. For areas of wildness and wild land (see section below), SNH has established a method for this assessment as detailed within SNH interim guidance 'Assessing the impacts on wild land' (2007). The key test applied in relation to NSAs, but often employed for other valued landscapes too, is not whether impacts would be significant, but whether these would affect the *integrity* of a valued landscape.

1 These Landscape Character Assessments are available to download from SNH's website under the 'Landscape Character of Scotland' series on the publications page at http://www.snh.org.uk/pubs/results.asp?Q=landscape
2 SNH and Historic Scotland Guidance, SNH 2005, para.2.2, p.8
3 The European Landscape Convention and information about its implications can be viewed at http://www.coe.int/t/dg4/cultureheritage/conventions/Landscape/florence_en.asp
4 Scotland's Scenic Heritage, Countryside Commission for Scotland (1978)

Wild land and places with a strong sense of remoteness

4.12 Areas of Scotland which are very remote, inaccessible, rugged and with little evidence of human influence are widely referred to as 'wild land'; however, even those areas that possess only some of these characteristics or in a slightly degraded way may have qualities of wildness. These characteristics and the value they receive are discussed in SNH policy statement 'Wildness in Scotland's Countryside' (2002). A recent study by SNH has revealed that the majority of Scottish residents think it important for Scotland to have wild places[5]. Some of the areas possessing qualities of wildness lie outside designated areas and are therefore not protected by statute, although NPPG14 recognises their sensitivity and asks Planning Authorities to take great care to safeguard their character through specific policies in Development Plans[6]. No detailed mapping of Scottish wild land has yet been undertaken, although SNH has identified 'Areas of Search' which represent the broad areas where wild land is likely to be present[7]. SNH's Strategic Locational Guidance for Onshore Windfarms, states that the mapped Areas of Search for Wild Land have high sensitivity to windfarms and proposals in such areas are unlikely to be compatible with their wild land qualities[8].

4.13 Wild land areas, due to their remoteness and poor grid connections, tend not to attract windfarm proposals.

4.14 However, because perception of wild land relies on there being no or minimal visibility of human features, windfarms, like any built structure, will be out of character in these areas – and scope for mitigating impacts will be very limited. In addition, the potential visibility of windfarms, individually and cumulatively, from within wild land areas can be a concern. This is a particular issue in relation to windfarms because of the long distances over which they can be seen. Therefore, proposals likely to affect an area of wild land merit careful consideration. SNH interim guidance[9] sets out a method for this assessment.

4.15 There may be rare situations where there are isolated built elements already within a landscape perceived to be wild land, such as bothies, shepherds' cottages, or shooting lodges, where small-scale wind turbines may be sited in a way that relates to these structures.

Experiencing windfarms in the landscape

4.16 Compared to pylons or roads, a windfarm is still a relatively unusual feature in the landscape. People's responses vary – to some a windfarm may seem to threaten its surroundings, while others may view it as an exciting, modern, or even futuristic addition with symbolic associations with clean energy and sustainability. Our understanding of people's responses to windfarm development over recent years has also been informed by a number of public attitude studies that have been undertaken[10]. These suggest that the majority of people are in favour of wind power, although visual impact issues are often highlighted as a concern to those surveyed.

4.17 The impact of a windfarm will depend on how and where it is experienced; for example, from inside a residence, while moving along a road, or from a remote mountaintop. These factors are taken into account through LVIA when determining

5 Public Perceptions of Wild Places and Landscapes in Scotland. SNH Commissioned Report No. 291. (2008)
6 NPPG14 – Natural Heritage, paragraphs 16, 47, 69 and 71.
7 SNH map of Search areas for Wild Land, available at http://www.snh.org.uk/pdfs/polstat/wsc-m3.pdf
8 SNH Strategic Locational Guidance for Onshore Windfarms with respect to the Natural Heritage. SNH 2002, updated March 2009
9 Assessing the impacts on wild land, interim guidance note SNH 2007
10 Renewable Energy Awareness and Attitudes Research Management Summary URN08/657, BERR (June 2008).
Public Attitudes to Windfarms: A survey of Local Residents in Scotland, The Scottish Government (2003).
Tourist Attitudes to Wind Farms. Mori Scotland (September 2002)
Economic Impacts of Wind Farms on Scottish Tourism, The Scottish Government (March 2008)

the sensitivity of the landscape and visual resource, and those people that will be affected by the development (receptors). Typically, LVIA includes assessment of impacts upon the key users of the landscape, including residents, motorists, workers, those partaking in recreation and tourists. Impacts of a windfarm on local residents require particular attention as, unlike visitors, residents will experience a windfarm from different locations, at different times of the day, usually for longer periods of time, and in different seasons. Conversely, impacts on tourists and those taking part in recreation may be relatively brief, but their sensitivity to landscape change is regarded as high because their purpose is specifically to enjoy their surroundings.

4.18 Through LVIA, it is important to take account of how a windfarm will be experienced from surrounding roads, transport, and recreational routes. Views will vary depending on proximity to the road, the angle of view, and intervening landscape features. The first glimpse of a windfarm is important, and careful consideration should be given to the design of the windfarm layout in relation to such views.

Perception of a windfarm depends on how it is viewed and the duration of a view

4.19 As larger numbers of windfarms are built in Scotland, it has been increasingly necessary to consider their cumulative effects, as seen sequentially, 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 in-between. Further detail on this aspect of LVIA can be found in SNHs 'Cumulative Effect of Windfarms' guidance[11].

4.20 The visibility and visual impacts of a windfarm are affected by the distance from which it is viewed, as well as other aspects such as weather conditions and siting. In the past, guidance notes such as Planning Advice Note 45 have offered generic categories of visibility and visual impact in relation to distance, suggesting the following: that in an open landscape at distances of up to 2 km, a windfarm is likely to be a prominent feature; between 2–5 km it will be relatively prominent; between 5–15 km only prominent in clear visibility when it is seen as part of the wider landscape; and over 15 km it will only be seen in very clear visibility and as a minor element in the landscape[12]. However, in practice these guidelines are limited in their application:

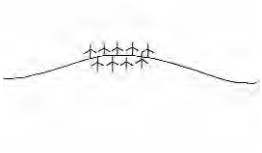
- firstly, because it is unclear what height of turbine these distances were based upon[13]; and,
- secondly, because visual impacts are not directly proportional to distance, as the nature of a view (e.g. a framed / open view or backclothed/skyline view) and its context are as important as the size of a development within that view.

11 Cumulative Effect of Windfarms, SNH (2005).
12 PAN 45 figure 8
13 A study in 2002 for SNH by the University of Newcastle suggests that for the current 3rd generation turbines of 100m+ the distances used by PAN45 should be increased by 20%

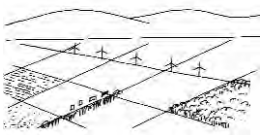
Windfarm siting and design in relation to landscape and visual characteristics

4.21 Like any built structure, the impacts of a windfarm depend on both the characteristics of the development and how these relate to the characteristics of its surroundigs. The most distinctive characteristics of a windfarm are typically its collection of tall, often uniformly spaced turbines, each with moving blades that change orientation according to wind direction. Windfarms are most appropriate in a landscape where their presence and design appear rational. They are usually sited in exposed places that are open, high and relatively prominent, in order to take advantage of maximum wind capture. However, other factors influencing their siting include 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 the need to avoid excessive turbulence.

4.22 It is important to site and design a windfarm so that it relates directly to the qualities of a specific site. As discussed previously within this section, this involves being able to determine the key characteristics of the landscape and visual resource, and then considering the relationship of all aspects of the windfarm in direct relation to these. This will range from the overall siting of the windfarm as a whole, to turbine size, location, pattern, and associated elements such as access tracks, powerlines or buildings.

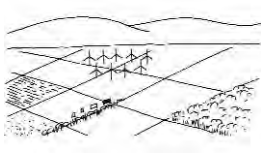


Cluster of wind turbines relates to open hill



Line of wind turbines relates to landscape pattern

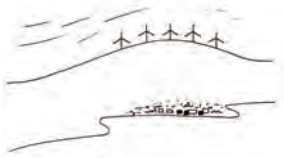
Line of wind turbines appears irrational across open hill



Cluster of wind turbines appears irrational in relation to linear elements of landscape pattern

Siting of house appears to relate to conditions favourable for inhabitation, principally shelter, water, access and well-drained ground

Woodland appears to relate to conditions favourable for growth, principally shelter and well-drained ground



Windfarm appears to relate to conditions favourable for wind energy generation, principally exposure

4.23 With regards to windfarm design in relation to key characteristics, the main variables addressed through LVIA are likely to include the following:

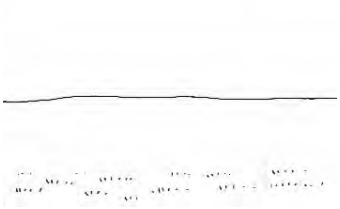
- Layout and number of wind turbines;
- Size, design, and proportion of wind turbines;
- Route and design of access tracks, including the junctions with public roads;
- Location, design and restoration of temporary borrow pits;
- Location, design and restoration of temporary construction compounds;
- Location and size of wind monitoring masts;
- Positioning and mitigation of turbine lighting (if required);
- Visitor facilities, including paths, signs, parking and visitor centre (if proposed); and
- Land management changes, such as muirburn, woodland management, fences, and stock grazing.

4.24 Through the process of design and assessment of various scenarios, regard should be given to the general principles summarised within the following section.

Landform

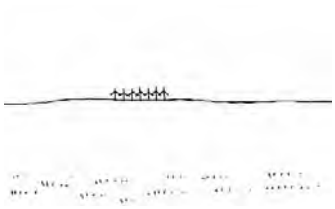
4.25 Landform is a key characteristic of many landscape character types, affecting whether it is rugged, flat, undulating or rolling, and upland or lowland. In flat landscapes, physical relief tends to become accentuated so that even low hills appear substantial.

4.26 It is very difficult to site and design a windfarm upon a variable landform, such as undulating moorland or hills, without presenting a confusing image. This is because the wind turbines will be seen from different directions at varying elevations and spacing, and against varying backdrops. To avoid this effect, it is generally preferable for wind turbines to be grouped upon the most level part of a site so the development appears more cohesive, rather than as a collection of disparate individuals.



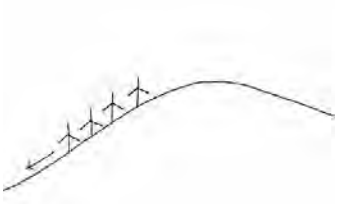
At a broad scale, moorland appears fairly simple in landform and pattern

Relative positions of wind turbines illustrates landform undulations that actually exist and, consequently, create complex image

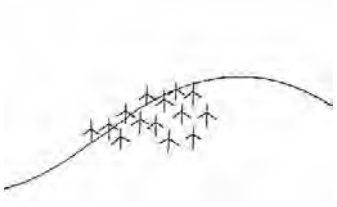


One option is to cluster wind turbines close together upon a local area of flatter ground, so that the variation is less obvious than the image of a single collective feature

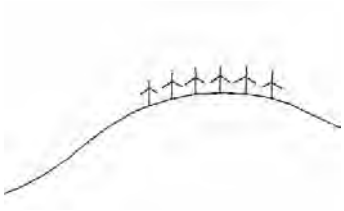
4.27 It is important to site and design a windfarm so that it appears visually balanced in relation to the underlying and surrounding landform. Turbines seen upon steep slopes often appear to be 'unstable'. It is also important that the scale and extent of a windfarm does not seem to overwhelm the distinctive character and scale of the landform.



Wind turbines upon slope create a visually dynamic image, seeming unstable



Windfarm appears visually unbalanced upon hill



Windfarm relates to underlying landform, creating a balanced image

4.28 Skylines are of critical importance. This is illustrated by the contrast between the simple horizontal skylines of wide flat landscapes and the more complex vertical and diagonal skylines where there are mountains and hills. The viewer's eye is naturally drawn to skylines, although the extent to which this happens depends on the nature of the skyline and the distribution and type of other elements and foci within the landscape. The character of a skyline may be particularly valued if it conveys a sense of wildness, if it forms the backdrop to a settlement, if it comprises a particularly distinctive landform, or where distinctive landmarks and/or cultural features appear on it.

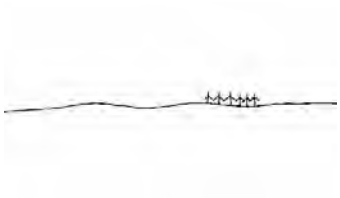
4.29 Given the prominence of skylines, it is particularly important that a windfarm is sited and designed to relate to this feature. A key challenge of this is, however, that the skyline will vary in relation to the position and elevation of a viewer and visibility conditions, such as weather. Nevertheless, design of a windfarm from key viewpoints and sequential routes should ensure a windfarm does not detract from the character of a distinctive skyline. Care should be taken to ensure that the windfarm does not overwhelm a skyline. If the skyline is 'simple' in nature, for

example over moorland and hills, it is important that wind turbines possess a simple visual relationship to this feature, avoiding variable height, spacing and overlapping of turbines and, also, visibility of blade tips intermittently 'breaking' the skyline.

Windfarm relates simply to skyline

Windfarm contrasts in character to skyline

Windfarm seems to overwhelm visible extent of skyline



Windfarm appears as isolated and minor feature on skyline

4.30 During the design of a windfarm, there may be opportunities to take advantage of the landform to limit visibility of wind turbines and site infrastructure. For example, when sited on hill ridges, turbines may be set back from the edge and placed such that the slopes preclude visibility from below, even if they may be clearly visible from adjacent hills.

When only part of a turbine is visible on the skyline, it can create a confusing image.

Landscape scale

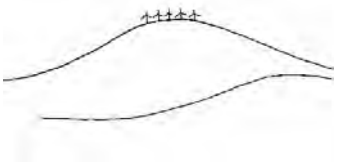
4.31 The scale of a landscape affects the sense of openness and enclosure. The term 'scale' does not refer to a definite dimension, but describes the perception of relative size between elements, for example a large scale open moorland or mountainous landscape and a small scale sheltered glen. To perceive scale, we rely on elements whose size and extent are recognisable to us – common features such as trees and houses. We use these as scale indicators to gauge the size and distance of other elements and make spatial judgements.

4.32 Landscape scale and openness are particularly important characteristics in relation to wind turbines because large wind turbines can easily seem to dominate some landscapes. For this reason, landscape scale can dictate the ability of an area to accommodate windfarm development, both horizontally in terms of its extent, and vertically with regard to wind turbine height.

Windfarm relates well to the scale of the landform and the skyline

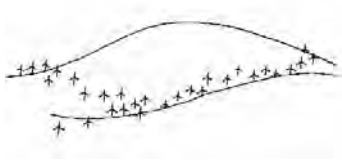
4.33 A key design objective for a windfarm will be finding an appropriate scale for the windfarm that is in keeping with that of the landscape. To achieve this, the siting and design of the development will need to ensure that the windfarm in relation to the following aspects, is:

- Of minor vertical scale in relation to the key features of the landscape (typically less than one third);
- Of minor horizontal scale in relation to the key features of the landscape – the windfarm surrounded by a much larger proportion of open space than occupied by the development;
- Of minor size compared to other key features and foci within the landscape; or separated from these by a sufficiently large area of open space (either horizontally or vertically) so that direct scale comparison does not occur.



Windfarm appears as minor feature, both horizontally and vertically in relation to the surrounding landscape

Windfarm appears as minor feature horizontally, but overwhelming vertically in relation to the surrounding landscape



Windfarm appears as minor feature vertically, but overwhelming horizontally in relation to the surrounding landscape

Perspective

4.34 Size indicators within a landscape affect our judgement of visual perspective and thus our recognition of whether a feature is small or far away, large or near. The introduction of turbines into a landscape can confuse this sense of perspective, however, as they are typically of undefined size, yet much larger than any other man-made structures that would help us judge how large and how near they are. Careful consideration is therefore needed in the siting and design of windfarms, and between windfarms, to avoid confusing our sense of perspective. This is particularly the case where different turbine sizes are used and / or where there are gaps between groups of wind turbines at varying distances to viewers.

Windfarm relates to key characteristic of the landscape, yet it is difficult to perceive scale and distance within moorland

Visual link between windfarm and elements of known size, aid perception of scale and distance, emphasising the height of the wind turbines

Perception of scale and distance seems distorted due to variable sizes of wind turbines combined with an absence of reference points and size indicators

Land use

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

4.36 Wind energy generation may form one part of many different land uses. Existing developments vary in their setting from urban areas, industrial and harbour areas, agricultural ground, woodland, and moorland. Wind energy is typically able to relate to other land uses, apart from within areas such as wild land areas and sensitive residential locations. A key design objective should be to either relate directly to the specific characteristics of the land use or, alternatively, to appear separate and removed from these, avoiding the incongruity of something in-between that conflicts in nature and function.

Windfarm related to harbour land use

Windfarm related to agricultural land use

Windfarm relates to scale of landscape and land use

Relationship between windfarm and land use not clear

4.37 Where appropriate, the development of a windfarm can act as the stimulus for restoration and/or improvement of land use within or around a windfarm site, which are typically assured through the planning process by legal agreements.

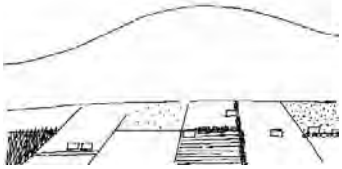
Landscape and visual pattern

4.38 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 drystane dykes, hedgerows, shelter-belts, drainage channels, the distribution of drumlins along a valley, or repeated rock formations.

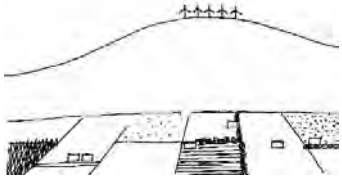
4.39 Developments should typically be designed to relate to landscape pattern where this contributes to landscape character and visual composition. However, the elements of landscape pattern to which a windfarm should relate will be strongly affected by their scale and prominence. The location of tall wind turbines, for example around 100 m high, in relation to small elements of pattern, such as 1.5 m high fences or 25 m high knolls, would represent a disparate relationship that would not appear rational from most viewpoints. Wind turbines that do not relate to

elements or features of similar prominence and/or scale within the underlying or adjacent landscape pattern, such as a forest plantation, will seem equally discordant.

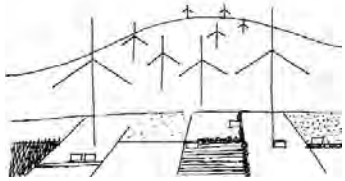
4.40 The distinctive character of some landscapes relies on strong contrasts of pattern, for example an intricate arrangement of fields and regular spacing of croft houses seen against a simple moorland hill backcloth. In these locations, it is important that the addition of a windfarm neither compromises the simplicity of the backcloth hills, or the hierarchy or pattern of the lowland landscape below.



Distinction of lowland landscape pattern relies partly on simple backcloth that highlights this in contrast



Windfarm detached from landscape pattern. Creates a focal feature that will distract slightly from lowland landscape, but distance maintains most of simple hill backcloth.

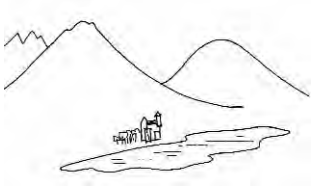


Windfarm not only contrasts to lowland landscape pattern, but reduces distinction by crossing over into neighbouring area of simple hill.

Focal features

4.41 Focal features can be natural features, such as mountain peaks, ridges, rock outcrops or clumps of trees; or they may be man-made structures like hill-forts, masts and towers; they can also be formed by existing wind turbines / windfarms. They may form part of landscape pattern or be seen as isolated features within a landscape. Often, where the landscape panorama is complex, there will be a hierarchy of foci that will be influenced by the relative size, distribution, position, prominence and cultural value placed upon them.

4.42 Windfarms, because of their very nature and typical location within open landscapes often become major focal points. Thus their interaction with the existing hierarchy of foci needs to be considered in their siting and design, in order to minimise potential visual conflicts or compromise the value of existing foci. In some instances, however, the introduction of a windfarm as a focal feature may have beneficial effect, helping to distract from negative prominent features.



Existing focal points within landscape

Windfarm reduces focal prominence and distinction of original foci

Windfarm creates prominent focal feature, but does not seem to intrude upon or reduce distinction of existing foci due to separation

Settlements and urban / industrial landscapes

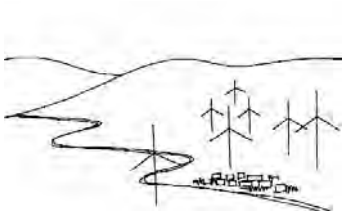
4.43 Settlements and buildings within a landscape tend to be sensitive to the development of a windfarm for three main reasons:

- by being places from which people will view a windfarm 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.

Turbines seen against other features

4.44 It is important that windfarms should not dominate or negatively affect settlements. The threshold for this effect will vary in different landscapes, for different settlements and with different windfarm and wind turbine designs.

4.45 Individual domestic-scale turbines can be located nearer to buildings for small-scale industry, agriculture or for residential use. These may be relatively noticeable due to the faster blade rotation of smaller machines. SPP6 and PAN45 recommend that any proposals within 2 km of a settlement should be considered individually to asses their suitability.

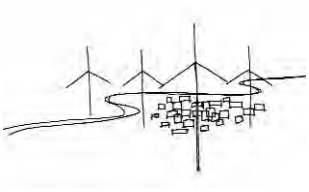


Windfarm appears to impinge upon neighbouring settlement

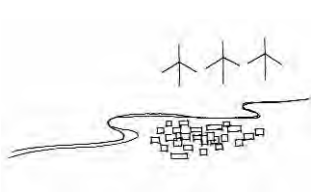
Windfarm separated from settlement by open space

4.46 There may be some locations where larger wind turbines can be accommodated near to or within urban and industrial locations. Additional key issues to address in these situations will be residential amenity, noise and shadow flicker. In these settings, large wind turbines typically appear most appropriate where they are separated slightly from buildings; are seen set back against an area of open space and visual simplicity; or are marginal to the urban/industrial area, for example, along a river edge, road corridor, the coast or large open space. The aim should be to minimise the sense of imposition upon buildings and more intimate spaces. This might be achieved by the turbines mainly being seen against an open background, and avoiding the creation of a visually complex image. In these circumstances, careful consideration of the nature of views in and out of these areas is needed, along with appreciation of the nature of impacts from recreational areas and residences.

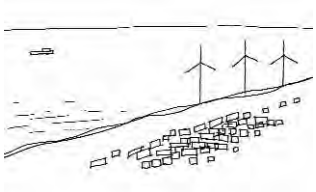
Wind turbines can relate well to urban features such as a harbour wall



Windfarm impinges upon space and views of adjacent settlement



Windfarm prominent in views from settlement but does not seem impinging because of separation space



Windfarm near to settlement, but seems less impinging due to adjacent open space offered by sea

4.47 In some places, larger turbines with slower rotation of blades may be preferable to smaller turbines with faster speeds. However, there will always be a need to relate the size of the turbines to the local context, taking account of the existing buildings and foci.

4.48 Landscape value, which may be reflected by designations such as World Heritage Sites, Conservation Areas or areas with Tall Building Policies, will also need to be considered.

4.49 Other factors to consider within urban situations, and which should be addressed through LVIA are;

- intervisibility and setting of turbines;
- lines of sight between well known viewpoints;
- views of existing focal points; and
- the relationship between wind turbines in urban areas and those in the surrounding landscape and seascape.

Wind turbines in an urban setting

Coast

4.50 Scotland has a great diversity of coastal landscapes, ranging from low-lying beaches with dunes, to craggy intricate cliffs and headlands. An assessment has been undertaken for SNH that characterises the coastline of Scotland into 33 seascape units[14].

4.51 Windfarms should relate to the sense of openness and exposure within coastal areas. However, as views are typically drawn to the coast, these areas will be sensitive to the location and design of a windfarm. This occurs both in relation to the inland and offshore land/seascape character and views, and includes views from boats and ferries. Simple, open, flat coastal areas can probably better accommodate windfarms than complex coastal landscapes, such as those with inlets and islands.

14 An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore windfarms, SNH Commissioned Report No. 103. (2005)

Wind turbines can relate well to some coastal landscapes

4.52 Due to the focus of views along coastlines and the typical concentration of settlements within these areas, a windfarm will often create a new focal feature or landmark near to the coast. For this reason, it will be important that they do not detract from existing landmarks, such as historical or navigational features, or coastal settlements and areas valued for recreation.

4.53 Cumulative impacts may occur between onshore and offshore wind energy developments, and this is likely to become an increasingly important design consideration in the future as leases are granted to develop windfarms in Scottish inshore and offshore waters. From inland areas, offshore developments may not even be perceived as being offshore if their immediate setting within the sea is screened by inland features. Views of offshore windfarms may also be affected by onshore developments. It may, for example, be undesirable to view off-shore development with onshore development in the foreground.

An offshore windfarm, 1km off the coast

4.54 Further guidance on this aspect of windfarm LVIA can be found in 'Guidance on the Assessment of the Impact of Offshore Windfarms – Seascape and Visual Impact Report'[15] and 'Guide to Best Practice in Seascape Assessment'[16].

15 DTI in association with SNH, CCW and The Countryside Agency (2005)
16 Maritime Ireland/Wales INTERREG 1994–1999. Countryside Commission for Wales, Brady Shipman Martin and University College Dublin (March 2001)

Woodland

4.55 Where turbines are seen from a distance in combination with woodland, their large scale can be difficult to discern. However, where windfarms are sited immediately adjacent to, or within woodland areas, trees may act as a scale indicator accentuating turbine size in comparison.

4.56 Trees are only likely to have a screening effect if they occur within the fore or midground of views looking towards turbines in the distance. If this occurs, the screening effect may change or be lost as one moves through the landscape.

4.57 Large-scale conifer plantations, particularly when seen from a distance and upon slopes, can create distinctive lines, colour, texture and shape. Ordinarily, the design objective would be to relate to this distinctive landscape pattern. However, in contrast to native woodland, forest plantations tend to be more temporary features of the landscape. For this reason, through LVIA, the designer needs to consider future plans for a forest and consider whether this, or the underlying and surrounding landscape, is of greater relevance in defining the character of the landscape to which the windfarm should relate.

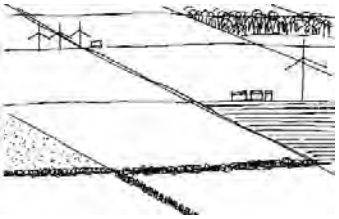
4.58 If a windfarm is located within a forest, the clearance of trees to create open spaces for the turbine bases and access tracks can create a pattern of spaces, lines and shapes that may increase the complexity of the windfarm from distant views.

The relationship between windfarms and forestry requires careful consideration

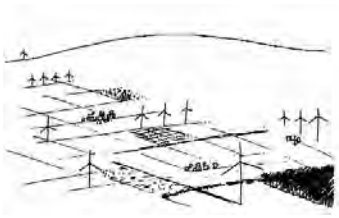
Small / Community Windfarms

4.59 Small scale community owned windfarms can make a positive contribution to rural economic development. However, it should be noted that single turbines or small windfarms do not necessarily result in less landscape and visual impact than a larger development. As the efficiency of wind turbines increases this may lead to proposals with fewer yet relatively large turbines in landscapes which have limited capacity to accommodate them. Whilst a community development may be preferred within an area due to its contribution to a local economy, the ownership of a development does not mitigate landscape and visual impacts, it affects the judgement of acceptability of impacts in line with planning policy. All windfarm development should be carefully assessed through LVIA (albeit scoped to fit the scale and nature of the development), including cumulative effects.

4.60 Cumulative impacts of multiple individual wind turbines and / or small windfarms are a particular concern, especially where these are randomly located or of different designs. This issue may become more widespread as opportunities and incentives to generate electricity for on-site or community use, or to generate community income, become more widespread. There is a need for developments to be sited and designed in relation to each other in order to avoid negative impacts on landscape character and visual amenity. It is therefore recommended that Local Authorities have suitably robust spatial and design policies to minimise landscape and visual impacts where small windfarm development is likely to occur outside their Broad Areas of Search.



Single and small windfarms fitted to agricultural landscape pattern



Although individual developments are all small scale and fitted to local characteristics, developments cumulatively become defining element of character type – a 'windfarm landscape'

5

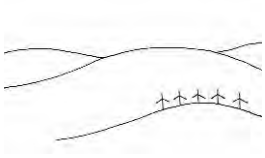
Designing in landscapes with multiple windfarms

5.1 The previous section highlighted the factors to be considered when designing individual windfarms. In many parts of Scotland, however, the issue is how best to plan for and accommodate multiple windfarms. This is complicated by the fact that, at any one time, many developments may be consented but not built, or submitted but not determined. This means that planning, siting and designing windfarms tends to be based on constantly changing baseline conditions.

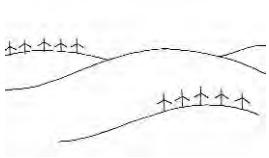
5.2 Cumulative impacts occur when one windfarm is proposed in the vicinity of another existing or already proposed windfarm. SNH has published guidance on assessing the Cumulative Effects of Windfarms[1] which sets out when and how cumulative effects should be considered. This section contains design guidance in circumstances where such cumulative effects are expected to arise. It also touches on aspects which Local Authorities may need to consider when drawing up spatial frameworks and Supplementary Planning Guidance for windfarm development to fulfil the requirements of SPP6 and PAN45 Annex 2. This is dealt with in more detail in Part 2.

5.3 As part of the design process where other windfarms exist or are proposed, it will be important to undertake an assessment at a strategic level of the potential cumulative landscape and visual impacts. The impact of smaller windfarms, and in some cases individual turbines, will also require consideration. The methodologies contained with the Cumulative Effects of Windfarms guidance should be helpful, as may Topic Paper 6 'Techniques and criteria for judging capacity and sensitivity'[2].

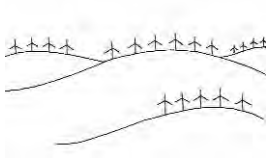
5.4 When designing an individual windfarm, key design objectives should be developed as stated previously in section 4. Where cumulative impacts are likely to occur within an area, design objectives should also be established that can be consistently applied to all proposed developments. This should result in a similarity of design and windfarm image within an area that limits visual confusion, and also reinforce the perceived appropriateness of each development for its location. Cumulative design objectives should relate to ancillary infrastructure as well as wind turbines.



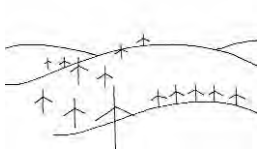
Individual windfarm relates directly to landform characteristic as single line upon horizon



Numerous developments relate consistently to key characteristic of the landscape, but not prevalent and thus remain as isolated features.

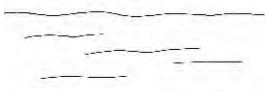


Multiple windfarms relate to same characteristic, to create consistent image and reinforce perceived appropriateness of each windfarm. However, by occupying every incidence of specific characteristic, will become key characteristic that changes overriding character



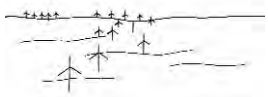
Additional windfarms contrast in pattern, scale and relationship to key characteristics, creating a confusing image and questioning relationship of original development to its surroundings.

1 'Cumulative effect of Windfarms'. SNH 2005 (currently under review)
2 Landscape Character Assessment Guidance for England and Scotland – Topic Paper 6:Techniques and Criteria for Judging Capacity and Sensitivity. SNH and The Countryside Agency (2005)



The key characteristics of the landform are often illustrated most clearly by the skyline. In this open landscape, the skyline has a horizontal emphasis and uninterrupted character.

Windfarm acts as a prominent focus. Although it does not occupy a major proportion of the skyline, it contrasts to the horizontal emphasis at a local level as a single collective feature.

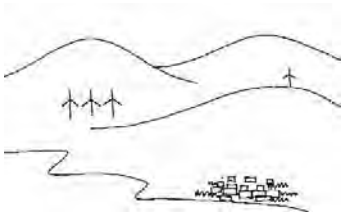


Additional development results cumulatively in major proportion of skyline being occupied by windfarms. In addition, its siting and shape does not relate to the skyline feature, nor horizontal emphasis.

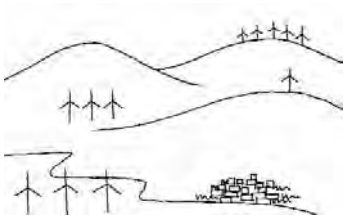
Windfarms cumulatively dominate the skyline feature, although they relate to its horizontal emphasis and simplicity of line.

5.5 The development of multiple windfarms within a particular area may create different types of cumulative effect, such as where:

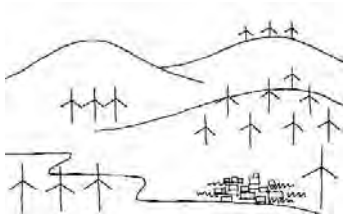
- The windfarms are seen as separate isolated features within the landscape character type, too infrequent and of insufficient significance to be perceived as a characteristic of the area;
- The windfarms are seen as a key characteristic of the landscape, but not of sufficient dominance to be a defining characteristic of the area;
- The windfarms appear as a dominant characteristic of the area, seeming to define the character type as a 'windfarm landscape character type'.



Separate isolated features

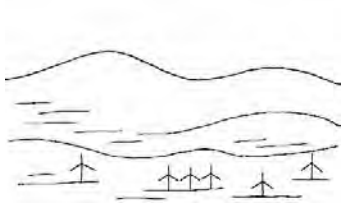


Windfarms become key characteristic of the landscape

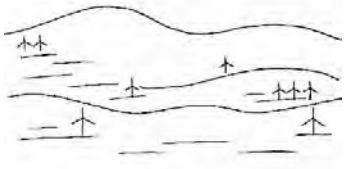


Windfarms become dominant characteristic of the area, creating a 'windfarm landscape'

5.6 These effects can occur at varying scales, for example affecting just a local character type, or prevailing over much of a character type at a regional level. The appropriateness of these different effects will depend on the character and value of a landscape and defined objectives for change. There will be differing circumstances where windfarm development would be welcomed – as landscape enhancement or accepted as part of the usual trend for landscape diversification and evolution – or else be considered undesirable, being contrary conservation aims.



Dominance of landscape character by windfarms occurs at local level only. Other areas of similar character not affected.



Dominance of landscape character at wider scale, but local pockets perceived as unaffected

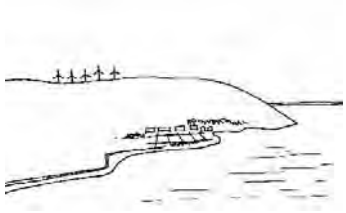
5.7 An opportunity may be taken in some instances to use windfarm landscapes to improve areas which have been considered lacking in defining character. It is important to stress that this approach is only appropriate in certain locations where study has revealed that capacity exists for further turbines – elsewhere it will be important to retain areas free from development to maintain landscape diversity.

Relating to landscape character

5.8 If windfarm development extends over several different landscape character types within an area, this can lead to a reduction in the distinction between these

different types. If windfarms already exist within a particular landscape character type, further windfarm development should be limited to the same or similar types within the neighbouring area. An exception could be where these developments are of distinctly different character themselves, for example if they strongly contrast in scale.

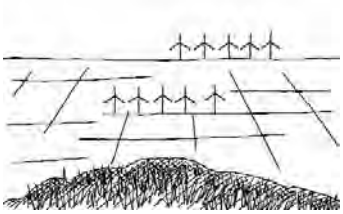
Distinct combination of contrasting character types – open hill, settlement and firth



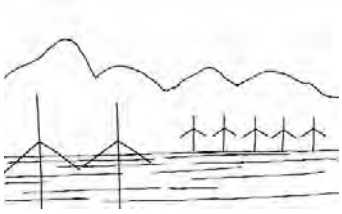
Windfarm creates new feature. This distracts from existing focus of view; however, distinction between character types is maintained.

Windfarms cross different character types, reducing the distinction between these.

5.9 The relationship of multiple developments to neighbouring landscape character types is very important, especially where developments are located near the boundary of these or will be highly visible from neighbouring landscape character types.



Windfarm siting and design relates to simple landform and appears distant enough not to impose on nearby hills



From alternative viewpoint, looking over agricultural ground, visibility of wind turbines is highlighted by backcloth. The turbines also compete with the visual prominence of the hill range.

Complementing landform

5.10 Multiple windfarms should not obscure distinctive landforms, either by 'flattening' out the varying relief (due to their relative magnitude) or by 'filling' up or crowding an enclosed or flat area.

Establishing new patterns

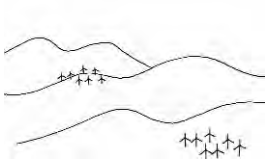
5.11 The opportunity to introduce a new, characteristic landscape pattern through consistent design of turbine arrays will be important where a 'windfarm landscape' has to be established. Existing landscape scale and pattern should be respected, as they may assist in designing a new landscape. Where a new spatial pattern is proposed it will be important to identify key design prompts or cues within the landscape (which may be existing windfarms) and work with these. Consideration needs to be given to how the new pattern relates to any existing neighbouring windfarms, and adjacent landscape character.

Relationship between windfarms

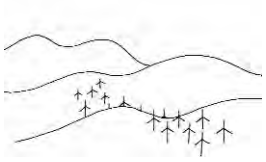
5.12 Where two or more windfarm proposals which would be inter-visible enter the planning system in parallel, or alongside existing or consented windfarms, this should be a material consideration in the planning process.

5.13 A key factor determining the cumulative impact of windfarms is the distinct identity of each group of windfarms, typically related most closely to their degree of separation and similarity of design. This applies whether they are part of a single development, a windfarm extension, or a separate windfarm in a wider group. A windfarm, if located close to another and of similar design, may appear as an extension; however, if it appears at least slightly separate and of different design, it may conflict with the other development. In these cases, and if a landscape is not able to accommodate the scale of a combined development, windfarm groups

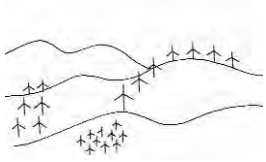
should appear clearly separate. It is critical to achieve a balance between windfarms and the undeveloped open landscape retained between them. Adequate separation will help to maintain windfarms as distinct entities. However, the separation distance required will vary according to the landscape characteristics.



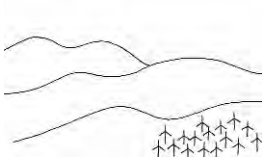
Distinct windfarm groups. Similarity of design and relationship to the landscape. With large areas of open space in between, character of underlying landscape prevails.



No clear distinction between group(s). Extending beyond skyline, it is not possible to confirm whether the groups link.

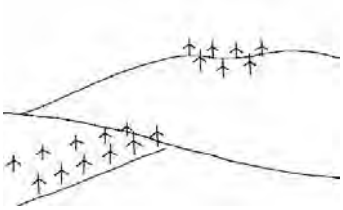


Although no clear area of space between windfarm groups, distinction highlighted due to contrasts of turbine scale and layout (variety of development type creates visual complexity).

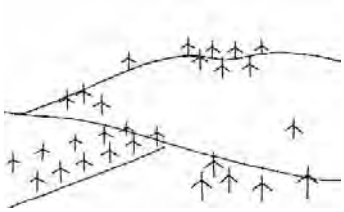


Extension to original development creates larger single windfarm. This has increased impacts in the local area, but limits the extent of impacts through the wider landscape.

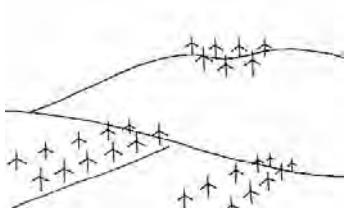
5.14 In some locations the existing pattern of windfarm development may be complex. Relating further development to a complex pattern will be challenging, but the same key principles should apply, focusing on improving the overall pattern and character of development rather than exacerbating existing conflicts between designs.



Existing windfarm developments of contrasting design and relationship to the landscape.



Additional windfarm designs amplifies adverse cumulative impacts



Additional windfarm reinforces character of one original windfarm, although increases the sense of incongruity of the other.

5.15 In some circumstances, intervening topography may limit visibility and reduce the need for visual compatibility between neighbouring proposals, although site design should always be compatible with landscape character.

Focal point pattern and scale

5.16 As multiple windfarms are built, they are more likely to 'compete' with the landscape's original foci and it may lack a sole dominating focal point as a result. The design aspiration should be to avoid visual confusion and to maintain focal point pattern and hierarchy.

Settlements

5.17 Care should be taken to avoid multiple windfarms dominating the landscape setting of a settlement. Windfarms may do this if they are close to it at high elevation, surround or enclose the access and main approaches, dominate approaches through sequential cumulative effects (through the presence of several windfarms in succession), or are physically too close. How a 'windfarm landscape' relates to a settlement will depend on the design of the windfarms and their spatial relationships with each other, and how the settlement relates to its hinterland.

Windfarm extensions

5.18 Recent windfarm development has included numerous extensions to existing windfarms. These give rise to similar issues of consistency as those arising from adjacent windfarm developments, and similar design principles should apply. Layout and site design objectives and principles should echo those of the original windfarm. Extensions should use turbines which are compatible with those in the existing windfarm, including aspects of scale, form, colour, and rotation speed. Such compatibility issues will be more important the closer the windfarms are.

Extensions should not compromise the landscape setting of neighbouring windfarms and should respect existing focal points in the landscape. The potential for a windfarm extension to 'outlive' the existing windfarm (if this is decommissioned), and therefore stand on its own, should also be considered in the design process.

Windfarm as two distinct groups. This creates a complex image due to interactions between each wind turbine with the landscape and all the other wind turbines within its group as well as between the two groups of turbines. This is complicated further by the fact that most people view the development while travelling through it. In addition the windfarm has an irregular layout over a variable landform and there are a number of other prominent landscape features within the area, including forest blocks and powerlines.

Designing in landscapes with multiple windfarms – summary of key principles

- Multiple windfarms will result in different types of cumulative effect. For each windfarm or strategy concerning potential windfarms, 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 windfarms, while this may be inappropriate within others. Generally, it will be preferable for windfarm development to be limited in its range of landscape character type within a particular area, to avoid reduction in the distinction between types
- Individual windfarms should generally appear visually separated from one another in a landscape, unless specifically designed to create the appearance of a single combined windfarm
- Different forms of windfarm development should respond to different landscape character types, to ensure windfarm landscapes complement the landform in their positioning, extent and density
- Windfarms should not unacceptably dominate settlements
- Windfarms should take account of existing focal points in the landscape, which may be neighbouring windfarms
- Multiple windfarm development should not change distinctive skylines or occupy the major proportion of a skyline from key viewpoints or receptors
- Extensions should consolidate the scale, size and mass of the existing development; if the new turbines are compatible with the existing ones the resulting windfarm should relate to the area's landscape character in extent and scale

Part 2

Strategic planning for windfarms

Introduction

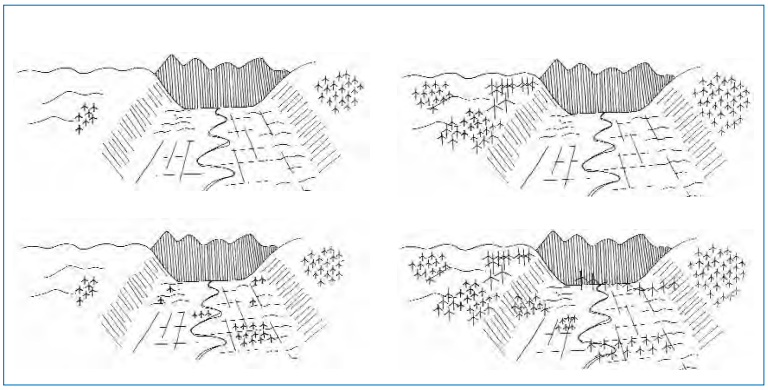
1. This section provides guidance to Planning Authorities. It does not replace or override the policy principles stated in SPP6, but seeks to compliment and expand upon the landscape and visual considerations as identified in Planning Advice Note (PAN) 45 Annex 2[1], published in November 2008. This guidance is being issued at a time of change within the planning system. The existing SPP / NPPG series is being replaced by a single, consolidated Scottish Planning Policy statement, to be published later in 2009. This section may require revision once the new SPP is published.

2. SPP6 requires planning authorities to set out a spatial framework for the consideration of windfarm proposals over 20MW, with broad areas of search identifying areas where proposals are likely to be supported, areas to be afforded significant protection from windfarm development, and the criteria to be followed in the remainder of the area. In most areas the pattern of existing windfarm development will strongly affect the scope of a framework.

3. Planning for multiple windfarms is a complex and sensitive issue. SNH seeks only to express key principles in relation to landscape within this guidance to help Planning Authorities produce a clear and robust spatial policy. At this strategic scale Planning Authorities will benefit from working together to consider the broader impacts of windfarms on neighbouring areas

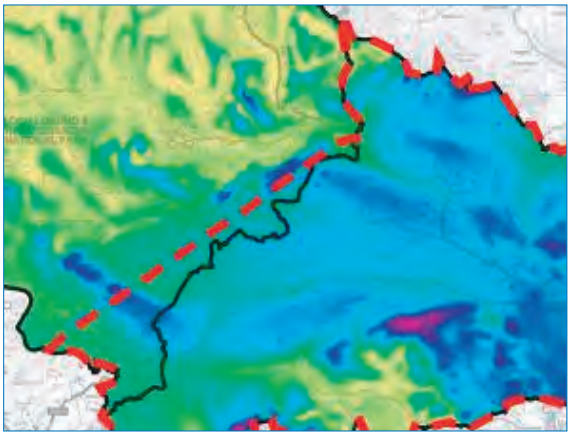
4. Landscape considerations are just one aspect of the process of identifying a spatial framework. Other constraints and natural heritage issues will also have to be taken into account to develop a robust and coherent framework. This guidance works on the assumption that other areas of natural heritage sensitivity will either have been sieved out earlier in the process of developing a spatial framework, or that these sensitivities are carried forward for consideration alongside landscape and visual and other issues. In an area with multiple windfarms there is potential for the overall landscape character to be significantly changed. The presence of a number of windfarms may make them a key characteristic of the landscape, or even a dominant characteristic such that it becomes a 'windfarm landscape'. There may be some loss of tranquillity and some aspects of naturalness may be lost. In any of these circumstances good design remains an important objective, even if the landscape has changed from its original character. The design principles outlined earlier in this guidance remain relevant.

1 Planning Advice Note (PAN) 45: Annex 2: Spatial Frameworks and Supplementary Planning Guidance for Wind Farms, Scottish Government, November 2008



Example of exploration of design concepts for multiple windfarms within a distinct region. The first diagram represents the existing cumulative situation with two windfarms upon upland hill areas. A key issue to address was whether all further windfarms should be restricted to the same character type to avoid reducing the distinction between this type and the flat bottomed valley below.

5. Potential cumulative visual impacts are difficult to address through strategic planning. The process can be assisted by viewshed mapping and analysis of representative viewpoints, key views and important tourist routes across the area, informed by 'dead ground' ZTVs[2] and viewpoint visualisations.



Example of visual exposure analysis. Pink represents places within which a wind turbine would be seen from the most extensive area within the study area, Yellow represents the where it would be seen from the least extensive area.

Plan showing sample viewpoint locations that informed the development of a windfarm capacity study. For each viewpoint, site assessment was carried out in addition to the production of visualisations that showed sample wind turbines of different height in various hypothetical locations in relation to the viewpoints across the region.

Identifying landscapes suitable for multiple windfarms

6. One of the potential consequences of considerable windfarm development across Scotland could be that few landscapes might be left unaffected by windfarms. This would diminish the diversity which is one of the key characteristics of the Scottish landscape. Good strategic planning can help to avoid this by ensuring that windfarms are sited within those areas best able to accommodate them. It should also mean that areas less suitable for such development, or more valued for the present character or qualities of the landscape, can be kept free of windfarm impacts. Views of windfarms from within these areas may also be affected, and will therefore require careful consideration. This has been shown by some planning exercises[3].

7. Landscape capacity studies can help to inform and identify where development would be preferable in landscape terms. They can be particularly helpful when spatial frameworks are being developed.

8. As the landscape and visual impacts of windfarm development can extend over a wide area and across Planning Authority boundaries, it is important to consider the

2 ZTV maps that show the area within which an element of defined height and extent would be visible from a specific viewpoint.
3 Such as those undertaken in Ayrshire and the Clyde Valley

current pattern of development in a regional and national context. SNH has developed a windfarm footprint map[4] which identifies the location and size of most of the windfarms which are already installed, approved or being considered. The map demonstrates that windfarm development is currently clustered in those areas which are generally of lower constraint (in natural heritage terms) and with access to the national grid. Further development activity is likely to continue to focus on those areas with good access to the grid and close to areas of existing development or land use change. This has led to a pattern of 'clustering' of windfarms which crosses Planning Authority boundaries and which reflects the range of constraints on windfarm development. In considering which areas are suitable for further windfarm development this existing pattern of development must form a key consideration.

A large windfarm in a large scale, open landscape.

9. The intrinsic characteristics of a landscape also render some landscape types more suitable for multiple windfarms than others. Analysis of landscape character information at a strategic level can help in identifying those landscape types best suited to large scale and multiple windfarm development.

10. Impacts on recreational interests also need to be considered at a strategic level. This will include the effects on users of Long Distance Routes where relevant, impacts on popular destinations for recreation such as National or Regional Parks, and also on important recreational resources such as rivers and mountains. Summits and other elevated viewpoints are often popular destinations that are likely to be particularly affected by views of multiple windfarms.

Different landscapes – different approaches

11. In judging whether or not an area should be kept free of windfarm impacts it is helpful to develop a clear view about which of three possible landscape objectives should apply[5]: landscape protection, accommodation, or change. These should not be seen as rigidly distinct objectives. They seek only to illustrate the different approaches that are relevant to different landscapes.

A large windfarm in a rolling managed upland landscape.

4 Available at http://www.snh.org.uk/strategy/renewable/sr-rt01.asp
5 For further discussion on landscape objectives see SNH's Landscape Policy Framework. Policy Statement No. 05/01

12. **Landscape Protection:** where the aim is to maintain the existing landscape and visual resource, retaining or reinforcing its present character and protecting its quality and integrity. It is likely to be difficult to accommodate windfarms in such areas. Small-scale development may nonetheless be possible where it relates well to the existing landscape in terms of both scale and design. Micro generation may be acceptable where this relates well to the existing built environment. Where a landscape designation is in place, it is important to understand the special qualities for which the area is designated and to consider how the proposal could affect these. In National Scenic Areas, for example, landscape protection will be the most appropriate objective, reflecting the high degree of protection afforded to these areas by SPP6 and NPPG14[6].

> Nationally and internationally designated areas where landscape protection is an appropriate approach are likely to be afforded 'significant protection' in Planning Authority Spatial Frameworks.

13. **Landscape Accommodation:** where the aim is to retain the overall character of the landscape, yet accepting that development may be allowed which will have an impact on the landscape locally; development fits within the landscape and does not change its character on a large scale. Landscape accommodation implies that there may be important landscape-related constraints in terms of the siting and scale of windfarms, but that suitably designed windfarms can be compatible with this objective. Within local landscape designations the degree of landscape protection will be less than for National Scenic Areas. In some local landscape designations an appropriate objective may be to accommodate windfarms, rather than seek landscape protection. Where this approach is chosen the justification will need to be clearly articulated in relevant planning policy.

> Landscape accommodation may be an appropriate approach within the 'other' areas in Planning Authority Spatial Frameworks, where other constraints and policy criteria will apply. A landscape accommodation approach could also be relevant to 'Broad Areas of Search' if the associated criteria make it clear that overall landscape change is to be avoided.

14. **Landscape Change:** where it is accepted that the area is one whose landscape character may be allowed to change, which could result in a perception of a windfarm landscape. Landscape change does not imply that 'anything goes': good landscape design principles still need to be followed to ensure that the development is appropriate for the scale and character of the landscape.

> Areas where landscape change is an appropriate approach are likely to be consistent with 'Broad Areas of Search' in Planning Authority Spatial Frameworks.

SNH Strategic Locational Guidance

15. SNH has published Strategic Locational Guidance for Onshore Windfarms[7] to guide planners, practitioners and others in respect of natural heritage constraints at the strategic level. It identifies three zones of natural heritage sensitivities and aims to promote a consistent approach to windfarm development. It is important to note that the zones identified within the Strategic Locational Guidance are mainly designations-based and do not take account of landscape character or potential visual effects.

6 National Planning Policy Guideline 14 Natural Heritage, Scottish Government 1999
7 Strategic Locational Guidance for Onshore Windfarms with respect to the Natural Heritage. SNH 2002, updated March 2009, www.snh.org.uk.

16. To date, the majority of windfarm development has been in Zone 1 – the zone of least natural heritage sensitivity. Areas where landscape change is an appropriate objective, and where multiple windfarm development might be encouraged, are most likely to be found within Zone 1. However, it should not be assumed that all of this zone should be open to landscape change. The scale and detail of some landscapes will always make it difficult for them to accommodate windfarms satisfactorily, and there are many areas within Zone 1 which are valued locally for the character, quality and amenity value, for example on account of the recreation opportunities they provide close to towns. In some locations, the concentration of proposed developments in Zone 1 is leading to the potential for undesirable cumulative impacts.

Identifying capacity and the limits to development

17. Within areas identified as being suitable for multiple windfarms there will still be a limit on the number or extent of windfarms which can reasonably be accommodated. SPP6 states that '*Development plans should identify those areas where there are existing windfarm developments and set out, in relation to the scale and proximity of further development, the critical factors which are likely to present an eventual limit to development*'[8]. Within Broad Areas of Search, Planning 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 factors summarised below.

8 SPP6, Annex A, paragraph 3

Critical factors relating to capacity for windfarms

This box lists key factors that ought to be taken into account when considering capacity for windfarms. It was developed in response to a need identified in SPP6 (paragraph 3 Annex A, cumulative impacts).

– Effects on landscape designations – or 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 windfarms 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 distance
Effects on distance may be distorted with additional windfarm 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 windfarm development may act as a focal point in the landscape and the effects of other windfarm development on this should be considered.

– Effects of skylining
A viewer's eye tends to be drawn towards the skyline. Where an existing windfarm is already prominent on a skyline the introduction of additional structures along the horizon may result in development that is disproportionally 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.

Surrounding areas

18. Where an area is identified for multiple windfarm developments, it will be important to establish a clear boundary to that area. This is in order to achieve visual separation, such that those travelling through the landscape will perceive a clear distinction between the windfarm landscape and the landscape outwith. Otherwise, the perception of being within a windfarm landscape may become extended, or may only peter out gradually, thus losing diversity in the landscape experience. There may be some benefit in maintaining the current development pattern – of clustering and gaps – that has evolved in some areas due to a range of opportunities and constraints. This approach should also help to address cumulative impacts[9].

19. The scale required of such landscape planning is necessarily large, given the extent of a typical large windfarm which may extend across Local Authority boundaries. Surrounding areas to be kept free of windfarms may have to be substantial to be effective, considering intervisibility and sequential impacts. They

9 SPP6, Annex A, paragraph 3

also need to take account of the distance necessary to provide an area of undeveloped ground in between. Perception of this will typically depend on factors such as the concealment offered by landform and windfarm size. In very open landscapes larger separation distances may be required than in hilly areas where the landform may provide more effective visual separation. It may not be necessary to preclude small windfarm developments within such separation areas, e.g. farm-scale developments or single turbines, where these are clearly of a smaller size or scale than the large-scale windfarm developments within the windfarm landscape itself. However, there will be a limit to the number of smaller developments that can be accommodated in this way.

In developing Spatial Frameworks for windfarms Planning Authorities should consider identifying areas that should be afforded significant protection in order to reduce the potential for further cumulative impacts[10]. These areas may be required between very large individual windfarms, clusters of windfarms, and Broad Areas of Search.

10 Para 33, Planning Advice Note 45, Annex 2, 2008

Appendix 1

Design Statement for Clyde Windfarm

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Please note that the references to other chapters/tables are not included within this guidance.

Design Strategy

1 Requirements for a 'design strategy' stem from national policy[1], and were reinforced in the scoping responses from the Royal Fine Arts Commission for Scotland and Scottish Natural Heritage. In addition, it has now become accepted best practice in the design of windfarms, to consider how the windfarm will relate to the landscape, its landform, scale and other landscape features.

2 The overall aim of the design strategy was to create a windfarm with a cohesive design that relates to the surrounding landscape. The inherent nature of turbines as bold, modern structures means that the form of the windfarm as a whole is important, and a strong, clear cut design strategy is necessary. The strategy therefore considered the appearance of the windfarm as an object or composition in the landscape as the primary factor in generating the layout.

3 The objectives of the design strategy were as follows:

- to produce a cohesive layout which would be legible in views from the surrounding landscape and be easy to understand;
- to develop a layout that reflects the landform and topography of the landscape;
- to develop a layout that seeks to match the scale of the turbines, and the scale of the overall development, with the scale of the landscape.

4 The background to the design strategy also included an examination of alternative patterns for the layout in relation to the topography.

Scope of the Strategy

5 The design strategy sets out the overall approach to the design development of the windfarm. Subsequent alterations to the layout were made in response to, for example, ecological, hydrological, archaeological and energy yield considerations, as well as to reduce visual impacts arising from these alterations. With the design strategy in place, however, these latter changes could be reviewed with an understanding of the appearance of the windfarm within the landscape.

6 The design strategy did not consider site selection, with the site already having been selected by Airtricity using their site selection methodology. The design strategy therefore focussed on considering layout options for the Clyde site in response to the site conditions. The design strategy did, however, influence the site boundaries of the development. Both extensions and reductions to the original site boundary were consequences of the implementation of the design strategy.

7 In the development of the designed layout, computer modelling was used as a tool to aid design. In particular, wireframes were generated for views from key locations around the site and photomontages produced for viewpoints used in the assessment of landscape and visual impacts (see **Chapter 6**).

8 The major development components considered in the design were turbines and deforestation/replanting. Forestry design issues have been progressed alongside this design strategy and are set out below.

9 Cumulative issues with other windfarms have not been considered as part of the design strategy, as the closest other, existing or known potential, windfarms are unlikely to be seen as part of the same windfarm, although some views from the surrounding area will include more than one development (see **Chapter 6**).

1 Scottish Executive (2001) *Designing Places: A Policy Statement for Scotland*.

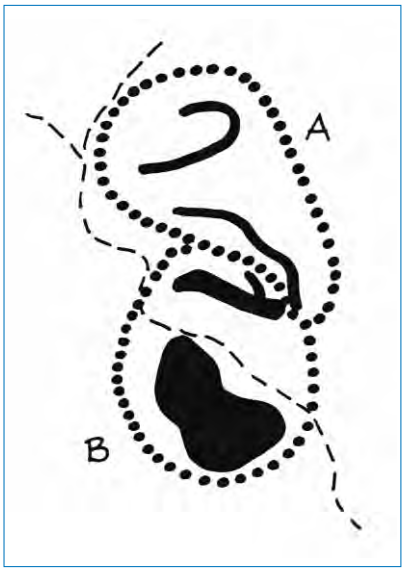
Topography

10 The general topography of the windfarm area is one of undulating hills of the Southern Uplands. Valleys divide the hills such that the site is not seen as a whole from valley locations. This has the effect that in views from much of the surrounding landscape, only part of the site is visible, and turbines will often not be seen in full, and are likely to be seen against the sky. The experience is very different in views from hill tops, where the full extent of the windfarm may be appreciable.

11 These different viewing conditions exclude options for layouts that are dependant on full visibility of most turbines. Instead, there are opportunities for different strategies for different parts of the windfarm that are not seen together in the same view.

12 The site can be divided into two parts that have different landform types. The design strategy that has been developed for each of these is described below.

Sketch 1: Topography of the site. The northern part of the site is made up of ridges, whilst more plateau-like areas lie to the south.



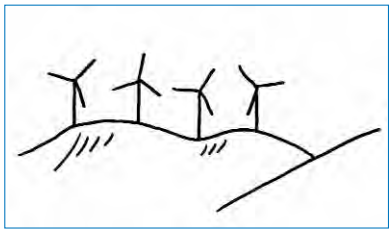
Sketch 2: Design approach A is used for the northern part of the site, and design approach B is used for the southern part of the site.

Design Approach A

13 The northern part of the site has many strong hill and ridge features to which the layout responds. In particular, the ridges of Ewe Hill to Hardrig Head, Tewsgill Hill to Rome Hill to Duncangill Head and Normangill Rig to Yearnhill Head and Hare Cleuch Head form strong topographic features. Lady Cairn, Rodger Law, Harleburn Head, Pin Stane and Clyde Law form a broader area with spurs to the north (for example Mid Hill), and therefore form an area of transition to plateau.

14 This overwhelming characteristic of the landform has been used as the basis for the design in this part of the site. At the scoping stage, a layout with many more turbines along the ridges and down the slopes was used as an initial layout, but this was found to be unsuitable given the lack of clarity of the relationship with the local topography. Visual analysis of the scoping layout further confirmed that the layout should be designed as lines of turbines that related more closely to the ridges.

15 Another design option placed double rows of turbines on the ridges, but this was found not to result in a clear reflection of the ridges in views from the surrounding area. The strategy adopted was therefore *to place single lines of turbines along the ridges, with closer spacing and centred upon the ridges*. The visual effect of this is that the hubs of the turbines reflect the profile and topography of the landform when viewed from the surrounding area. In view of the transition from single ridges to broader plateau, design approach B was used for Lady Cairn to Clyde Law.

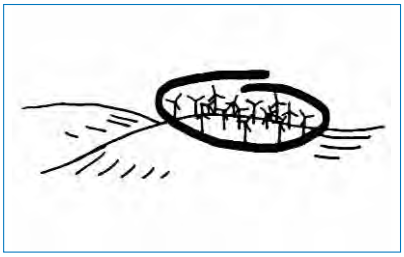


Sketches 3 and 4: A double line of turbines hides the profile of a ridge, while a single line relates to it.

Design Approach B

16 Across the southern part of the site, immediately north of the M74, and the whole area to the south of the M74, the topography is less distinct than the northern part, and there is broad undulating moorland without distinct ridges.

17 The design principles applied for the northern part of the site were found to be unsuitable for this part of the site, given that they are developed for more distinct landform types. An alternative layout, based on a grid was also found to be unsuitable, given the smooth contours and irregular plateau form when seen from viewpoints around the area. For this part of the site, therefore, the strategy was *to develop groupings, using the subtle ridges to orientate them*.



Sketch 5: A group of turbines on an undulating plateau.

Infrastructure

18 Alternative designs for the substation buildings were considered in the design of the windfarm. Should the Scottish Executive be minded to grant consent for the windfarm, a detailed architectural design brief for the substations will be drawn up. This will consider the relative design merits of both traditional buildings (for example, with a slate pitched roof and painted roughcast walls, in the style of existing local farmhouses) versus a more modern design, which more closely reflects the function of the buildings.

19 The access tracks that serve the turbines have been routed so as to follow the ridge tops wherever possible. This is to minimise their visibility in the surrounding landscape. Where tracks cannot follow ridges, they follow other features such as existing farm tracks, valleys, or field boundaries wherever possible.

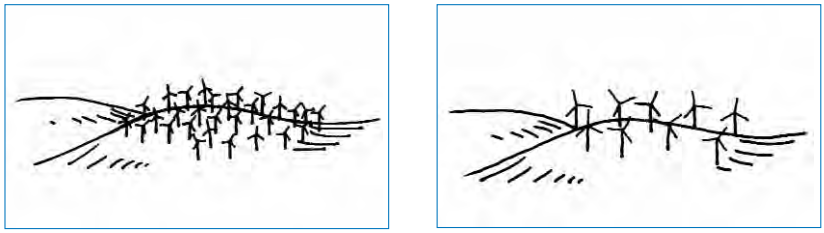
20 The grid connection for the windfarm does not form part of this application for consent. However, the design strategy for the windfarm aims to avoid the potentially confusing design impacts of additional pylons in the site area, by supporting the underground routing of the grid connection.

21 The colour of turbines and transformers has been considered, and it is judged that a non-reflective pale grey should be used for all elements. This is because it would not be possible to use other colours for the lower parts of towers (where they are seen against the land rather than against the sky), or turbines in forested areas, for any one viewing angle, without increasing the impact on other views. In addition, the introduction of more than one colour would reduce the overall visual coherence of the windfarm.

Sketches 6 and 7: Bicoloured turbines are difficult to match up with the horizon..

Scale

22 Larger numbers of smaller turbines compared with smaller number of larger turbines would generate similar yield but have different grouping and visual impacts. A comparative analysis confirmed that greater numbers of smaller turbines have broadly similar ZVIs to fewer larger turbines. However, the greater number of smaller turbines would result in more frequent 'bunching' or 'overlapping' of turbines in views from the surroundings. This 'bunching' or 'overlapping' adversely affected the design objective of reinforcing ridgelines. As a consequence, it was concluded that larger turbines (and fewer) was preferred.



Sketches 8 and 9: Comparison of small and large turbines.

Outcome

23 The application layout is based on the design strategy described above. In particular, the strategy seeks to create a design that reads coherently with the landscape, and is not reliant on arbitrary boundaries that are not present in the landscape (i.e. the site or administrative boundaries).

24 The layout also considers issues of energy yield and incorporates further changes resulting from mitigation of other impacts (see **Table 3.1** below). As a consequence of these other factors, consistent spacing of the turbines has not always been possible along the full length of some ridges. Whilst this may be noticed in some views from the surrounding landscape, on the whole, it is judged that the development will appear to relate to the topography, and that the design objectives have not been compromised.

Modifications to Scheme Design

25 As a consequence of the EIA process, there have been a number of modifications to the design to avoid and minimise environmental impacts without compromising the overall design strategy. These are set out fully in **Table 3.1** below and have included the relocation or removal of turbines, access tracks, borrow pits and associated infrastructure to:

- comply with the overall design strategy;
- reduce visual impacts from key viewpoints;
- increase distances between development components and watercourses;
- avoid key habitats of nature conservation interest;
- increase distances from bird breeding locations;
- reduce noise impacts on residential properties;
- avoid Scheduled Ancient Monuments (SAMs) and other areas of archaeological interest;
- minimise transport impacts;
- remove turbines from the MOD's low fly zone;
- avoid the lines of sight for telecommunications installations.

To illustrate the extent of change, the scoping, baseline and assessment layouts are included as **Appendix 3.2**.

Appendix 2

GLOSSARY

Ancillary infrastructure	The built elements 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.
Broad Area of Search	Area(s) to be specified by a Planning Authority within their Spatial Framework for Windfarms where proposals are likely to be supported, subject to specific proposals satisfactorily addressing all other material considerations.
Borrow pit	A quarry within a windfarm site excavated to provide stone for site infrastructure.
Capacity Study	Research which attempts to identify the acceptable limits to development in a given area.
Decommissioning	The process by which a windfarm is dismantled and the site restored.
Design Statement	A document which records the design process that is undertaken for a development.
EIA	Environmental Impact Assessment, the process by which the identification, prediction and evaluation of the key environmental effects of a development are undertaken, and by which the information gathered is used to reduce likely negative effects during the design of the project and then to inform the decision-making process.
European Landscape Convention	Also known as the Florence Convention, the ELC promotes the protection, management and planning of European landscapes and organises European co-operation on landscape issues. It is the first international treaty to be exclusively concerned with all dimensions of European landscape.
LCA	Landscape Character Assessment, a documented process which describes and categorises the landscape, highlighting key landscape characteristics and the main forces for change.
LIA	Landscape Impact Assessment, part of the LVIA process 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 of a development.
Micrositing	The movement of wind turbines by small distances within the overall windfarm layout, either at the design or construction stages of development.
NSA	National Scenic Area – area designated for its outstanding scenic value and beauty in a national context.

PAN	Planning Advice Notes provide advice on good practice and other relevant information, e.g. PAN45 on Renewable Energy Technologies.
Planning Authority Spatial Frameworks	Frameworks set out in Development Plans by the Local Authority, supported by broad criteria, for the consideration of windfarm proposals over 20 megawatts.
Strategic Locational Guidance (SLG)	SNH Policy Statement which sets out a number of principles that should guide the location of onshore wind farm projects so as to minimise effects on the natural heritage. Provides broad overview at a Scottish level of where, in natural heritage terms, there is likely to be greatest scope for windfarm development, and where there are the most significant constraints.
SPP	Scottish Planning Policy. A statement of Scottish Government planning policy on nationally important land use and other planning matters, supported by a locational framework, e.g. SPP6 focusses on 'Renewable Energy'.
VIA	Visual Impact Assessment, part of the LVIA process, which considers potential changes that arise to available views in a landscape from a development proposal, the resultant effects on visual amenity and people's responses to the changes.
ZTV	Zone of Theoretical Visibility – a mapped visualisation of the areas over which a development can theoretically be seen.

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