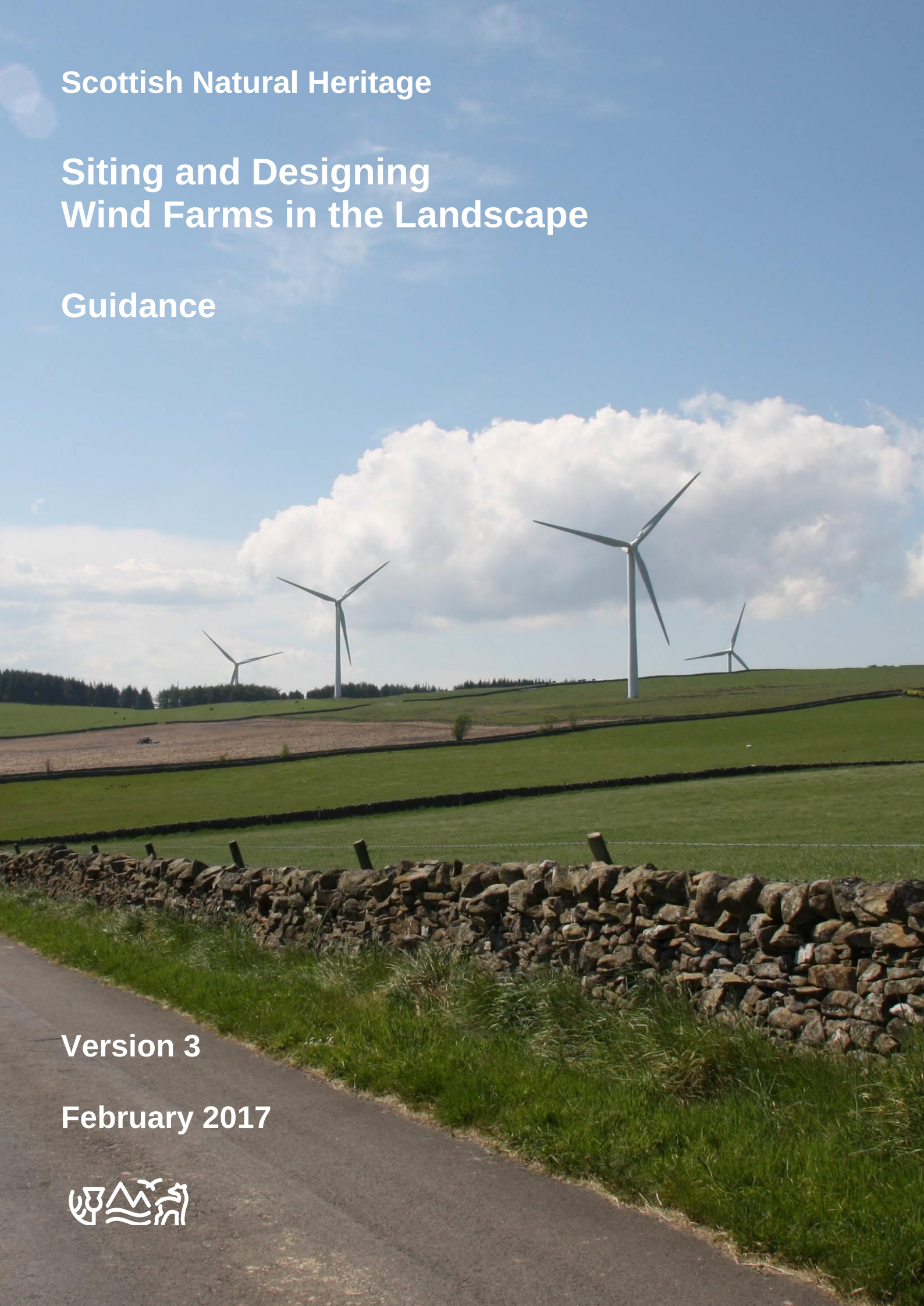
Scottish Natural Heritage

Siting and Designing Wind Farms in the Landscape

Guidance



Version 3

February 2017

Contents

1. Introduction

1.1 This guidance provides advice on the siting and design of wind farms in Scotland's landscapes. It also includes advice on assessing the landscape and visual effects of wind farms, as this is an iterative process with design. The guidance draws on two decades of experience of planning for wind farms by SNH, planning authorities and landscape assessors. Design is a material consideration in the planning process and good siting and design helps to produce development which is appropriate for a landscape whilst delivering renewable energy. It should also maximise the capacity for further development by reducing negative cumulative effects.

1.2 In 2001 we published '*Guidelines on the Environmental Impacts of Wind farms and Small Scale Hydroelectric Schemes*', which included guidance on the siting and design of wind farms. Our understanding of the effects of wind farm siting and design has developed significantly since then and new issues, such as the cumulative impacts of multiple developments, have emerged.

1.3 This version – version 3 - reflects **Scottish Planning Policy**, published in 2014. References to new guidance and research are also included. However, the basic siting and design principles are the same as version 1 as these remain relevant and have proven to be valuable in determining applications. Knowledge, understanding and technologies in this area continue to evolve and it is expected that this guidance will need to be reviewed and updated as a result[1].

1.4 Version 1 contained two parts, with Part 2 focussing on strategic planning. Part 2 has been removed and replaced by new guidance on **Spatial Planning for onshore wind farms – natural heritage considerations**, published in June 2015.

1.5 This version also includes a new annex on siting and design for turbines of between 15 and 50m. This replaces previous SNH guidance published in 2012.

1.6 Wind farms are increasingly being located in areas of commercial forestry and woodland. This version takes on board comments from the Forestry Commission Scotland (FCS) about their recent experience of responding to applications in forested areas. Applicants should seek advice from FCS as early as possible in the process and refer to the **Control of woodland removal policy**.

1.7 This is guidance on landscape and visual issues. 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. A range of other considerations such as noise, archaeology, access and transport are also relevant to the design of wind farms and guidance on these topics is available elsewhere.

1.8 This document should be used alongside our guidance on Assessing the Cumulative Impact of Onshore Wind Energy Developments[2] (2012), and **Visual Representation of Wind farms** (2014). For offshore wind farms reference should be made to **Offshore Renewables – guidance on assessing the impact on coastal landscape and seascape** (2012).

1.9 Developers and those involved in wind farm design should also refer to the Spatial Frameworks being developed by planning authorities in response to **Scottish Planning Policy** (SPP). When considering an individual application the adopted development plan, relevant supplementary guidance, wind energy capacity studies and SPP provide the framework within which the application should be considered.

[1] Please send any comments and feedback to **brendan.turvey@snh.gov.uk**
[2] Note, a new version of this guidance is due out soon

1.10 The views expressed in this document are drawn from the experience of SNH staff who have advised on wind farm 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. The first version was published in December 2009. Since then it has been referred to extensively at Public Local Inquiries. Experience gained at Inquiry and decisions by Scottish Government Reporters have also influenced this revision.

Background

1.11 We strongly support the adoption of renewable energy technologies, including wind farms, to address the effects of climate change. We support the Scottish Government's adopted policy in SPP and the current target of generating the equivalent of 100% of our electricity from renewables by 2020. Wind farms have an important role to play in this, taking advantage of the excellent wind resource in Scotland.

1.12 Scotland is renowned for the diversity and quality of its landscapes and scenery. 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. Landscape is the basis for many of our social, community and cultural values.

1.13 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. Our **Landscape Policy Framework** recognises the importance of landscape to Scotland's natural heritage and people's lives, while acknowledging that this relationship will change as landscapes evolve.

1.14 Wind turbines are generally large structures with the potential to have significant landscape and visual impacts. The development of wind farms, 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. More wind farms will be needed to meet renewable energy targets and the challenge is to make sure these are sited and designed well in landscapes most suited to this form of development.

1.15 Wind farms should be sited and designed so that adverse effects on landscape and visual amenity are minimised and so that landscapes which are highly valued are given due protection. If wind farms are sited and designed well the capacity of our landscape to incorporate this type of development is maximised.

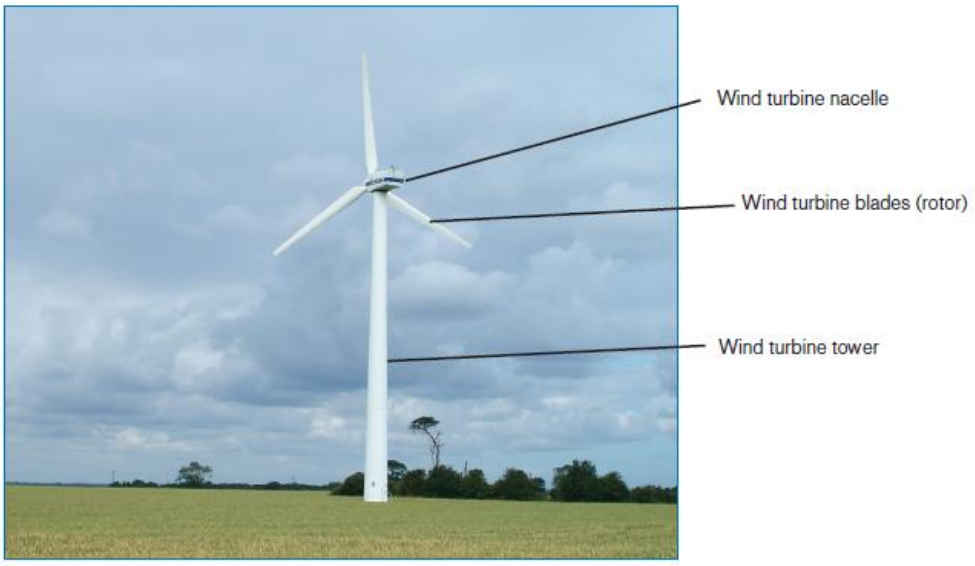
2. Wind Turbine Design and Layout

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

2.2 Impacts also result from infrastructure serving the development, such as access tracks and borrow pits, anemometers, control buildings, and substations (where necessary). Design and siting of this ancillary infrastructure are also considered in this section, as are impacts from the removal of woodland and forests.

Turbine form and design

2.3 A wind turbine comprises a tower that supports a nacelle which contains the electric generator and to which the turbine blades attach via a hub. Further guidance on wind turbines is available in the Scottish Government Planning Advice Note "***Onshore wind Turbines***".



2.4 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 appearances due to their different design and technical characteristics. There is a varied selection of turbine designs now available, especially in the lower height ranges. For further detail see the advice on turbines of between 15 and 50m in **annex 1**.

2.5 It can be difficult for wind turbine developers to specify the actual model of turbine to be used because market availability, costs, and turbine technology may 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 Landscape and Visual Impact Assessment (LVIA) and Environmental Impact Assessment

(EIA) should assess, as far as is possible, impacts of the model within the shortlist that represents the 'worst case scenario'.

2.6 Factors to consider when choosing the most appropriate model for a site include:

- overall height to blade tip, colour and individual design
- the proportion of blade length to tower height
- the turbine's dynamic impact, resulting from rotation of its blades (larger, slow moving blades will have a very different impact from shorter, faster moving blades which may give the impression of increased clutter)
- consistency with other existing and consented turbines in the vicinity
- the relative scale of the landscape and proximity of the viewer (larger blades in a relatively small scale and enclosed landscape may appear to completely dominate the scene).

The proportion of the tower to the blades should be considered as the visual effects can be quite different.

Turbine colour

2.7 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. Experience has shown that it is not possible to 'hide' turbines. There are a large number of variables which affect visibility of wind turbines. These include:

- the immediate landscape context and anticipated backcloth against which the turbines will be viewed predominantly (for example sky, heather moorland, woodland, sea horizon). Colour contrast is an important factor affecting visibility. Generally, the base of a turbine is seen against the land and the tower and moving blades seen against the sky, so colour choice will inevitably be a compromise between reducing contrast with the land or with the sky

- 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)

– seasonal variation in landscape colours

– the direction of main views and the nature of the viewpoint

– distance from the development. Colour is most apparent in close views, and in these situations turbines are most likely to be viewed against the sky

– the proposed design and layout of the wind farm; and other wind farms within the area.

2.8 Colour choice is therefore likely to be a judgement based on a clear design objective or objectives. Examples of design objectives may include:

- reduce visual impacts
- camouflage
- integrate with the landscape
- reinforce local identity
- reduce cumulative effects, or
- make a statement.

When dealing with a situation where a large number of variables exist, it is important to focus on one or two key design objectives.

2.9 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 as public perception studies have demonstrated that aesthetic unity is viewed more favourably. Graduated schemes, or turbines with colour variation, should be used with caution

– a light grey colour generally achieves the best balance between reducing visibility and visual impacts when seen against the sky, although this works less well when viewed against the land

- light coloured turbines seen against a land backdrop may have greater prominence than light or dark turbines 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 although variation from the standard light grey colour, using a darker grey, may be successful when the wind farm is backclothed from important viewpoints or receptors. The chosen turbine colour should respond to the character of the site and its setting

- there is more scope to vary the colour of smaller turbines, which are often located on lower ground than larger turbines, and therefore more often backclothed by land

– paint reflection should be minimised. Texture is an important factor in reducing reflectivity, and matt or light absorbent finishes are preferable

– for multiple wind farm groups or wind farm extensions, cumulative colour effects will be a key consideration. A strategic approach to turbine colour is desirable and the colour of turbines should generally be consistent

– precise colour tone and the degree of paint reflectivity should be specified at the application stage. Commercial implications may be a limitation to varying turbine colour on a commercial scale, including cost, availability, lead-in-time and weathering/fading

- colour may be subject to aviation restrictions or, for off-shore turbines, navigational requirements. For example it is a navigational safety requirement for the base of off-shore turbines to be coloured bright yellow for 25 metres above sea level.

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'

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

Pale grey 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

Turbine transformer colour

2.10 It is preferable to house wind turbine transformers within the turbine towers to minimise the number of elements and visual complexity of a wind farm. Where transformers are housed separately near the turbine bases, the colour of the housing requires careful consideration. This should be site specific, relating to the surrounding land cover, but not the wind turbines, as transformers are rarely viewed against the skyline. This reduces their visibility and ensures that they are seen as a separate element to the turbine. They are less likely to detract from the simplicity of the turbine's form if well located and coloured. Browns, khakis and 'earth' colours are generally the most successful colour choices for transformers, with greens often appearing too bright.

Poorly coloured external transformer units can detract from the relatively simple form of turbines and complicate the visual effect

Turbine lighting

2.11 In some locations it may be necessary to light wind turbines for reasons of civil or military aviation safety or, for offshore wind farms, marine safety. Such lighting, typically on the nacelle of the wind turbine, may appear prominent in night views, particularly in predominantly un-lit rural areas. Where lighting is necessary, it 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; by lighting a reduced number of turbines; or by using lighting systems which are triggered by the proximity of aircraft.

2.12 Developers should always refer to the National Air Traffic Services (**NATS**), Civil Aviation Authority (**CAA**) and Ministry of Defence (MoD) for current requirements. All turbines of greater than 150m to tip will require aviation lighting and, whilst the exact requirements may not be known at application stage, the potential effects should still be considered by the LVIA.

2.13 Lighting is predicted to become more widespread as sites are explored within flight paths and as larger turbines are considered. Current experience suggests that the main landscape and visual effects are likely to include:

- lighting being visible over a considerable distance. The lights on the Beatrice offshore turbines, off the Caithness coast, are visible in clear conditions at distances of over 20 kilometres
- movement of turbine blades will create different effects depending on where the viewer is in relation to the wind farm. If the turbine blades pass in front of the light, a flashing effect as they cut across the light can occur. If the blades pass behind the light, there can be a striped effect as the light runs up the passing blades. In both cases these effects draw the eye to the turbines
- certain situations where constantly flashing lights are required, especially offshore.

These effects are likely to be more significant in areas with less artificial lighting, including remoter rural locations, Wild Land Areas and dark sky sites where the absence of artificial lighting contributes to the feeling of remoteness or the direct appreciation of the night sky. Lit turbines may lessen the contrast between developed and undeveloped areas, e.g. when viewed from nearby settlements. Whilst it may be possible to mitigate these effects, they should still be considered in the assessment. Effects at dawn and dusk should also be considered where these could be significant.

Turbine size

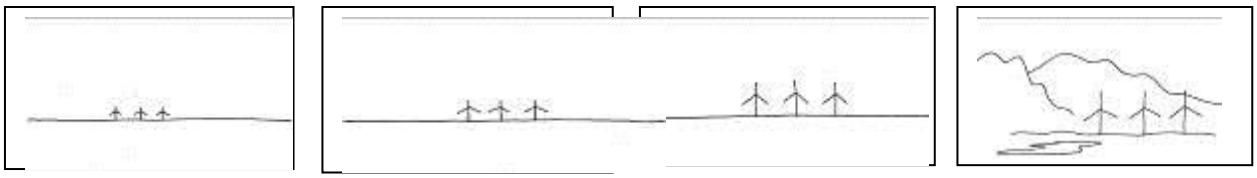
2.14 Wind energy technology has developed quickly, and significantly larger wind turbines are now available. Turbines typically consist of 60 – 100 metre high towers with blades of 40 metres or more, so their overall height to blade tip is between 100 – 140 metres, though larger turbines are available. Longer blades result in a greater rotor area and this, combined with the fact that they extend upwards into higher wind velocities, means that their wind capture and energy production is significantly larger than the smaller turbines. Since 2010, mainly as a result of the Feed in Tariff, slightly smaller turbines have been more readily available, measuring between 60-80 metres to blade tip. This provides greater flexibility in choosing a turbine appropriate to local landscape characteristics.

Wind turbine in commercial forestry of mixed age

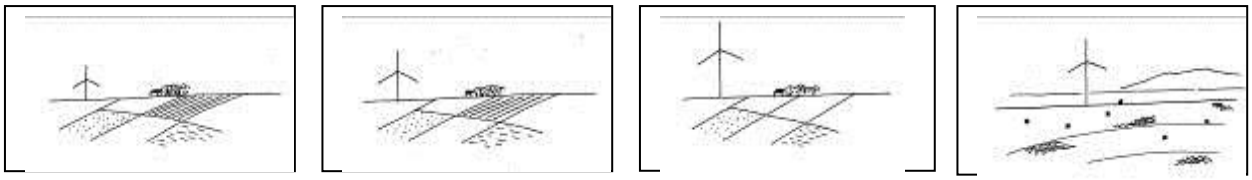
2.15 Choice of turbine size is an integral part of the design process. Identification of the key landscape characteristics, their sensitivity and capacity to accommodate change will inform this. Generally speaking, large wind turbines will appear out of scale and visually dominant in lowland, settled, or smaller-scale landscapes, which are often characterised by the relatively 'human scale' of buildings and features. They are best suited to more extensive, upland areas, and set back from more sensitive upland fringes. This can reduce effects on settled and smaller-scale valleys and lowland landscapes.

2.16 Turbine size is also a key issue in upland landscapes, where they are viewed against, or from, landscapes of a more intricate scale and pattern; or where it is otherwise difficult to discern the landscape scale and distance. By illustrating the scale of an upland landscape, wind turbines may seem to conflict with the expansive nature of these areas.

2.17 Wind farms in woodland or forestry raise issues related to turbine size (turbines are often increased in height to avoid turbulence) and the management of the woodland below the turbines. These require careful assessment and dialogue with Forestry Commission Scotland (FCS). In some cases larger turbines may be appropriate. In others, it may be preferable to manage the woodland resource to allow smaller turbines without a reduction in energy output.



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 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 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 but seem 'elevated' above it, by appearing to relate to larger components.

2.18 People's experience of different landscapes varies greatly, so it is not appropriate to provide generic guidelines on the turbine sizes to be used for particular landscape types. Site-specific assessment and design is essential for each development proposal.

Buildings can act as a relative scale indicator in the landscape and by visual comparison can accentuate the larger scale of the wind turbines

Turbine scale

2.19 The scale of a feature – such as a wind turbine – is relative to the object it is being compared to, such as a person, building or tree. In an open and extensive large scale landscape a wind turbine may appear a relatively small scale feature. Adjacent to a large building, such as a power station, the turbine may appear a relatively medium scale feature. Conversely, within an enclosed intimate landscape the turbine will appear a large scale feature, dwarfing its surrounds. The comparison of the size of features helps people appreciate the height of a wind turbine, particularly where it is near to a known structure.

Ancillary infrastructure

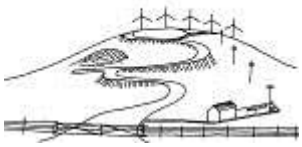
2.20 Ancillary elements for a wind farm development should be designed so they relate to the key characteristics of a landscape. It is important that these elements do not confuse the simplicity of the wind farm design, or act as a scale indicator for the turbines themselves. Undergrounding power lines within the wind farm, using transformers contained within tower bases (where possible), and careful siting of substations, transmission lines, access tracks, control buildings and anemometer masts will all help to achieve a coherent wind farm design. Simplicity of appearance and use of local, high quality materials will further enhance this. Woodland planting can sometimes be used to screen infrastructure, whilst contributing to biodiversity and woodland enhancement objectives.

2.21 Forest felling, restructuring and management should also be considered as part of the LVIA, including changes to landscape character, requirements for additional infrastructure and timber transport.

2.22 Other forms of energy generation (for example solar arrays) and storage (for example battery systems or pumped hydro) are increasingly being proposed on or adjacent to wind farms. The impacts of this additional infrastructure should be assessed, and considered in the design process, as should the benefits of co-locating these with the wind farm. In most cases, impacts of co-located energy generation / storage systems are likely to be limited compared to the overall landscape and visual impacts caused by the wind farm. However, in all cases additional infrastructure should be designed and located to minimise impacts, especially if they include significant structures (such as a new dam) or are likely to add to the 'clutter' of the landscape. For example, it may be beneficial for energy storage facilities to be located within or near to existing control buildings, and solar arrays should be sited to minimise the effects from key viewpoints.

Wind turbines can create an over-complex visual image in association with transmission lines and other infrastructure

Wind farm creates simple image in the landscape



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

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

2.24 Detailed advice on the siting and design of tracks can be found in **Constructed tracks in the Scottish Uplands**.

Considerable road widening may be required to facilitate turbine access and removal of site materials such as tree harvesting. These effects should be considered by the LVIA.

Turbine layout / array

2.25 In a wind farm, turbines can be arranged in many different layouts. The layout 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 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 wind farm, 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 technical separation distances.

2.26 From this starting point turbines will 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 some 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.

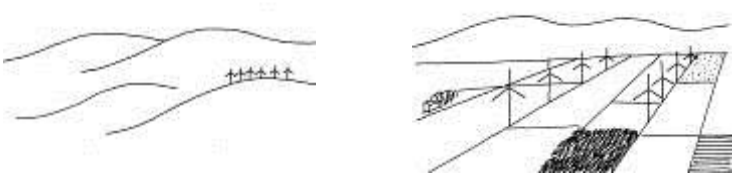
2.27 There are several common types of layout divided into regular or irregular formats. Generally, the fewer turbines and the simpler the layout on an even landform, the easier it is to create a positive feature - visually balanced, simple and consistent in image. This is most easily achieved by a simple line upon level ground. As soon as there is deviation from this, the design becomes more complicated.

2.28 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 you move through the landscape and see it from different directions and elevations, views of the grid change and reveal a variable effect, seemingly ordered along some rows, but in others overlapping. In addition, the rationale of the position of turbines can appear confused if they are at different elevations.

2.29 Irregular layouts can be more appropriate in landscapes of variable elevation and pattern. However, irregular forms pose a greater challenge in terms of achieving 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 negative effects such as uneven visual densities of wind turbines, overlapping turbine rotors (often termed 'stacking'), partial screening behind a skyline and turbine outliers separate from the main group.

2.30 Wind farms should relate to underlying landscape characteristics of a similar scale and/or prominence. Wind turbines can be accommodated in areas of complex pattern, provided that their siting and design does not dominate the elements which define this. Odd numbers of turbines often present a more balanced composition than even numbers.

2.31 The design of offshore wind farms, with the greatest number of turbines in formal grid layouts, can lead to distinctive visual effects. From one part of the coast offshore turbines will be seen clearly in rows with the sea horizon visible between them, but by moving along the coast the design can appear more confused, with the turbines appearing as a constant mass on the horizon. It will be important to consider these design effects during project development and appraise the wind farm's image from sensitive receptors.



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

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 wind farm can be designed to relate to the broad scale landform

Micrositing

2.32 Micrositing is the siting of wind turbines in small incremental distances and is used at two main stages of wind farm 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.

2.33 Developers should seek to minimise the need for micrositing during the construction phase by conducting thorough site investigation during the design process. Micrositing is usually covered by a planning condition which limits this to 50-100m from the consented turbine location.

2.34 Micrositing during construction can have a significant effect on the appearance of a wind farm, 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.

Regular layouts require careful assessment from key viewpoints and care is required during micrositing

2.35 Where there is a clear need to maintain turbine layout in accordance with submitted plans, 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 wind farm's relationship with surrounding topography.

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

2.37 Turbines can often be microsited to maximise the opportunity for screening by woodland. However, woodland cannot be relied upon to provide permanent screening and management plans may be required to ensure the continuation of screening from key viewpoints.

3. Wind farm Siting and Design

3.1 This section applies the design principles outlined in Section 2 to landscape and visual effects. Experience has shown that the application of these principles will reduce the overall landscape and visual impacts of a wind farm.

3.2 Reference is made to the categories of wind farm size listed below. This grouping is for the sake of simplification: landscape and visual impacts are not directly proportional to wind turbine numbers. Turbine height is also an important consideration in design.

Wind farm size	Number of turbines
Small	1-3
Medium	3-20
Large	20-50
Very Large	50+

Landscape character

3.3 The first step in the Landscape Impact Assessment (LIA) is to assess the landscape character of the study area and to identify the key characteristics relevant to wind farm 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 'sense of place'. Understanding a landscape's key characteristics and features is vital in considering how new development would affect it or, with appropriate design, could contribute to it.

3.4 Landscape Character Assessment (LCA) helps us 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 does not undermine whatever is characteristic or valued about a particular landscape, and that ways of improving the character can be considered.

3.5 At a regional scale, **our Landscape Character Assessments** inform this assessment. Our national programme of LCA comprises 27 studies and an overview report. These LCAs describe landscape character across the country, and also identified the main forces for change in these landscapes. 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 wind farm development. We are currently working on refreshing the LCA suite, in order to bring the individual reports into a single digital database of landscape character types in 2017.

3.6 LIA should also include a more detailed assessment of local landscape characteristics and how they are experienced in relation to the specific proposal. Areas of transition between landscape character types are often particularly sensitive, such as the change from a lowland strath to upland foothills or scarp slopes. LIAs should include an assessment of the extent and distribution of predicted visibility within all relevant character areas.

Landscape and scenic value

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

3.8 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. 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 Special Landscape Areas (SLA) and Areas of Great Landscape Value (AGLV), World Heritage Sites and Conservation Areas. In many areas, wind farm development is located outwith but close to these designations. In these circumstances the effects on the designated landscape remain a key consideration.

3.9 Designations are usually supported by legislation and / or specific planning policies at a national and local level. The lack of any designation does not imply that a landscape has no value. Some landscapes are strongly valued in cultural heritage terms, for example, while others may be valued for their perceived lack of human influence. In line with the **European Landscape Convention** we promote an 'all-landscapes approach', founded on the recognition that all landscapes are important.

3.10 The challenge is to ascertain why a landscape is valued and by whom, and then assess the predicted impacts of the proposed development on these values. The quality of a valued landscape is often set out in a citation or description. NSAs for example are described in '**Scotland's Scenic Heritage'** and our series of **Special Qualities reports**.

3.11 The key test applied in relation to NSAs, but often employed for other valued landscapes too, is whether impacts would affect the *integrity* of a valued landscape. It is important to consider the effects of wind farms located just outside areas identified for their scenic quality, as these have the potential to affect the designation, and potentially its integrity.

3.12 For local landscape designations, relevant information is contained within Development Plans. Where Planning Authorities have undertaken recent reviews of their local landscape designations, there may be Statements of Significance which can be referred to. However, for some valued areas, this information may not be available and the LVIA needs to first establish the quality of the valued landscape through assessment of the baseline conditions and how people use and benefit from the landscape (for example through consultation, visitor information and user websites).

Wild land

3.13 The map of **Wild Land Areas** (WLAs) was published in 2014. The **National Planning Framework** recognises these WLAs as a nationally important asset and requires them to be taken into account as set out in Scottish Planning Policy. SPP reflects that areas of wild land character are very sensitive to any form of intrusive human activity and have little or no capacity to accept new development. They are categorised as 'Areas of Significant Protection' for the purposes of spatial frameworks for onshore wind, though paragraph 215 in SPP states that development may be appropriate in some circumstances. Any development within them is required to demonstrate that any significant effects on their qualities can be substantially overcome by siting, design or other mitigation. A wind farm out with a Wild Land Area may still have an effect on its qualities.

3.14 Proposals likely to affect a Wild Land Area merit careful consideration. Our **draft technical guidance** sets out a method for assessing effects. In addition, **short descriptions** of each of the Wild Land Areas to aid understanding of their key qualities are available. Wind farms will

generally be out of character in these areas, and the scope for mitigating impacts is limited. Potential mitigation may include limiting visibility of the proposal through careful siting and design and reducing the height and/or number of turbines. Careful consideration will be required of not just the turbines, but also the associated infrastructure.

3.15 Where there are isolated, built features in wild land areas, such as bothies, shepherds' cottages, or shooting lodges, small wind turbines could be located near to these structures. Care is still required to ensure that wild land qualities would not be significantly adversely affected.

Experiencing wind farms in the landscape

3.16 People's responses to wind farms vary – to some a wind farm may seem to dominate its surroundings, while others may view it as an exciting, modern addition with symbolic associations with clean energy and sustainability. Our understanding of people's responses to wind farm development is informed by a number of public attitude studies. **UK-wide research** has shown that two thirds of adults are in favour of wind power, although this varies regionally and between social groups.

3.17 The impact of a wind farm will depend on how, and from 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 the sensitivity of the landscape and visual resource, and the people that will be affected by the development (receptors). LVIA includes assessment of impacts upon the key users of the landscape, including residents, motorists, workers, those partaking in recreation and tourists.

3.18 A wind farm's impacts on local residents requires particular attention as, unlike visitors, they will experience a wind farm from different locations, at different times of the day, usually for longer periods of time, and in different seasons. 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 often to enjoy their surroundings.

3.19 It is important to take account of how a wind farm will be experienced from surrounding roads, transport, and recreational routes. Views will vary depending on proximity to the road, the mode of transport, the angle of view, and intervening landscape features. The first glimpse of a wind farm is important, and careful consideration should be given to the design of the wind farm layout in relation to these views.

3.20 As larger numbers of wind farms are built it has become increasingly important to consider their cumulative effects and the context in which they are seen. Of particular importance are: how developments relate to each other in design and relationship to their surroundings; 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 assessing these aspects can be found in our '**Cumulative Effect of Wind Farms'** guidance, which is currently being updated.

3.21 The visibility and visual impacts of a wind farm are affected by the distance from which it is viewed, as well as other aspects such as weather conditions, siting and its context. In the past, several guidance notes offered generic categories of degrees of visibility and visual impact related to distance. This is no longer considered helpful as there is now such variation in turbine size and design. Wind turbines of between 100 – 150m can be visible at distances of up to 40 or 50km in some conditions; whilst single turbines of up to 50m are only visible at smaller distances. The design and assessment need to consider the likely visibility of an individual application in detail.

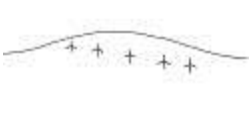
Views from above the wind farm should be considered if there are sensitive recreational viewpoints

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

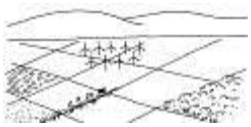
3.22 It is important to site and design a wind farm so that it relates directly to the qualities of a specific site. The rest of this section looks at relevant landscape aspects in more detail. Overall, the main design elements are likely to include the following:

- layout and number of wind turbines
- size, design, and proportion of wind turbines
- type, route and design of access tracks, including the amount of cut and fill required and the junctions with public roads
- location, design and restoration of hardstandings
- location, design and restoration of 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 (including woodland removal, felling and restocking), fences and stock grazing.

Line of wind turbines relates to regular geometric landscape pattern



Line of wind turbines appears unrelated to landscape features across open hill



Cluster of wind turbines conflicts with the organised geometric landscape pattern

Landform

3.23 Landform is a key landscape characteristic, whether it is rugged, flat, undulating or rolling, upland or lowland. In flat landscapes, any undulations tend to become accentuated so that even low hills appear substantial.

3.24 It is very difficult to design a wind farm upon a variable landform, such as undulating, rugged 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

most level part of a site so the development appears more cohesive, rather than as a poorly related group of turbines.

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

3.25 It is important to site and design a wind farm 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 wind farm do not seem to overwhelm the distinctive character and scale of a landform, especially prominent landforms. Single turbines are particularly challenging to site as they are often the only major vertical forms in the landscape.

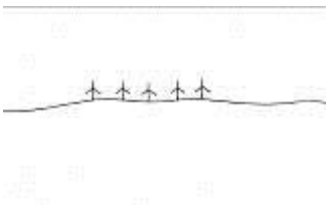
3.26 Skylines are of critical importance. This is illustrated by the contrast between the simple, horizontal skylines of wide, flat landscapes and the more complex, vertical and diagonal components of skylines formed by mountains and hills. The viewer's eye is naturally drawn to the skyline, although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

3.27 Given the prominence of skylines, it is particularly important that a wind farm avoids these, or is sited and designed to relate to them. A key challenge is that the skyline will vary in relation to the position and elevation of a viewer. Nevertheless, the design of a wind farm from key viewpoints and routes should ensure it does not detract from the character of a distinctive skyline.

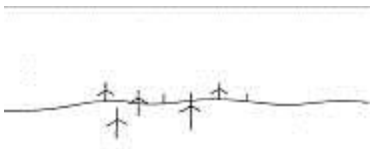
3.28 Care should be taken to ensure that the wind farm does not overwhelm the skyline. Distinctive and prominent skylines should not be interrupted by turbines. If the skyline is 'simple' in nature, for example over moorland and hills, it is important that wind turbines possess a simple visual relationship to this feature, avoiding variable height and spacing, the overlapping of turbines, or blade tips intermittently 'breaking' the skyline.

The relationship between a wind farm and more distant skylines should be considered, particularly in open landscapes where long distance views are important

3.29 The landform may provide a design opportunity to limit visibility of wind turbines and site infrastructure. For example, where a wind farm is to be sited on a hill ridge, turbines may be set back from the edge and placed to limit visibility from below, reducing visual intrusion on the more settled lowlands. Narrow bands of uplands between settled and smaller-scale valleys should be avoided, if a windfarm on the hills would dominate the landscape on both sides.

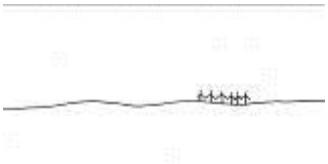


Wind farm relates simply to skyline



Wind farm interrupts the simplicity of the skyline

Wind farm appears to interrupt and dominate the visible extent of the skyline



Wind farm related to local landform appears as discrete feature on the skyline

Landscape scale

3.30 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.

3.31 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 wind farm development, both horizontally and vertically.

3.32 A key design objective will be finding an appropriate scale for the wind farm that is in keeping with that of the landscape. The wind farm should be:

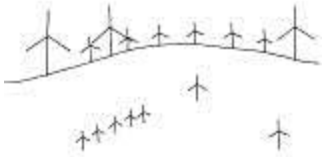
- of minor vertical scale in relation to the other key features of the landscape
- of minor horizontal scale in relation to the key features of the landscape (where the wind farm is surrounded by a much larger proportion of open space than occupied by the development)
- of minor size compared to other key features and foci within the landscape; or separated from these by a sufficiently large area of open space[3] (either horizontally or vertically) so that direct scale comparison does not occur.

Perspective

3.33 Scale indicators within a landscape affect our judgement of 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 as they are of undefined size, yet often 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 wind farms, and between wind farms, 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. Further guidance for small turbines is provided in **annex 1**.

In a simple rolling, open landscape with an absence of known elements, the relative scale, distance from the viewer and size of the wind turbines are difficult to discern

Visual link between wind farm 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

3.34 Land use is an important 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 through 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.

3.35 Wind energy generation may form one part of many different land uses. Existing developments vary in their location from urban areas, industrial and harbour areas, agricultural ground, woodland, and moorland. Wind energy can relate to some land uses, but wind farms are less likely to relate well to wild land areas and sensitive residential locations. A key design objective is to relate directly to the specific characteristics of the land use; or to appear separate and removed from these, avoiding conflicts in nature and function.

[3] Open space does not imply the removal of, or absence of, woodland. Blocks of woodland or forestry may help to define the scale of a wind farm and the local pattern of development.

This wind farm relates well to neighbouring land use and maintains the distinction between agricultural, forestry and upland character

3.36 Where appropriate, the development of a wind farm can act as the stimulus for restoration and/or improvement of land use within or around the site. For example the removal of commercial forestry can lead to new uses such as grazing, heathland or peatland. It may also lead to the creation of new woodland habitats in and around the wind farm, improving the recreational and biodiversity value of the site. Paragraphs 3.54 – 3.64, on woodland, provide more detail on these aspects.

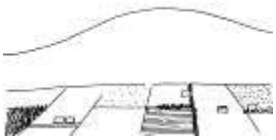
Landscape and visual pattern

3.37 Landscape and visual pattern are created through the presence and arrangement of key landscape elements and features. They are strongly influenced by land use. They arise from the way in which features in an area interact, be they a network of drystane dykes, hedgerows, shelter-belts, individual trees and woodlands, drainage channels, the distribution of drumlins along a valley, or repeated rock formations.

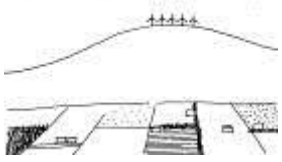
3.38 Wind energy developments should be designed to relate to landscape pattern where this contributes to landscape character and visual composition. However, the elements of landscape pattern to which a wind farm should relate can be strongly affected by the relative scale and prominence of the development.

3.39 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 wind farm neither compromises the simplicity of the backcloth hills, nor the hierarchy or pattern of the lowland landscape below.

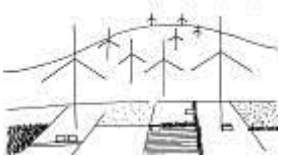
Lowland settings often have more complex landscape patterns



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



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



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

Focal features

3.40 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 / wind farms. 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.

3.41 Wind farms, because of their very nature and typical location within open landscapes, often become major focal points. Their interaction with the existing hierarchy of foci needs to be considered in their siting and design, in order to minimise visual conflicts or avoid compromising the value of existing foci.

Existing focal points within landscape

Wind farm reduces focal prominence and distinction of original foci

Wind farm 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

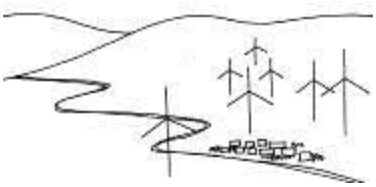
3.42 Settlements and buildings within a landscape tend to be sensitive to the development of a wind farm for three main reasons:

- by being places from which people will view a wind farm and within which a key quality may be the provision of shelter and a sense of refuge that may seem impinged upon by the movement and proximity of a wind turbine
- because buildings act as a size indicator in views that may emphasise the much greater scale of wind turbines in comparison; and
- because the settlement itself often forms a focal feature / landscape pattern to which a development would need to relate.

3.43 It is important that wind farms do not dominate or negatively affect settlements. The threshold for this effect will vary in different landscapes, for different settlements and with different wind farm and wind turbine designs.

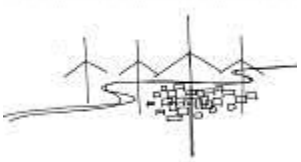
3.44 Individual domestic-scale turbines can be located nearer to buildings for small-scale industry, agriculture or for residential use. These may be relatively noticeable due to the faster blade rotation of smaller machines. Further guidance on smaller turbines is provided in annex 1.

3.45 There may be some locations where larger wind turbines can be accommodated near to or within urban and industrial locations. Key issues to address in these situations will be residential amenity, noise and shadow flicker. In these settings, large wind turbines can appear most appropriate where they are separated slightly from buildings; are seen set back against an area of visual simplicity; or are marginal to the urban/industrial area.

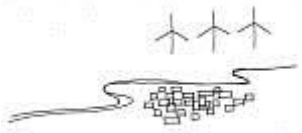


Wind farm appears to impinge upon neighbouring settlement

Wind farm separated from settlement by open space



Wind farm impinges upon space and views of adjacent settlement



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

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

3.46 The aim should be to minimise the sense of imposition upon buildings and more intimate spaces. This may be achieved by setting the turbines 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 residences and recreational areas.

3.47 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.

3.48 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.

Wind turbines can fit well in an urban / industrial context but the scale of the turbine must relate to local landscape features and buildings

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

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

Coast

3.50 Scotland has a great diversity of coastal landscapes and onshore wind farms near to the coast require careful consideration. Many coasts are remote, isolated and undeveloped. They range from low-lying beaches with dunes to craggy intricate cliffs and headlands. An **assessment undertaken for SNH** characterises the coastline of Scotland into 33 units at the national scale. Recent work, linked to landscape character assessment, sets out how to assess coastal character. Guidance on Coastal Character Assessment is due to be published in spring 2017.

3.51 Wind farms, both on- and off-shore, should relate to the sense of openness and exposure within coastal areas. However, as Scotland's settlement pattern has a strong coastal focus, and views are typically drawn to the coast, these areas will be sensitive to wind farm location and design. These considerations relate to the inland and offshore land/seascape character and views, including views from boats and ferries. Simple, open, less settled, flat coastal areas can better accommodate wind farms than complex coastal landscapes, such as those with inlets and islands. Industrial or port areas may be considered more suitable than less developed coasts.

3.52 Due to the focus of views along coastlines and the typical concentration of settlements within these areas, a wind farm located near the coast will tend to create a new focal feature or landmark. For this reason, it is important that they do not detract from existing landmarks like historical or navigational features (such as lighthouses), distinctive coastal landforms, coastal settlements and areas valued for recreation.

3.53 Cumulative impacts can occur between onshore and offshore wind energy developments. From inland areas it may not be apparent that a wind farm is situated offshore if its location within the sea is screened by inland features. In turn, onshore developments may affect how those offshore are perceived. It may, for example, be undesirable to view off-shore development with onshore development in the foreground. Further guidance can be found in **'Offshore Renewables – guidance on assessing the impact on coastal landscape and seascape'**.

Woodland

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

3.55 Woodland management can create positive opportunities to improve local landscape characteristics. The wind farm LVIA should be linked to the woodland management plan (if one is required) to ensure that maximum benefits are derived from restructuring and restocking. The **Forests and landscape guidance** should be referred to early in the design process.

3.56 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 are less permanent features of the landscape. For this reason 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 wind farm should relate.

3.57 If a wind farm 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 wind farm from distant views. Equally, well managed restructuring could lead to landscape benefits and these should be considered in a well thought out woodland management plan.

3.58 Woodlands and forests have the capacity to spatially define a landscape: they change over time, reflecting species pattern, seasonal changes and those as a consequence of the chosen management system. All of Scotland's woodlands are to be managed sustainably to the requirements of the **UK Forestry Standard** and to deliver the aspirations of the Scottish Government's **Scottish Forestry Strategy**.

3.59 Options that incorporate a wind farm into an existing forest are preferred. In a relatively large scale open landscape, where wind turbines can be seen from a distance in combination with woodland, the large size of the turbines can be difficult to discern. In a relatively small scale landscape, however, where the turbines are sited adjacent to, or key-holed within, a woodland and are at close proximity to the viewer, the known height of the trees act as a scale indicator, accentuating the perception of the large size of the wind turbines.

3.60 Woodland can screen a wind farm from view but this is only likely if the trees are within the foreground of views between the viewer and the wind turbines. It should be appreciated, however, that this screening effect may change or be lost as the viewer moves through the landscape to more open and higher ground. The management regime of the woodland will also determine for how long and how effective the screening will be. For example, some forests can be planted and clear-felled in a felling coupe system on a 40-50 year cycle, whereas woodlands managed under a continuous cover system can sustain a degree of cover indefinitely.

3.61 The UK **Forestry Standard Forests and Landscape Guidelines** promotes best practice in terms of achieving the design of a forest that associates well with local landscape character and reflects the underlying pattern of the landscape. When incorporating a wind farm into an afforested landscape a wind farm designer should have an appreciation of both the forest as it currently relates to the surrounding landscape and any future management plans, including felling and restocking proposals, that are intended to restructure the forest for all the benefits it can provide, including improving its association with the local landscape.

Wind turbines key-holed in commercial forestry

3.62 If a wind farm is being proposed within and/or immediately adjacent to an existing forest, the designer should consider how that development can be best integrated with the spatial pattern the forest currently contributes as a key characteristic of the local landscape. Should the installation of the wind farm and associated infrastructure require the removal of and/or felling and restocking of forest areas, their design should make a positive contribution towards the entire forest restructuring process. In particular, the removal of the trees in these areas should be designed to ensure the integrity of the overall spatial pattern of the forest and its contribution towards the character of the local landscape remains intact.

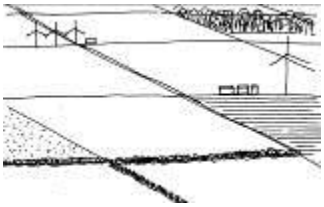
3.63 The principles and process of forest landscape design are outlined in the Forestry Commission Practice Guide **Design Techniques for Forest Management Planning**.

Wind farm with a mix of key holing and clear fell

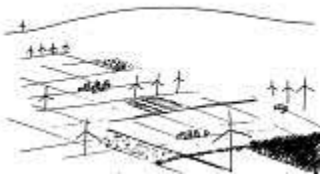
3.64 Where forestry removal is planned, the **control of woodland removal policy** should be referred to. The policy's principal aims are to provide a strategic framework for appropriate woodland removal and to support the maintenance and expansion of forest cover in Scotland. To further the policy's strong presumption in favour of protecting Scotland's woodland resources, design approaches which reduce the scale of felling required to facilitate the development should be considered and integration of the development with the existing woodland structure is a key part of the consenting process. On-site and off-site compensatory planting, for any areas of the forest that are cleared of trees, should be designed to positively contribute to local landscape character and achieve the requirements of the UK Forestry Standard.

Small / Community Wind farms

3.65 Small-scale community owned wind farms can make a very positive contribution to rural economic development. However, single turbines or small wind farms 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 the local economy, the ownership of a development does not mitigate landscape and visual impacts. All wind farm development should be carefully designed and consistently assessed through LVIA (albeit scoped to fit the scale and nature of the development), including cumulative effects. Further guidance on small scale wind energy is provided in annex 1.



Single and small wind farms 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 'wind farm landscape'

4. Designing in landscapes with multiple wind farms

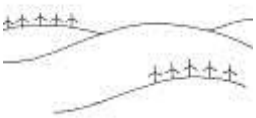
4.1 The previous section highlighted the factors to be considered when designing individual wind farms. In many parts of Scotland the issue is how best to plan for and accommodate multiple wind farms. Many current proposals either form extensions to operational wind farms or are close to operational wind farms. 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 wind farms tends to be based on constantly changing baseline conditions.

4.2 Cumulative impacts occur when one wind farm is proposed in the vicinity of another existing or proposed wind farm. We have published guidance on assessing the **Cumulative Effects of Wind Farms** which sets out when and how cumulative effects should be considered. This section contains design guidance to be used in circumstances where cumulative effects are expected to arise.

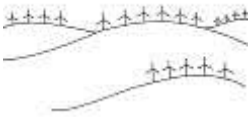
4.3 As part of the design process where other wind farms exist or are proposed, it will be important to undertake an assessment at a strategic level of the potential cumulative landscape and visual impacts. The impact of smaller wind farms, and in some cases individual turbines, will also require consideration. The methodologies contained in the Cumulative Effects of Wind farms guidance should be helpful, as may Topic Paper 6 'Techniques and criteria for judging capacity and sensitivity' (Natural England, 2004)[4]. Updated guidance on this topic is being considered.

4.4 When designing an individual wind farm key design objectives should be developed as discussed in section 3. Where cumulative impacts are likely to occur within an area it is important to establish design objectives that can be consistently applied to all proposed developments. This should result in a similarity of design and wind farm image within an area that limits visual confusion, and reinforces the appropriateness of each development for its location. Cumulative design objectives should relate to ancillary infrastructure as well as wind turbines.

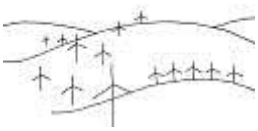
Individual wind farm relates directly to landform characteristic as single line upon horizon



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



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

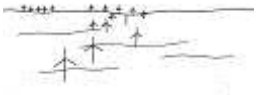


Additional wind farms contrast in pattern, scale and relationship to key characteristics, creating a confusing image and questioning relationship of original development to its surroundings.

[4] Note, this is currently under review.

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.

Wind farm 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.

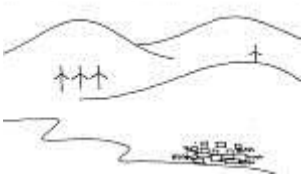


Additional development results cumulatively in major proportion of skyline being occupied by wind farms. In addition, its siting and shape does not relate to the skyline feature, nor horizontal emphasis.

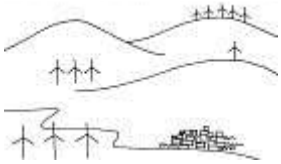
Wind farms cumulatively dominate the skyline feature, although they relate to its horizontal emphasis and simplicity of line.

4.5 The development of multiple wind farms can create different types of cumulative effect if they:

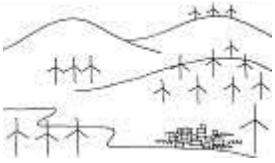
- are seen as separate isolated features within the landscape character type, too infrequent and of insufficient significance to be perceived as a characteristic of the area
- are seen as a key characteristic of the landscape, but not of sufficient dominance to be a defining characteristic of the area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



Separate isolated features

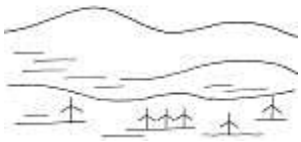


Wind farms become key characteristic of the landscape

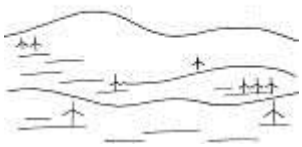


Wind farms become dominant characteristic of the area, creating a 'windfarm landscape'

4.6 These effects can occur at varying scales, for example affecting a local character type, or at a regional level. The appropriateness of these different effects will depend on the character and value of a landscape and the objectives for change as defined in Local Authorities' capacity studies.



Dominance of landscape character by wind farms 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

Relating to landscape character

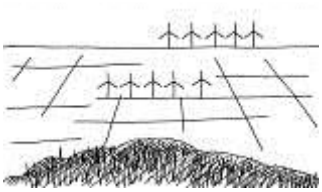
4.7 If wind farm development, or the visibility of wind farms, extends over several different landscape character areas or types, this can reduce the distinction between them. If wind farms already exist within a particular landscape character area or type, and it is appropriate to encourage further development, further wind farms 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.

4.8 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. The edges of character types or areas are generally more sensitive to development, as these occur where landscapes are more varied.

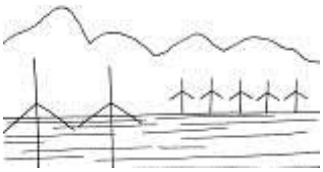
Distinct combination of contrasting character types – open hill, settlement and firth

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

Wind farms cross different character types, reducing the distinction between these.



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



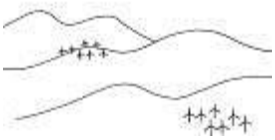
From alternative viewpoint, looking over agricultural ground, visibility of wind turbines is highlighted by backcloth. The turbines also compete with the visual prominence of the hill range.

Establishing new patterns

4.9 The opportunity to introduce a new landscape pattern through consistent design of turbine arrays will be important where a 'wind farm landscape' would be established. Existing landscape scale and pattern should be respected. Where a new pattern is proposed it will be important to identify key design prompts or cues within the landscape (which may be existing wind farms) and work with these. Consideration needs to be given to how the new pattern would relate to any existing neighbouring wind farms, and adjacent landscape character.

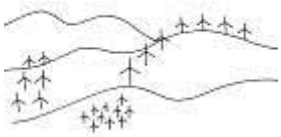
Relationship between wind farms

4.10 Where two or more wind farm proposals entering the planning system in parallel have the potential for landscape and visual effects in combination with existing or consented wind farms, this should be a material consideration in the planning process.

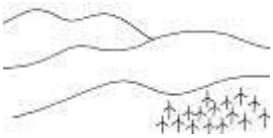


Distinct wind farm groups. Similarity of design and relationship to the landscape. With large areas of open space in between, character of underlying landscape prevails.

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



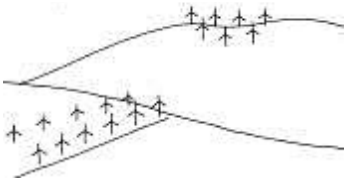
Although no clear area of space between wind farm groups, distinction highlighted due to contrasts of turbine scale and layout (variety of development type creates visual complexity).



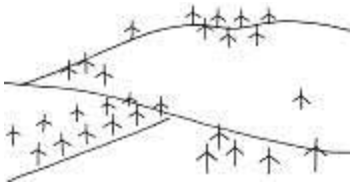
Extension to original development creates larger single wind farm. This has increased impacts in the local area, but limits the extent of impacts through the wider landscape.

4.11 A key factor determining the cumulative impact of wind farms is the distinct identity of each group. This relates to their degree of separation and similarity of design. This applies whether they are part of a single development, a wind farm extension, or a separate wind farm in a wider group. A wind farm, if located close to another 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, if a landscape is unable to accommodate the scale of a combined development, wind farm groups should appear clearly separate. It is important to achieve a balance between wind farms and the undeveloped open landscape retained between them. Adequate separation will help to maintain wind farms as distinct entities. The separation distance required will vary according to the landscape characteristics.

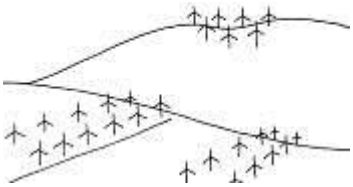
4.12 In some locations the existing pattern of wind farm development may be complex. Relating further development to a complex pattern will be challenging, but the same key principles should apply, focusing on improving the overall pattern and character of development rather than exacerbating existing conflicts between designs. Ancillary infrastructure, such as tracks, road upgrades, crane pads, fences, borrow pits and substations should be included in this assessment, as they may also cumulatively affect the character of the area.



Existing wind farm developments of contrasting design and relationship to the landscape.



Additional wind farm designs amplifies adverse cumulative impacts



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

4.13 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

4.14 As multiple wind farms 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

4.15 Care should be taken to avoid multiple wind farms dominating the landscape surroundings of a settlement. Wind farms 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 wind farms in succession), or are physically too close. How a 'wind farm landscape' relates to a settlement will depend on the design of the wind farms and their spatial relationships with each other, and how the settlement relates to its hinterland.

Wind farm extensions

4.16 Proposals for extensions to existing wind farms can give rise to similar issues of consistency as those arising from adjacent wind farm developments, and similar design principles should apply. Design objectives and principles should echo those of the original wind farm. Extensions should use turbines which are compatible with those in the existing wind farm, including aspects of scale, form, colour, and rotation speed. Generally, the design rationale of the original wind farm development should not be eroded.

4.17 Such compatibility issues will be more important the closer the wind farms are. Extensions should not compromise the landscape context of neighbouring wind farms and should respect existing focal points in the landscape. The potential for a wind farm extension to 'outlive' the existing wind farm (if this is decommissioned), and therefore stand on its own, should also be considered in the design process, and through assessment.

The turbines used in wind farm extensions should closely match the existing turbines, such as in this example (original turbines in foreground, new turbines in background)

5. Landscape and Visual Assessment of Wind Farms

What is Landscape and Visual Impact Assessment?

5.1 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 (3rd Edition, 2013).

5.2 LVIA follows an iterative process by which alternative sites and designs for a development are assessed and amended (a process often referred to as mitigation). Through this, 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. The preceding sections include specific points on assessment of wind farm landscape and visual effects.

5.3 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 impartial understanding of the predicted effects of wind farm proposals.

Context for Landscape and Visual Impact Assessment

5.4 LVIA is a standard process of assessment that may be presented as a separate report, or form part of an Environmental Statement (ES). While a LVIA will usually be required for every wind farm proposal, an EIA is only a statutory requirement for wind energy proposals where the proposal is likely to have significant effects on the environment. **The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011** set out when EIA may be required for wind farms.

Landscape and visual impacts of Wind Farms

5.5 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. This includes a consideration of the effects on landscape designations. 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.

5.6 Early in the LVIA process it should 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 wind farm will be if it is sited and designed in different ways. The main design aim should be to create a wind farm that relates well to the landscape. Changing technologies and sizes of wind farms may influence the specific aspects to be assessed; for example, larger turbines currently require lighting and this would form part of the LVIA when relevant.

5.7 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 wind farms will also be a consideration, and guidance can be found in ***Assessing the Cumulative Impact of Onshore Wind Energy Developments***.

Design Statements

5.8 Design Statements help communicate the issues, constraints and decision making processes behind a design. A design statement need not be a lengthy or complex document and diagrams can be used to summarise the design process. They are a valuable way for designers to explain why a particular layout or appearance has been chosen to consultation bodies, Local Authorities and the public, and their preparation is encouraged. They should examine design permutations based on the number and arrangement of turbines tested against key viewpoints and turbine height, where this could reduce landscape and visual effects. Further guidance on producing design statements is provided in **PAN 68**.

5.9 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 wind farm extension, amendment of the type of wind turbines, or for another wind farm nearby. Design objectives can help to:

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

Presentation of information within landscape and visual impact assessment

5.10 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, and as an aide-memoire
- provide computer generated Zone of Theoretical Visibility maps (ZTVs) to show the area from which a proposal may be visible
- 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
- illustrate key concepts and design principles using line drawings and diagrams.

5.11 When used on site, these illustrative tools are typically sufficient to make judgements of predicted landscape and visual impact for the LVIA. Computer generated simulations, fly-throughs and video-montage may also be useful. Further guidance on the selection, production methods and use of illustrative techniques is available in **Visual Representation of Wind farms** (2014).

Small wind farms and the need for assessment

5.12 In addition to large wind farm developments there has been a recent increase of interest (driven mainly by the Feed in Tariff) in single turbines and small groups of turbines. This is particularly evident in lowland settings, where schemes typically include 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 Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011**. It is for the Planning Authority to decide whether they are likely to have significant environmental effects and therefore require an Environmental Impact Assessment (EIA).

5.13 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. Our guidance on '***Assessing the impact of small-scale wind energy proposals on the natural heritage***' provides advice on the level of landscape and visual assessment likely to be appropriate for different scales of turbines. It is important to highlight that the landscape and visual impacts of turbines are not directly proportional to their height. We have also produced more detailed **guidance on the installation of micro wind turbines** (<50kw) and for small turbines of between 15 and 50m in annex 1.

Duration of impacts and decommissioning

5.14 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 wind farm.

5.15 Decommissioning commonly proposes that turbines and ancillary buildings are removed. There is the potential for some residual visible change to the landscape, even when infrastructure is removed, although this can be minimised through careful design and consideration of how decommissioning will proceed at the project outset. The use of carefully worded legal agreements or planning conditions to ensure restoration of the site is critical. We have published **research on the restoration and decommissioning wind farms** which explores these issues in more detail, including the issue of repowering. In addition, our guidance on **Decommissioning and Restoration plans** provides advice on the process to be followed.

5.16 There is likely to be continued demand for renewable energy generation for many decades ahead. It is possible that existing well-designed wind farms may remain in use well beyond 25 years, with turbines either refurbished or replaced and a planning consent renewed. However, a time-limited consent provides the opportunity for decommissioning and a change in land use, if the location is no longer considered appropriate for a wind farm.

Partial restoration of access tracks to grass

GLOSSARY

Ancillary infrastructure	The built elements and structures of a wind farm, 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 wind farm site, usually the same height as the turbine hubs, to monitor wind speed
Borrow pit	A quarry within a wind farm site excavated to provide stone for site infrastructure
Capacity or Sensitivity Study	Research which attempts to identify the landscapes more suited to a particular type of development in a given area
Decommissioning	The process by which a wind farm 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
LCA	Landscape Character Assessment, a standard process which describes and categorises the landscape, highlighting key landscape characteristics
LIA	Landscape Impact Assessment, part of the LVIA process which identifies, explores and assesses the likely significant 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 wind farm layout, either at the design or construction stages of development.
PAN	Planning Advice Notes are issued by the Scottish Government, providing advice on good practice and other relevant information, e.g. PAN 68 on Design Statements
VIA	Visual Impact Assessment, part of the LVIA process, which considers the effects of changes resulting from development on people's views and visual amenity

Annex 1 – Siting and design considerations for turbines of 15-50m in height

Introduction

This annex replaces SNH's guidance on turbines of between 15 and 50m in height published in 2012. Many of the principles outlined in the main guidance document apply to smaller turbines and this section focusses only on the specific consideration for turbines of this scale.

Small scale turbine characteristics

In contrast to larger scale commercial wind turbines, a greater variety of styles, designs and colours of small turbine are available, generally with faster rotation speeds. Choice of turbine is a key factor in the suitability of small turbines at any site, especially where cumulative effects may occur. Careful choice of turbine at an early stage in the design process will help to ensure an improved landscape fit and avoid complex visual mixes of turbine types in any location. Applicants are encouraged to consider and discuss relevant turbine options at the pre-planning stage.

There are two main operational forms of small turbine currently available – those which rotate on a horizontal axis and those which rotate on a vertical axis.

Horizontal axis turbines

3 bladed Proven turbine on tubular tower

2 bladed turbines on lattice and tubular towers

3 bladed turbines on lattice towers

Two main types of turbines have a horizontal axis:

- Domestic/micro turbines.

  These turbines are usually installed for supplying electricity to domestic, agricultural or small scale industrial properties, although excess energy produced may be sold back to the national grid. Some are less than 15m to hub height, although similar larger versions are available. Even though these are considerably smaller than most commercial turbines they have the potential to be taller than buildings (even sizeable farm buildings) and mature trees. They are most commonly three bladed machines mounted on a tubular tower, although 2 bladed machines are becoming more common and lattice towers are sometimes used. 2 bladed turbines tend to have longer, aircraft–like blades whose rotational movement is commonly perceived as being less smooth than 3 bladed models from some aspects, despite their movement being regular. This can be a particular consideration when 2 bladed turbines are viewed in combination with 3 bladed models. Some small scale horizontal axis turbines have yaw arms (to orientate them to the wind) which can be as visible as the turbine blades align themselves.

- Small commercial turbines

  Some smaller turbines have the same form as large commercial turbines, with 3 blades and mounted on a solid tapering tower. These tend to be around 50 metres in height. They are most commonly a pale grey colour. Their blade movement, as with the micro turbines, will be faster than larger models and therefore less "restful" on the eye. These may be most appropriate:

  - in industrial settings
  - adjacent to large scale buildings in agricultural settings, and
  - in rural locations where they may relate to any existing similarly styled large commercial turbines, although varying blade rotation speed will be an important consideration. However, it will be important to consider how they would relate to existing nearby large turbines or wind farms, to avoid awkward scale relationships.

Vertical Axis Turbines

(www.wIndturbinezone.com)

(www.legacy.aero.gla.ac.uk)

(www.eng.src-vertical.com)

Vertical Axis Wind Turbines are generally smaller than horizontal axis turbines and tend to be more common in urban areas where there are townscape issues to consider (such as their scale in relation to their setting, effects of wind tunnelling and resultant turbulence and acoustic concerns). Their forms are more often specially tailored to create a design statement for individual sites.

Turbine factors

Turbine colour

Whilst larger commercial turbines are generally light grey in colour to reduce their contrast with the sky, there may be scope to consider use of other colours for small scale turbines which would reduce their prominence. Small scale turbine development is often located in lowland situations in lower elevation, non-skyline, smaller scale, more enclosed landscapes. In these situations there may be scope to relate the turbines to the landscape backdrop, pattern, tones or colour. A variety of seasons and weather conditions should be considered when choosing turbine colour. There may be locations where small turbines are predominantly viewed against the skyline (i.e. where they break the distinction between landform and open sky) and therefore a paler colour may be appropriate. In all cases reflectivity of the turbine components should be minimised.

Care needs to be taken with differing tower/blade colouring. For example, darker turbine heads can look as if they are floating in situations where a light turbine base is seen against the sky. Conversely lighter turbine heads can disappear in bright conditions, leaving the darker tower with no clear rationale for being there.

Turbine size and scale

Whilst large commercial wind farms are often located in isolated upland locations where their scale is difficult to perceive, small turbines are often located close to built features (such as farms, walls, houses or settlements) and vegetation features like hedges or copses which provide scale indicators in the landscape. It is important to ensure that turbines relate to the scale of adjacent landscape features (see relationship with buildings and structures section below).

Small scale turbines will in many cases, depending on their setting, have less landscape and visual impacts than large commercial models. However, there is still scope for this scale of development to visually dominate nearby landscape features. Their size will be key to their relationship with their surroundings. Table 1 shows the relative heights of elements found in the Scottish landscape which may be located near to small scale turbine development.

Landscape element	**Height in metres**
Single storey house	5 metres
1.5 to 2 storey house	6 – 10 metres
Farmyard grain silo	10 metres
Telegraph pole	10.5 metres
Mature forest trees	20 metres
Pylon	Usually around 30 - 35 metres

Table 1 - Height comparison of common elements in the Scottish landscape

Identifying the key landscape and visual characteristics of the area (such as landform and elevation and the presence or absence of woodland blocks), and their sensitivity to (and capacity for) change will help to inform decisions on size.

Turbine Layout/Array

Small scale turbines can be arranged in different layouts, or arrays, and still fulfil operational requirements. In comparison with commercial scale development it is likely that fewer turbines will need to be accommodated. There is potential to present a simple, often sculptural, visual image. This maybe more difficult where turbines are viewed with other built elements, such as existing buildings, masts, etc. Turbine layout should, if possible, respond to the patterns in the landscape, eg. arranged regularly in a line parallel to a straight field boundary on flat ground, or grouped in a less formal arrangement on a hillside next to irregular shaped woodland.

Turbines in urban areas should relate to existing landscape features. These turbines are aligned along a pathway and compliment the vertical elements such as lamp posts and trees.
(Photo - Marc van Grieken)

Alignment of turbines should respect underlying landform as this will help to reduce the need for localised levelling and subsequent ground disturbance at turbine bases.

In all cases the turbine layout should be considered when viewed from several viewpoints, and ideally from all sides (four directions), particularly the most sensitive and/or frequently viewed viewpoints, from which overlapping (or "stacking") of turbine towers/blades should be avoided.

Micrositing

Micrositing allows developers to change the precise location of turbines to avoid unforeseen constraints, such as deep peat or an important archaeological site. Micrositing of small-scale turbine proposals requires particular care because:

- even a few metres of movement can make a big difference proportionally to the design
- where the turbines are near to property, turbines could be moved nearer to or further away from buildings, including dwellings, changing the association of turbine and building
- where the turbines are arranged in formal regular lines or grids, the turbine position changes could affect the regularity of the design.

Small turbines are likely to be sited at lower levels in less exposed environments than larger wind farms. Nevertheless, developers should be encouraged to carry out complete pre-application site investigations to reduce the need for micrositing. This obviously has cost implications at an early stage in the development process, but it is preferable to the use of detailed micrositing conditions.

In the event of a micrositing condition being required within a permission for small-scale turbine development, **the distances should be kept to a minimum**, proportionate to the height (and therefore spacing) of the turbines to retain the best overall design. The visual relationship with nearby tall features such as trees and masts is an important consideration. Outwith micrositing tolerances reassessment of the proposal may be needed if the design of the scheme changes significantly.

Ancillary infrastructure

Attention to the initial siting and design of any ancillary development will help to minimise impacts and reduce visual clutter. For example:

- advantage should be taken of local topographical variation or screening features in the landscape to conceal ancillary features where possible
- ancillary structures, such as fencing, access tracks and, more occasionally, control buildings should be designed to be appropriate to the scale and character of the landscape and its surroundings

- existing tracks should be used for access where possible. New tracks, if required, should be designed to reflect local character, for example by following a field boundary or woodland edge, rather than cutting across a distinctive or highly visible landform. They should also follow the characteristic patterns of existing tracks in the locality, eg. following the lower fenceline of a field. This may, in some cases, result in slightly longer lengths of track being required than would be needed for a direct route, but will considerably reduce the overall landscape and visual impact. Use of surfacing materials which relate to local landscape character will help to integrate any new routes.

- any requirement for cut and fill on sloping sites to accommodate supporting infrastructure, such as for access tracks or turbine bases, should be minimised.

- turbines with integral transformers should be used where possible, especially on exposed sites

- fencing or walling, where required (e.g. for safety or agricultural reasons) should reflect the local situation, for example steel palisade fencing is likely to appear inappropriate in a rural situation where drystone dykes are characteristic

- small scale turbine development often serves adjacent buildings or is located relatively close to the electricity distribution network for reasons of financial viability. Grid connecting cables, particularly in rural locations, should be buried where possible to reduce clutter of the landscape, unless there is a clear justification not to.

Siting and design factors

The following paragraphs outline the main issues to be considered, but they should be read in conjunction with the checklist at Annex 1 which provides a more comprehensive list of relevant factors. For example, landscape designations may affect the policy for turbines, and the design requirements.

Landform

Smaller turbines have more potential to use landform to restrict their visual impact than larger commercial models. This should be explored, particularly when there are potential adverse effects on views from sensitive receptors, such as settlements, which could be mitigated through screening. The combined screening properties of topography and vegetation (see woodland section below) should be utilised where possible. However, in certain situations turbines may have the potential to influence or confuse the perception of landscape. For example a farm may be screened by landform from a certain view, yet the small-scale turbine installed to produce its electricity is visible – this would introduce visibility of a built element to the landscape where there was previously nothing evident.

The screening properties of landform and vegetation can be used to reduce visibility of small scale turbines, although a balance is required with the need for a good wind resource.

Landscape pattern and scale

The potential for the design of groups of small turbines to reflect the characteristic patterns in the landscape should be exploited whenever possible. Turbines could be arranged in a straight line where a geometric field pattern or straight road edge exists, or in an informal more scattered group or sweeping line adjacent to an indented woodland edge. The overall effects on the landscape should be assessed to inform the most suitable layout.



Small scale turbines can be positioned to reflect and accentuate field edge patterns and road or coastal edges (Photos: Marc van Grieken)

There may be situations where proposed turbines do not "sit" happily in the existing scale or pattern of the landscape. For example, it may be preferable in landscape terms to group 3 turbines together to form a single feature in an already visually complex or cluttered landscape. In a larger scale landscape, a single larger turbine with the same generating capacity may be preferable to three smaller ones. This will help to reduce cumulative landscape and visual impacts. However, in lowland situations it is more likely that multiples of a smaller size would be preferable so as not to clash with existing scale indicators in the landscape.

Care should be taken when siting turbines in an already complex or busy landscape not to create an overly cluttered visual image. (Photo: Marc van Grieken)

Focal Features

In many situations small scale turbines cannot be hidden, and they can become focal points in the landscape partly due to the movement of their blades. Care is required to avoid visual conflict with existing focal points in the landscape, either in terms of visual confusion or competition, or comparative scale. Small turbines may, where appropriate, have the potential to create new focal points which could:

- introduce a sculptural element into a landscape. This potential is particularly strong where new or unfamiliar turbine designs are developed in relation to contemporary architecture

- interrupt views to or adversely affect the setting of key landscape features. This effect should be avoided wherever possible

- highlight settlement which is not currently a prominent feature in a landscape. For example, installing a turbine at a farm which was previously screened by trees or the landform near to an area which has wild land qualities. In such cases turbine location should be reassessed to see if the turbine can be better associated with the steading, building or settlement, to reduce these effects.

Wind turbines should not compete with existing focal features - for example this turbine is not the dominant feature of this view

Relationship with settlement and urban/industrial landscapes

Small scale turbines are commonly associated with settlement, building groups and other built structures such as silos. It is important to relate the proportion of the turbine to these neighbouring built forms, although this relationship will vary with the context of the site – an urban edge is very different to an isolated farmstead in its scale. It is good practice to:

- Consider the height of the turbine in relation to nearby buildings or structures. The turbine should not have an overbearing presence or dominate adjacent buildings

- Where a turbine has no direct visual relationship to a building group it is important for its setting to have some logic. Consideration of its relationship to existing settlement pattern is required to give some rationale to its location

- Greater care is likely to be needed in settled areas designated for their landscape or recreational value, such as Local Landscape Designations (LLDs), Conservation Areas, Gardens and Designed Landscapes, and Countryside Around Towns or Coastal Protection Zones. These will have distinct planning policies which should state what type of development may be appropriate

- The relationship between small-scale turbines and the setting of and approaches to settlements is important. Care should be taken not to let turbines dominate views of the settlement when approaching on main access routes or when viewed from, for example, popular recreational features outwith the settlement. Views from within the settlement to important views or distinctive landscape features should also be considered when siting and designing new small scale proposals

- The form of turbine chosen may be influenced by its proximity to settlement – a 2 bladed turbine may appear less balanced and calm next to dwellings, but be less noticeable in a busier industrial setting

- Small scale turbines should be sited in the most appropriate location when viewed from a variety of viewpoints, including settlement, public roads and footpaths

- Local Authorities may require developers to submit an assessment of the potential impacts on residential amenity where these are of significant concern.

It is important for small-scale turbines to relate well to, and compliment the scale of, nearby buildings. These turbines are of suitable height and distance from their associated buildings and do not have an overbearing relationship with them. (Photos: Scottish Government website)

Woodland

Trees and vegetation can cause turbulence which affects the efficiency and longevity of turbines. However, there may be potential for trees, woodland or forestry to screen small scale turbines in certain situations (where these don't affect turbine performance), especially in conjunction with undulating landforms. However, care should be taken not to allow turbines to compete with or dominate locally distinctive landmark vegetation features, such as tree knolls, avenues or single specimen trees.

When proposing a location for a turbine development in relation to broadleaved woodland, seasonal variation in leaf cover should be considered in relation to turbine location and the screening properties of the vegetation. When relying on commercial forestry cover to screen turbine views, consideration of felling/restocking regimes will be necessary to ensure that the screening properties of the trees can be maintained during the life of the turbine.

Cumulative Effects

In the following situations particular attention should be paid to siting and design considerations when dealing with small-scale development. Sequential cumulative effects are as important as simultaneous or combined views.

In combination with micro renewables

Even micro turbines (below 15m to blade tip) can be prominent in some locations. Groups of turbines can be visually significant, as they draw the eye due to their fast speed of blade rotation. Care is needed not to create situations where views are cluttered or create confusing perspective in combination with small scale turbine development.

Where there are already other small scale turbines in an area.

To avoid multiple small scale turbine developments dominating a landscape the following principles should be considered:

(i) the use of turbines of a similar form, design, colour and scale as those already associated with the area or Landscape Character Type to reduce visual complexity and clutter

(ii) associating a certain form of turbine proposal with a particular land use to create some local distinctiveness, such as use of a lattice towers in an industrial area and tubular towers in countryside locations

(iii) carefully siting a proposed development from important viewpoints (such as a popular hilltop or visitor attraction), in relation to other developments present in the vicinity

(iv) ensuring that all developments associate in the same way with landscape features, such as farmsteads, forestry, head dykes, skylines or contours ensuring a consistent spatial relationship between small scale turbine proposals and other forms of development, especially tall structures such as masts, pylons and grain silos.

Where there are already larger turbines in an area

When seen in combination with larger turbines, small-scale turbines have the potential to create a confusing and poorly coordinated visual image, in relation to their form, size and grouping combinations. It may be possible to minimise this by:

- using the same turbine form in views where more than one scale of development is visible; and/or
- creating similarity by having similarly grouped and laid out turbines (e.g., in groups or lines of 3, or in even numbers in grids), whatever size they are, in a certain landscape character type.

Nevertheless, maintaining an appropriate gap between developments, even when they are different sizes, remains important.

Although these turbines are all of the same form their differing locations confuse turbine relationship with landscape character. The smaller turbine in the foreground seems to make the large scale turbine development 'creep' into a more transitional lowland landscape character and brings turbine closer to settlements.

Large and small scale turbines seen together make the judgement of distance and size of landscape features difficult

The effects of differing blade rotation speeds on different scales of turbine (with the slower speeds of commercial turbines versus faster speeds of domestic ones), may accentuate cumulative effects of the turbines when viewed simultaneously. Situations where turbine speeds would be significantly different should be discouraged.

Checklist for small-scale turbine development

Aspect to consider	Checklist
Turbine choice	Have you considered a range of different turbine forms in relation to your site? Do the proposed turbines have the most appropriate form, appearance and blade movement for the proposed site? Would another type of turbine fit in better?
Turbine colour	What is the relationship between the proposed turbines and nearby landform and skylines? Are they predominantly seen against the sky or backclothed by landform or trees? Can turbine colour choice help to make the turbines less prominent?
Turbine size/scale	Have you identified key landscape and visual characteristics (landform/elevation/landcover/built elements/scale indicators)? Does the proposed turbine(s) relate well to and not dominate these aspects?
Turbine array	Is the proposal for a group of turbines? Have you identified where they could be seen from and which are the most sensitive or significant views to the site? How could the turbines best be arranged to relate well to, respect and compliment their setting?
Micrositing	Has the site been surveyed as fully as possible to minimise the need for micrositing, especially near to properties and other tall structures?
Ancillary infrastructure	Have existing tracks been utilised wherever possible? Do proposed tracks fit in with the landscape character and compliment the pattern of existing tracks and road networks? Do proposed tracks use surfacing material which relates to the local landscape character? Do proposed tracks and turbine bases avoid steep slopes and minimise need for cut and fill operations? Do new ancillary features, such as buildings, walls and

	fences use materials characteristic of the locality and are they appropriate to the scale and character of the landscape? Has visibility of ancillary features been minimised? Is it proposed to bury connection cables?
Landscape character	Has the local Landscape Character Assessment (LCA) been referred to establish the key landscape characteristics of the site? What is the scale of the landscape? Does the proposal relate well to this? Is the landscape tranquil or busy? Will the blade movement of the proposed turbine(s) change this? Is the landform simple or complex and diverse? Will the proposal confuse or undermine these qualities? Is the proposal likely to affect more than 1 landscape character are or type? Does it relate well to all of those it could potentially affect?
Designated landscapes	Is the proposal within or near to a landscape designated for its special scenic or recreational qualities? Has the proposal been designed to minimise potential impacts on these qualities (e.g. the **Special Qualities** identified for National Scenic Areas)?
Landform	Can local landform features be utilised to limit visibility of the proposal?
Focal features	Will the proposed turbine(s) introduce a new focal landscape feature ensure that does not create visual confusion or compete with other notable features? Does the proposal interrupt views to or from existing focal features?
Perspective	Does the proposal create a false or confusing sense of perspective, especially in combination with other wind energy developments? (see cumulative section below)
Relationship with settlement	Do the turbines respect the scale of adjacent buildings? Does the proposal have a logical visual relationship with relation the settlement pattern? Will the turbines dominate approaches to settlement?

	Have the turbines been sited to minimise impact on people who live in, work in, travel through the locality or use the area for recreation?
Woodland	Can existing woodland be used to help screen the proposed development without affecting turbine performance?
Cumulative	Have you considered the relationship between the differing blade movement speeds of different developments? Can this be minimised? Does the introduction of the turbines create local landscape "clutter", especially where different turbine designs are being proposed close to each other? Could a turbine with the same form as the existing turbines be used?

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