13 Other Issues

13.1 Introduction

13.1.1 This chapter assesses the potential effects of the Proposed Development in relation to:

- Television and Telecommunications;
- Shadow Flicker;
- Socio-economics, Tourism and Recreation; and
- Carbon Offset and Carbon Payback.

13.1.2 Elements relating to Major Accidents and Disasters have been addressed in the individual technical discipline chapters where relevant.

13.1.3 Impacts on Population and Human Health have been addressed in the individual EIA topic chapters where relevant.

13.1.4 The assessments relating to Television and Telecommunications; and Shadow Flicker have been undertaken by the Applicant.

13.1.5 The Socio-economics, Tourism and Recreation assessment has been undertaken by Biggar Economics Ltd.

13.1.6 The assessments relating to Carbon Offset and Carbon Payback have been undertaken by SLR Consulting.

13.1.7 See **Chapter 1: Introduction** for details of the qualifications and expertise of the individuals who undertook the assessments reported in this chapter.

13.2 Television and Telecommunications

Introduction

13.2.1 This section of the chapter summarises the potential television and telecommunications effects associated with the Proposed Development.

Guidance

13.2.2 Tall structures such as wind turbines may cause interference of nearby television signal or telecommunications links. As such, any links in the vicinity of the Proposed Development must be identified and operators must be consulted.

13.2.3 The Ofcom Spectrum Information Portal was used in the first instance to identify fixed telecommunications crossing or adjacent to the site.

13.2.4 A number of other telecommunications services in addition to fixed links may be present, however most of these services are generally only affected if wind turbines are located in immediate vicinity. Furthermore, where other services are present, there is usually a supporting fixed link to allow onward signal transmission, which would be identified in this assessment. It is therefore considered that the search for fixed microwave links, and discussion with identified operators, also covers all other services.

Scope of Assessment

Effects Scoped Out

13.2.5 Effects on television and radio signal have been scoped out of detailed assessment for the following reasons:

- Operational effects on television / radio broadcasting: digital television is less likely to be affected by the atmospheric conditions that rendered analogue television unwatchable and does not suffer from reflection effects or ghosted image generation.
- It is not considered likely that radio broadcasting signals will be affected by the Proposed Development once operational. This is because:
    - the length of radio broadcast signal wavelengths are such that interference from wind turbines is unlikely; and
    - any interference to the radio signal is unlikely to noticeably affect the audio signal.

Microwave Fixed Links and Scanning Telemetry

13.2.6 Fixed links are direct line-of-sight communication links between transmitting and receiving dishes placed on masts generally located on hilltops that vary in length from a few kilometres to over 70km. They are used for the transmission of information to broadcasting masts for television and radio and for the mobile telephone networks and other use-cases.

13.2.7 No nearby operations were identified on the Ofcom Spectrum Information Portal[1] which was used in the first instance to identify fixed telecommunications links crossing or adjacent to the site.

13.2.8 Three major operators were still contacted as a matter of best practice.

13.2.9 Telecommunications and broadcasting network operators were consulted during the scoping exercise. **Table 13.1** summarises the responses from link operators contacted.

Table 13.1: Link Operators responses

Link Operator	Response/Issue Raised	Actions
BT	No concerns raised	No actions required
JRC	No concerns raised	No actions required
Atkins	No concerns raised	No actions required

13.2.10 BT responded the 5th of December 2023, to confirm that the Proposed Development should not cause interference to their current and presently planned radio network and maintained this position on 13th of May 2024 with sight of the final layout of the Proposed Development.

13.2.11 The Joint Radio Company (JRC) Limited responded on the 8th of May 2023, to confirm that the Proposed Development should not cause interference to JRC's current and presently planned radio network and maintained this position on 9th May 2024 with sight of the final layout of the Proposed Development.

13.2.12 Atkins responded on the 11th of May 2023, to confirm that the proposed development should not cause interference to Atkins's current and presently planned radio network and maintained this position on 9th of May 2024 with sight of the final layout of the Proposed Development.

13.2.13 With the information available to the Applicant, the Proposed Development does not directly affect fixed links.

Summary

13.2.14 The Proposed Development does not directly affect fixed links.

[1] https://www.ofcom.org.uk/spectrum/information/spectrum-information-system-sis/spectrum-information-portal (last accessed 23/05/2024)

13.2.15 The potential effect of the proposed development is considered to be not significant with respect to other television or radio communication networks.

13.3 Shadow Flicker & Reflected Light

Background Information

13.3.1 In sunny conditions, any shadow cast by a wind turbine will mirror the movement of the rotor. When the sun is high, any shadows will be confined to the wind farm area but when the sun sinks to a lower azimuth moving shadows can be cast further afield and potentially over adjacent properties. Shadow flicker is generally not a disturbance in the open as light outdoors is reflected from all directions. The possibility of disturbance is greater for occupants of buildings when the moving shadow is cast over an open door or window, since the light source is more directional.

13.3.2 Whether shadow flicker is a disturbance depends upon the observer’s distance from the turbine, the direction of the dwelling and the orientation of its windows and doors from the wind farm, the frequency of the flicker and the duration of the effect, either on any one occasion or averaged over a year.

13.3.3 In any event and irrespective of distance from the turbines, the flickering frequency will depend upon the rate of rotation and the number of blades. It has been recommended (Clarke, 1991)[2] that the critical frequency should not be above 2.5Hz, which for a three-bladed turbine is equivalent to a rotational speed of 50rpm. The proposed turbines at Killean Wind Farm would rotate at a maximum of approximately 9.3rpm, well below this threshold.

13.3.4 The common rate or frequency at which photosensitive epilepsy might be triggered is between 3Hz and 30Hz (flashes per second). Large commercial wind turbines, such as the proposed, rotate at low speeds resulting in less than three flashes per second and are therefore unlikely to cause epileptic seizures. (Harding et al., 2008 [3]; Smedley et al., 2010[4]). Therefore, there are not considered to be any health effects associated with the shadow

[2] Clarke A.D (1991), A case of shadow flicker/flashing: assessment and solution, Open University, Milton Keynes
[3] Harding et al. (2008), Wind turbines, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them, Epilepsia
[4] Smedley et al. (2010), Potential of wind turbines to elicit seizures under various meteorological conditions, Epilepsia

flicker due to the proposed development and the assessment will address the effects of shadow flicker related only to local amenity.

Reflected Light

13.3.5 A related visual effect to shadow flicker is that of reflected light. Theoretically, should light be reflected off a rotating turbine blade onto an observer then a stroboscopic effect would be experienced. In practice a number of factors limit the severity of the phenomenon and there are no known reports of reflected light being a significant problem at wind farms.

13.3.6 A limiting factor is that wind turbines have a semi-matt surface finish which means that they do not reflect light as strongly as materials such as glass or polished vehicle bodies.

13.3.7 Secondly, due to the convex surfaces found on a turbine, light will generally be reflected in a divergent manner.

13.3.8 Thirdly, as with shadow flicker, certain weather conditions and solar positions are required before an observer would experience this phenomenon.

13.3.9 It is therefore concluded that the Proposed Development will not cause a material reduction to amenity owing to reflected light.

Policy and Guidance

13.3.10 The update to Shadow Flicker Evidence Base[5], published by the then Department for Energy and Climate Change (DECC), states that assessing shadow flicker effects within ten times the rotor diameter of wind turbines has been widely accepted across different European countries, and is deemed to be an appropriate area.

Methodology

13.3.11 Analysis was performed on all properties within ten rotor diameters of any turbine.

13.3.12 This shadow flicker assessment is based on turbines with a 155m rotor diameter, and the section 36 application includes a request for a 100m

[5] Brinckeroff, Parsons (2011) 'Update of UK Shadow Flicker Evidence Base', Department of Energy and Climate Change, UK Government

micro-siting allowance for infrastructure. As such, this 100m distance is added to the ten-rotor diameter (1,550 = 10 * 155)m distance to give a total distance of (1,650 = 1550 + 100)m from any turbine.

13.3.13 Analysis was undertaken for shadow flicker at all properties within 1,650m from any wind turbine.

13.3.14 This analysis takes into account the motion of the Earth around the Sun, the local topography and the turbine locations and dimensions. The analysis was performed using a layout of nine turbines, each with maximum tip heights of 180m.

Results

13.3.15 With due reference to the DECC report, and an allowance for 100m micro-siting, there are no inhabited houses within 1,650m of any wind turbine (as shown in **Figure 13.1**); and thus no flicker is predicted.

13.3.16 A property referred to as Braids is scoped out of the assessment as it is uninhabited and would require planning permission to make habitable. The building currently lacks a roof, windows and some walls, and is therefore not considered to be a building used for long-term residential purposes.

13.3.17 It is therefore concluded that Killean Wind Farm will not cause a material reduction to residential amenity owing to shadow flicker.

13.4 Socio-economics, tourism and recreation

13.4.1 BiGGAR Economics was commissioned to undertake the socio-economics, recreation and tourism elements of the Proposed Development. Socio-economic and tourism assessments of onshore windfarms over the last decade have found no significant socio-economic effects in EIA terms. Since there is no reason to expect significant effects in the presence of the Proposed Development, socio-economics, tourism and recreation was scoped out of the EIA Report.

13.4.2 Nevertheless, socio-economic and tourism issues are of interest to key stakeholders and local authorities, and so an assessment of Socio-economics, tourism and recreation is presented in **Technical Appendix 13.1**.

13.4.3 In summary, the development of onshore wind projects such as the Proposed Development offer an opportunity to generate economic impact regionally and nationally while driving the delivery of a more sustainable economy in Scotland. The Proposed Development could deliver a series of economic benefits. In particular, it was estimated that during its development and construction, the Proposed Development could generate:

- £5.9 million Gross Value Added (GVA) and 80 jobs in Argyll and Bute; and
- £18.1 million GVA and 260 jobs in Scotland.

13.4.4 During its operations and maintenance, each year the Proposed Development could generate:

- £0.3 million GVA and three jobs in Argyll and Bute; and
- £1.1 million GVA and 12 jobs across Scotland.

13.4.5 The Proposed Development will offer a community benefit fund of up to £5,000 per annum per installed MW. The local community will also have the opportunity to take part in the Applicant's Local Electricity Discount Scheme, reducing the household energy bills in the community, as well as shared ownership options.

13.4.6 Although tourism assessments usually focus on tourism assets which are located within 15 km of the Proposed Development, this assessment has extended the radius to 25km to incorporate the west coast of Arran and other areas identified in the zone of theoretical visibility. It found that the wind farm proposals are not expected to affect the local accommodation providers, recreation trails and core paths, and tourism attractions.

13.5 Carbon Offset and Carbon Payback

Introduction

13.5.1 In addition to generating electricity, the Scottish Government sees wind turbines and other renewable technologies as an important mechanism for reducing carbon dioxide (CO_2) emissions. However, such development projects can themselves create carbon emissions (e.g. the use of concrete and vehicle emissions). Therefore, this section estimates the CO_2 emissions associated with the manufacture and construction of the Proposed Development compared to the estimated contribution the Proposed Development would make to reducing CO_2 emissions. This gives an estimate of the whole life carbon balance of the Proposed

Development. Once the CO_2 emissions have been offset or paid back by the Proposed Development, each subsequent unit of wind generated electricity transmitted would be likely to displace a unit of conventionally generated electricity, thereby replacing traditional fossil fuel based power station emissions and contributing to reduction of CO_2 emissions.

Carbon and Peatland

13.5.2 Renewable energy developments in upland areas may often be sited on peatlands which hold stocks of poorly protected carbon, and so have the potential to release carbon to the atmosphere in the form of CO_2 if disturbed. Scotland has the majority of peat soils in the UK and, therefore, has a responsibility to ensure stability of this carbon and to ensure that developments do not cause a significant loss of this carbon reservoir.

13.5.3 The Scottish Government Carbon and Peatland Map 2016[6] shows that most of the Proposed Development is mapped as Class 5 peat. This indicates that it is unlikely that peatland habitats are present in those areas and that soils are carbon-rich. No peatland habitat is recorded and the area may also include areas of bare soil. Soils are carbon-rich and deep peat. There is a very localised area of Class 3 peat in the north-west of the site, predominantly comprised of peaty soil with some peat soil. Mineral soils are mapped across the site adjacent to watercourses. In the east of the Proposed Development there are a large areas of Class 1 peat deposits which have been avoided during the design process.

13.5.4 The carbon balance assessment considers the implications of any parts of the Proposed Development which could lead to the additional release of CO_2 resulting from the disturbance of peat.

13.5.5 In order to minimise the requirement for the extraction of peat, the layout design process has avoided areas of deeper peat. The layout design process is described in **Chapter 3: Design Evolution and Alternatives.** Specific details on the peat depth and probing surveys undertaken are included in **Technical Appendices 9.1: Peat Landslide Hazard Risk Assessment (PLHRA) and 9.2: Peat Management Plan (PMP)**.

Characteristics of Peatland

6 Scottish Government, Carbon and Peatland Map 2016, Available online at: map.environment.gov.scot/soil_maps/

13.5.6 When flooded, peat soils emit less carbon dioxide but more methane than when they are drained. In flooded soils, carbon emissions are usually exceeded by plant fixation, so the net exchange of carbon with the atmosphere is negative and soil stocks increase. When soils are aerated, carbon emissions usually exceed plant fixation, so the net exchange of carbon with the atmosphere is positive.

13.5.7 To calculate the carbon emissions attributable to the removal or drainage of the peat, emissions occurring if the soil had remained in situ and undrained are subtracted from the emissions occurring after removal or drainage.

13.5.8 The loss of carbon from the carbon fixing potential from plants and vegetation on peatland is small but is calculated for the area from which peat is removed and the area affected by drainage. The carbon stored in the peat itself represents a much larger potential source of carbon loss.

13.5.9 The indirect loss of CO_2 uptake (fixation) by plants originally on the surface of the site but eliminated by construction activity including the destruction of active bog plants on wet sites, is calculated using a blanket bog assumption to capture a worst-case scenario.

13.5.10 Emissions due to the indirect, long-term liberation of CO_2 from carbon stored in peat due to drying and oxidation processes caused by construction of the Proposed Development can also be calculated from site specific data for the Proposed Development. This figure is a worst-case scenario, as very limited peat is anticipated to be disturbed on site. Any disturbed peat would be re-used onsite to minimise carbon losses, for restoration of the Proposed Development and for habitat restoration including ditch blocking, where possible.

Carbon Payback Methodology

13.5.11 The assessment of the carbon payback is based on a detailed baseline description of the Proposed Development and its location. All calculations are based on site specific data, where available. Where site specific data is not available approved national/regional information has been used.

13.5.12 The methodology to calculate carbon emissions is based on 'Calculating carbon savings from windfarms on Scottish peat lands - A New Approach'

(Nayak et al, 2008)[7], prepared for the Scottish Government Science, Policy and Co-ordination Division. This was superseded in 2011 by the document 'Calculating Carbon Savings from Wind Farms on Scottish Peatlands - A New Approach', (Nayak et al, 2008 and 2010) and (Smith et al, 2011)[8]. In terms of carbon footprint, the 'carbon calculator' is the Scottish Government's tool provided to support the process of determining the carbon impact of wind farm developments in Scotland.

Effect of Carbon Emissions from Construction

13.5.13 Emissions arising from the fabrication of the wind turbines and the associated components are based on a full life analysis of a typical wind turbine and include CO_2 emissions resulting from transportation, erection, operation, dismantling and removal of wind turbines and foundations and transmission grid connection equipment from the existing electricity grid system.

13.5.14 With respect to wind turbines, emissions from material production are the dominant source of CO_2. Emissions arising from construction (including transportation of components, quarrying, building foundations, access tracks and hardstands) and commissioning are also included in the calculations. The assessment has used Nayak et al (2008) default values for 'turbine life' emissions, calculated with respect to installed capacity.

13.5.15 An operational lifespan of 50 years has been used.

Input Parameters

13.5.16 To undertake this assessment, the following parameters were considered, which encompass a full life cycle analysis of the proposed development. These parameters include:

- emissions arising from the fabrication of the wind turbines and all the associated components;
- emissions arising from construction, (including transportation of components; quarrying; building foundations, access tracks and hardstands; and commissioning);

7 Nayak et al (2008). http://www.gov.scot/Publications/2008/06/25114657/0 [Accessed 30 October 2023].

8 Nayak et al; (2008 and 2010) and Smith et al (2011). Calculating Carbon Savings from Wind Farms on Scottish Peatlands - A New Approach.

- the indirect loss of CO_2 uptake (fixation) by plants originally on surface of the site but eliminated by construction activity (including the destruction of active bog plants on wet sites);
- emissions due to the indirect, long term liberation of CO_2 from carbon stored in peat due to drying and oxidation processes caused by construction; and
- loss of carbon due to drainage.

13.5.17 As part of their methodology, Nayak et al have provided a spreadsheet called 'Scottish Government Windfarm Carbon Assessment Tool' to calculate whole life carbon balance assessments for windfarms on peat lands. The calculation spreadsheet (online calculator version 1.8.1 and reference number 4T36-0YH7-2URH v3)[9] allows a range of data to be input in order to address expected, minimum and maximum values. However, if several parameters are varied together, this can have the effect of 'cancelling out' a single parameter change. For this reason, the approach for this assessment has been to include 'maximum values' as those values which would result in the longest (maximum) payback period; and 'minimum values' as those values which would result in the shortest (minimum) payback period.

13.5.18 This spreadsheet tool provides generic values for CO_2 emissions associated with some components (such as wind turbine manufacture) and requires site specific information for other components (such as habitat type, extent of peat disturbance and ground water levels).

13.5.19 This assessment draws on information detailed in the EIA Report, **Appendix 2.3: Forestry Report**, **Chapter 7: Ecology** and **Chapter 9: Geology, Hydrology & Hydrogeology**. For the purpose of this assessment, it is assumed that all the embedded good practice measures outlined in **Chapter 7** and **Chapter 9** would be employed.

13.5.20 The final wind turbine choice is not yet known but would likely be around 6.6MW and the greenhouse gas savings and carbon payback are based on the input parameters of the proposed 9 wind turbines. Figures are based

[9] Scottish Government (2022). Windfarm Carbon Assessment Tool online version 1.8.1. Available at https://informatics.sepa.org.uk/CarbonCalculator/ [accessed 03/07/2024]

on currently available wind turbines and assume a consistent supplier for all wind turbine locations (i.e. wind turbine types are chosen by manufacturer). Note that, within the calculation spreadsheet, the expected, maximum and minimum values have been adjusted to suit the input parameter.

13.5.21 The capacity factor used within the calculation spreadsheet is based on measured onsite wind data giving a capacity factor of 43.77%.

13.5.22 The input parameters for the Scottish Government calculation spreadsheet are detailed in **Technical Appendix 13.2: Carbon Calculator Core Input Data**. The reference number relating to the carbon calculator is 4T36-0YH7-2URH v3. The choice of methodology for calculating the emission factors uses the 'Site Specific methodology' defined within the calculation spreadsheet.

Results

13.5.23 This section presents a summary of the carbon assessment which has been undertaken in respect of the Proposed Development. The purpose of the 'carbon calculator' is to assess, in a comprehensive and consistent way, the carbon impact of wind energy developments. This is undertaken by comparing the carbon costs of manufacture and construction with the carbon savings attributable to a development through operation. An assessment has been undertaken to calculate the carbon emissions which would be generated in the construction, operation and possible decommissioning of the Proposed Development after an illustrative 50 years.

13.5.24 **Technical Appendix 13.3, Carbon Payback and CO_2 Emissions** provides a breakdown of the estimated emissions displaced per annum and over the assumed lifespan for the Proposed Development as calculated by the carbon calculator. The Proposed Development is seeking consent for an operational lifespan of 50 years, and so this figure has been used.

13.5.25 The calculations of total carbon dioxide emission savings and payback time for the Proposed Development indicates the overall payback period of a development with 9 wind turbines with an average (expected) installed capacity of around 6.6MW each would be approximately 1.5 years, when compared to the fossil fuel mix of electricity generation.

13.5.26 This means that the Proposed Development is expected to take between 0.6 and 1.9 years to repay the carbon exchange to the atmosphere (the

CO_2 debt) through construction of the wind turbines; the Proposed Development would in effect be in a net gain situation following this time period and would contribute to national CO_2 reduction targets.

13.6 Summary

13.6.1 The Proposed Development does not directly affect fixed links and is considered to have no significant effects with respect to other television or radio communication networks.

13.6.2 There are no habitable dwellings within 1,650m of any proposed wind turbine, and therefore no shadow flicker effects are predicted from the Proposed Development.

13.6.3 During its construction, it is estimated that the Proposed Development could generate:

- £5.9 million Gross Value Added (GVA) and 80 jobs in Argyll and Bute; and
- £18.1 million GVA and 260 jobs in Scotland.

13.6.4 During its operations and maintenance, each year the Proposed Development could generate:

- £0.3 million GVA and three jobs in Argyll and Bute; and
- £1.1 million GVA and 12 jobs across Scotland.

13.6.5 The Proposed Development will also offer an annual community benefit fund throughout its operational lifetime to be utilised and administered in consultation with local community.

13.6.6 The Proposed Development is expected to take up to 1.9 years to achieve a net gain situation in terms of Carbon Payback; and thereafter contribute for the remainder of its operational life to national CO_2 reduction targets.