

14 Aviation, Radar and Other Issues

14.1 Introduction

- 14.1.1 This chapter assesses the likely significant effects of the revised proposed development in relation to:
- Aviation, Radar & Defence;
 - Television & Telecommunications;
 - Shadow Flicker & Reflected Light; and
 - Carbon Balance
- 14.1.2 It details the post-submission consultation responses and how these have been addressed, relevant changes in policy, legislation and guidance, and the amendments to the original proposed development detailed and assessed in the EIA Report October 2023.
- 14.1.3 This AEI chapter is supported by the following figures and technical appendices:
- AEI Figures:
 - **AEI Figure 14.1: Aviation Lighting Scheme;** and
 - **AEI Figure 14.2: Shadow Flicker Assessment.**
 - AEI Technical Appendices:
 - **AEI Technical Appendix 14.1: Reduced Lighting Scheme;** and
 - **AEI Technical Appendix 14.2: Carbon Balance Assessment.**
- 14.1.4 AEI Figures 14.1– 14.2 and AEI Technical Appendices 14.1 – 14.2 are referenced in the text where relevant.
- 14.1.5 Elements relating to Major Accidents and Disasters have been addressed in the individual technical discipline chapters where relevant.
- 14.1.6 Impacts on Population and Human Health have been addressed in the individual EIA topic chapters where relevant.

14.2 Aviation, Radar & Defence

Introduction

- 14.2.1 This section of the chapter considers the likely significant effects on aviation, radar and defence associated with the construction, operation and decommissioning of the revised proposed development.

- 14.2.2 The assessment of potential effects on aviation, radar and defence considers technical acceptability, based on air navigation safety, rather than following a strict EIA process of assessing the significance of effects. Such effects often require the implementation of technical mitigation solutions to ensure continued safe operation in the presence of a wind farm. The assessment of effects on these receptors is therefore one of technical analysis and consultation and seeks to identify whether the effect is likely to be 'acceptable' or 'not acceptable' to air navigation services provision.

Legislation, Policy & Guidance

- 14.2.3 There have been no changes in legislation, policy or guidance relevant to aviation, radar or defence matters between the assessment of the original proposed development and the revised proposed development.

Consultation

AEI Table 14.1: Consultation Responses relating to Aviation, Radar & Defence

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action
Defence Infrastructure Organisation (03.05.23)	Scoping	<p>The turbines will be 73km from, detectable by, and will cause unacceptable interference to the AD radar at Brizlee Wood.</p> <p>Wind turbines have been shown to have detrimental effects on the operation of radar. These include the desensitisation of radar in the vicinity of the turbines, and the creation of "false" aircraft returns. The probability of the radar detecting aircraft flying over or in the vicinity of the turbines would be reduced, hence turbine proliferation within a specific locality can result in unacceptable degradation of the radar's operational integrity. This would reduce the RAF's ability to detect and deter aircraft in United Kingdom sovereign airspace, thereby preventing it from effectively performing its primary function of Air Defence of the United Kingdom.</p> <p>In this case the development falls within Low Flying Area 14 (LFA 14), an area within which fixed wing aircraft may operate as low as 250 feet or 76.2 metres above ground level to conduct low level flight training. The addition of turbines in this location has the potential to introduce a physical obstruction to low flying aircraft operating in the area.</p> <p>If the developer is able to overcome the issues stated above, to address the impact up on low flying given the</p>	<p>The Defence Infrastructure Organisation (DIO) indicated a potential impact on the AD radar at Brizlee Wood. The MOD will be consulted to ascertain the extent of the impact on the radar and agree a suitable scheme of mitigation.</p> <p>The DIO indicated that the site lies within a low flying tactical training area. The MOD Low Flying team will be consulted to agree a suitable aviation lighting scheme if deemed necessary.</p>

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action
		<p>location and scale of the development, the MOD would require that conditions are added to any consent issued requiring that the development is fitted with aviation safety lighting and that sufficient data is submitted to ensure that structures can be accurately charted to allow deconfliction.</p> <p>The development proposed includes wind turbine generators and/or meteorological mast(s) that exceed a height of 150m agl and are therefore subject to the lighting requirements set out in the Air Navigation Order 2016. In addition to CAA requirements, the MOD will require the submission, approval, and implementation of an aviation safety lighting specification that details the installation of MOD accredited aviation safety lighting.</p>	
Defence Infrastructure Organisation (04.01.24)	Post-application	<p>The MOD objects to original proposed development for the following reasons:</p> <ul style="list-style-type: none"> a. the development being detectable by one or more MOD radars as specified [AD radar at RRH Brizlee Wood]; and b. The potential to create a physical obstruction to air traffic movements. 	<p>Serco were formally requested by the applicant to provide a report, outlining the impact that the revised proposed development would have on UK Air Defence radar, TPS-77, located at RRH Brizlee Wood so that the MOD can decide if the mitigation solution is acceptable. The report has been provided to the MOD (20.01.25). The MOD has since confirmed the proposed non auto initiation zone (NAIZ) mitigation is acceptable and a mutually acceptable suspensive planning condition is currently being agreed.</p> <p>With respect to concerns around physical obstruction, it is understood that a planning</p>

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action
			condition will be requested to ensure that aviation safety lighting is fitted to the wind turbines.
Defence Infrastructure Organisation (17.02.25)	Post-application	The MOD has undertaken an assessment of the mitigation proposal [issued by Serco] and accepted on the condition that the revised proposed development is issued to the ECU.	AEI to be submitted to ECU detailing the revised proposed development for MOD to remove objection and issue planning conditions.
Edinburgh Airport Limited (24.03.23)	Scoping	Edinburgh Airport had concerns related to the proposed development. No turbine tower of any turbine may be erected, unless and until such time as the Local Planning Authority receive confirmation from the Airport Operator in writing that: (a) an IFP Assessment has demonstrated that an IFP Scheme is not required; or (b) if an IFP Scheme is required such a scheme has been approved by the Airport Operator; and (c) if an IFP Scheme is required the Civil Aviation Authority has evidenced its approval to the Airport Operator of the IFP Scheme (if such approval is required); and (d) if an IFP Scheme is required the scheme is accepted by NATS AIS for implementation through the AIRAC Cycle (or any successor publication) (where applicable) and is available for use by aircraft.	An Instrument Flight Procedure (IFP) assessment was commissioned by a Civil Aviation Authority (CAA) approved provider that showed there would be no impact on the IFPs. Edinburgh Airport confirmed on 07/08/2023 that they no longer had concerns.
Edinburgh Airport Limited (28.11.23)	Post-application	No objection	
NATS (05.04.23)	Scoping	NATS has indicated an impact from the proposed development on the Great Dun Fell NATS (En Route) plc	Dialogue is ongoing with NATS to identify the most appropriate mitigation scheme.

Consultee and Date	Scoping / Other Consultation	Issue Raised	Response / Action
		(NERL) radar, Kincardine Radar and Edinburgh Airport Radar.	
NATS	Post-application		NATS safeguarding has identified that a Large Blanking Zone mitigation would be suitable to mitigate the impacts on the Great Dun Fell radar. A statement of common understanding (SOCU) is currently being negotiated with NATS so that the objection can be lifted.

Scope of Additional Environmental Information

Effects Scoped Out

- 14.2.4 Interference with surveillance systems and radar can occur when wind turbine blades are moving, therefore likely significant effects during construction are not assessed.
- 14.2.5 Upon decommissioning, the Defence Geographic Centre (DGC) will be informed of the removal of wind turbines. Following this, no decommissioning effects are expected and are not considered further.

Effects Assessed in Full

- 14.2.6 The assessment identifies and considers the likely significant effects that the revised proposed development may have on civilian and military aviation, air safeguarding and, if required, the mitigation measures proposed to prevent, reduce or offset any potential adverse effects where possible.
- 14.2.7 In relation to military and civil aviation assets it considers potential impacts on the military Air Defence (AD) radar at Brizlee Wood and the NATS En Route Ltd (NERL) radar at Great Dun Fell and the potential mitigation measures identified to address these.
- 14.2.8 The assessment is based on an evaluation of existing data sources and desk studies, and consultation with key stakeholders.
- 14.2.9 The effects of wind turbines on aviation interests are well known but the primary concern is one of safety. The two principal scenarios that can lead to effects on the operations of aviation stakeholders are:
- physical obstruction: wind turbines can present a physical obstruction at or close to an aerodrome or in the military low flying environment, which itself presents a health and safety risk or otherwise requires changes to flight routes in the area which brings about other operational effects; and
 - radar/air traffic services (ATS): wind turbine clutter appearing on a radar display can affect the safe provision of ATS as it can mask unidentified aircraft from the air traffic controller and/or prevent them from accurately identifying aircraft under control. In some cases, radar reflections from wind turbines can affect the performance of the radar system itself.
- 14.2.10 In this context the scope of the assessment is to consider the impact of the revised proposed development on aviation stakeholders, including military, en route, airports and other airfields, radar systems and air space users. This assessment also considers civil and military stakeholder aviation obstruction lighting requirements.
- 14.2.11 As standard, the DGC will be provided with the following information for incorporation on to aeronautical charts and documentation:
- the date of commencement of the revised proposed development.
 - the exact position of the wind turbine towers in latitude and longitude;
 - a description of all structures over 300 feet high;

- the maximum extension height of all construction equipment;
- the height above ground level of the tallest structure; and
- details of a visible and/or infrared aviation lighting scheme.

Methodology

Baseline Characterisation

Study Area

- 14.2.12 Consideration is given to aviation infrastructure that is within operational range of the revised proposed development. Operational range varies with the type of infrastructure but broadly includes regional airports operating radar up to 50 km of the revised proposed development, non-radar aerodromes within 17 km, parachute drops zones within 3 km, and military radar and en route radar systems up to 100 km from the revised proposed development (dependent on operational range).

Desk Study

- 14.2.13 The applicant has a dedicated aviation manager who has provided input to the revised proposed development since its inception. This has included:
- civil and military radar line of sight (LoS) analysis;
 - review of relevant aviation charts;
 - review of military low flying charts; and
 - general aviation advice based on prevailing civil and aviation issues

Significance Criteria

- 14.2.14 Significance criteria for aviation impacts are typically difficult to establish; they are not strictly based on the sensitivity of the receptor or magnitude of change but on whether the industry regulations for safe obstacle avoidance or radar separation (from radar clutter) can be maintained in the presence of the wind turbines.
- 14.2.15 Any anticipated impact upon aviation stakeholders which results in restricted operations is therefore considered to be of significance.

Assessment Limitations

- 14.2.16 No limitations have been identified that would affect the findings of the assessment, based on the information available at the time of writing.

Baseline

CAA

- 14.2.17 The only civil airport to respond to provide an application response was Edinburgh Airport with no objection to the original proposed development. It is expected that they will provide the same response to the revised proposed development.
- 14.2.18 The Civil Aviation Authority will require the revised proposed development to have visible lighting to assist with air safety.

NERL

- 14.2.19 The revised proposed development is approximately 124 km north of the Great Dun Fell radar.
- 14.2.20 NERL has indicated that the original proposed development will have an unacceptable impact upon the Great Dun Fell en route radar as it will have LoS to some of the wind turbines at the original proposed development.
- 14.2.21 NERL has provided a technical solution to mitigate this impact for the original proposed development. It is expected that this technical solution will be available for the revised proposed development.

Military Aviation

- 14.2.22 The revised proposed development is approximately 72 km north-west of the Brizlee Wood Air Defence radar. While the DIO has indicated that the original proposed development will have an unacceptable impact upon the Brizlee Wood radar as it has LoS to some of the wind turbines at the original proposed development, they have accepted a technical solution to mitigate this impact.
- 14.2.23 It is expected that the DIO will remove their objection upon confirmation of the revised proposed development, matching the technical solution, issued to them by Serco.
- 14.2.24 In addition, and with respect to the original proposed development, the DIO will require that aviation safety lighting is installed onto the wind turbines, secured by planning condition. It is expected that this planning condition will be requested for the revised proposed development.

Updated Assessment of Potential Effects

Operational Effects

- 14.2.25 Wind turbines have the potential to impact the performance of air traffic control radars. These impacts include:
- The creation of false targets, whereby the wind turbines present on the radar display. Multiple false targets can lead to the radar initiating false aircraft tracks.
 - False returns can also cause track seduction, i.e. real aircraft tracks are 'seduced' away from the true position as the radar updates the aircraft track with the false return. This can lead to actual aircraft not being detected.
 - Shadowing whereby the aircraft is not detected by the radar as it is flying within the physical 'shadow' of the wind turbine.
- 14.2.26 Prior to mitigation, it is considered that the revised proposed development would affect the operation of the military AD radar at Brizlee Wood and also the NERL Great Dun Fell radar.

Mitigation

- 14.2.27 It is expected that the DIO will require an Air Defence Radar Mitigation (ADRM) Scheme to be agreed with them that will remove the impact upon their AD radar at Brizlee Wood to an acceptable level. A technical solution, that will be included in the ADRM Scheme, has already been identified by Serco

and accepted by DIO. The ADRM Scheme will be agreed prior to the revised proposed development becoming fully operational.

- 14.2.28 It is expected that NATS will require a technical solution to be agreed with them that will remove or reduce the impact on NERL Great Dun Fell Radar to an acceptable level. The technical solution will be agreed prior to the revised proposed development becoming fully operational. It is likely that a technical solution will be provided through a standard 'blanking contract'. The applicant is currently in discussion with NATS to determine the most suitable technical mitigation solution.
- 14.2.29 A reduced visible aviation lighting scheme has been agreed with the CAA. The reduced scheme means that not every perimeter wind turbine needs to be lit and no tower lights are required provided an infrared scheme is agreed with the DIO. A copy of the correspondence from the CAA can be seen in **AEI Technical Appendix 14.1** and **AEI Figure 14.1** presents the wind turbines that are proposed to be lit in accordance with this correspondence. The results of the assessment for night-time lighting are contained in **AEI Chapter 6: Landscape & Visual Impact Assessment**. An infrared lighting scheme will be agreed with the DIO prior to the proposed development becoming fully operational.

Summary

- 14.2.30 The revised proposed development will potentially impact the MOD AD radar at Brizlee Wood and the NERL radar at Great Dun Fell. In both cases it is expected that the impact can be mitigated with a technical solution that could be secured through an appropriately worded suspensive planning condition. Infrared lighting will be agreed with the DIO for the MOD low flying requirements and a visible lighting scheme has been agreed with the CAA.

14.3 Television & Telecommunications

Introduction

- 14.3.1 This section of the chapter considers the likely significant effects on television & telecommunications associated with the construction, operation and decommissioning of the revised proposed development.

Legislation, Policy and Guidance

- 14.3.2 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 revised proposed development must be identified and operators must be consulted.
- 14.3.3 The Ofcom Spectrum Information Portal was used in the first instance to identify fixed telecommunications crossing or adjacent to the site.
- 14.3.4 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 Additional Environmental Information

Effects Scoped Out

14.3.5 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

- 14.3.6 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 70 km. 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.
- 14.3.7 No nearby operations were identified on the Ofcom Spectrum Information Portal¹ which was used in the first instance to identify fixed telecommunications links crossing or adjacent to the site.
- 14.3.8 Three major operators were still contacted as a matter of best practice.
- 14.3.9 BT responded on the 17th of November 2024, to confirm that the original proposed development should not cause interference to their current and presently planned radio network. It is expected that they will maintain this position with respect to the revised proposed development
- 14.3.10 The Joint Radio Company (JRC) Limited responded on the 22nd of November 2024, to confirm that the original proposed development should not cause interference to JRC's current and presently planned radio network. It is expected that they will maintain this position with respect to the revised proposed development
- 14.3.11 Atkins confirmed with the applicant on 14 September 2023 that it would have no objection to the original proposed development.
- 14.3.12 With the information available to the applicant, the revised proposed development does not directly affect fixed links.

¹ <https://www.ofcom.org.uk/spectrum/information/spectrum-information-system-sis/spectrum-information-portal>

Summary

- 14.3.13 As reported in Chapter 14 of the EIA Report October 2023 for the original proposed development, the revised proposed development does not directly affect fixed links
- 14.3.14 The potential effect of the revised proposed development is considered to be not significant with respect to other television or radio communication networks.

14.4 Shadow Flicker & Reflected Light

Introduction & Background

- 14.4.1 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 site 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.
- 14.4.2 Whether shadow flicker is a disturbance depends upon:
- the observer's distance from the wind 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.
- 14.4.3 The common rate or frequency at which photosensitive epilepsy might be triggered is between 3 and 30 Hz (flashes per second). It has been recommended (Clarke, 1991)² that the critical frequency should not be above 2.5 Hz, which for a three-bladed wind turbine is equivalent to a rotational speed of 50 rpm. The candidate wind turbines considered for the revised proposed development would rotate at 8.8 rpm, therefore unlikely to cause epileptic seizures. (Harding et al., 2008³; Smedley et al., 2010⁴). Therefore, there are not considered to be any health effects associated with the shadow flicker due to the revised proposed development and the assessment will address the effects of shadow flicker related only to local amenity.

Reflected Light

- 14.4.4 A related visual effect to shadow flicker is that of reflected light. Theoretically, should light be reflected off a rotating wind 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.

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

- 14.4.5 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.
- 14.4.6 Secondly, due to the convex surfaces found on a wind turbine, light will generally be reflected in a divergent manner.
- 14.4.7 Thirdly, as with shadow flicker, certain weather conditions and solar positions are required before an observer would experience this phenomenon.
- 14.4.8 It is therefore concluded that the revised proposed development will not cause a material reduction to amenity owing to reflected light.

Legislation, Policy & Guidance

- 14.4.9 The update to Shadow Flicker Evidence Base (2011)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.
- 14.4.10 The Scottish Borders Council Supplementary Guidance, Renewable Energy, (2018)⁶ further describes that,
- "... there is some recent evidence that shadow flicker can be experienced at greater than 10 rotor diameter distance and that the modelling of those residences within 10 rotor diameter may not capture all homes where people experience shadow flicker effects. Where requested by the Council, the developer will be required to produce shadow flicker assessments modelled to take into account all residential property within 2 km of a wind turbine. This distance threshold should take into account any screening of turbines offered by topography."*

Methodology

- 14.4.11 Analysis was performed on all properties within 2,000 m of any wind turbine, in accordance with Scottish Borders Council Supplementary Guidance.
- 14.4.12 The planning application includes a 100 m micro-siting distance for infrastructure. As such, this 100 m distance is added to the 2,000 m distance to give a total distance of 2,100 m from any wind turbine.
- 14.4.13 Analysis was undertaken for shadow flicker at all properties within 2,100 m from any wind turbine.
- 14.4.14 The assessment area and properties included therein are shown in **AEI Figure 14.2**.
- 14.4.15 This analysis takes into account the motion of the Earth around the Sun, the local topography and the wind turbine locations and dimensions.

Results

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

⁶ Scottish Borders Council. (2018), Scottish Borders Council Supplementary Planning Guidance, Renewable Energy. Available at: https://www.scotborders.gov.uk/downloads/download/659/draft_renewable_energy_supplementary_guidance

- 14.4.16 With due reference to 2,000 m distance of interest requested, and allowance for 100m micro-siting, the potential shadow flicker is given in **AEI Table 14.2**.

AEI Table 14.2: Predicted maximum annual potential shadow flicker

RES Property ID	Property Address	Distance to the Nearest Wind Turbine (m)	Maximum Hours of Flicker Per Year
H315	The Howe, Tollishill, Lauder, Berwickshire, TD26QZ	1,270	48.6

- 14.4.17 The above predictions in **Table 14.2** represent a worst-case scenario for the following reasons:

- The analysis assumes that there is always sufficient lack of cloud cover, for there to be sufficient sunlight for shadows to be cast by the wind turbine blades.
- The analysis assumes that there is always enough wind for the wind turbine blades to be turning.
- The analysis assumes that the wind is always coming from the right direction for the wind turbine rotor to be facing towards the property, to thus cast a shadow.
- The analysis assumes that the property has windows and/or glazed doors facing towards the wind turbine rotor.
- The analysis assumes there is no shielding, e.g. in the form of trees or outbuildings, between the wind turbine rotor and the property.

Mitigation and Residual Effects

- 14.4.18 Mitigation can be incorporated into the operation of the revised proposed development to reduce the instance of shadow flicker including shutting down individual wind turbines during periods when shadow flicker could theoretically occur.
- 14.4.19 Shadow flicker control modules, consisting of light sensors and specialised software, will be installed on wind turbines identified as having the potential to cause shadow flicker. This is to prevent operation during periods when shadow flicker is experienced at nearby properties if it is determined there is an issue post-construction.
- 14.4.20 The shadow flicker control module consists of bespoke software, a clock, a timer, a switch, a wind direction sensor and a light sensor. The module can control a specific wind turbine (or wind turbines) which would be programmed to shut down on specific dates at specific times when the sun is bright enough, there is sufficient wind to rotate the blades and the wind direction is such that nuisance shadow flicker could occur.
- 14.4.21 The installation of a programmable shadow flicker module will allow future conditional control of wind turbines in order to eliminate shadow flicker, irrespective of which turbine in the range is installed. The correct operation of the installed shadow flicker control measures will ensure that there will be no impact from shadow flicker. The operation and performance of the shadow flicker control measures will be monitored on an ongoing basis.

Summary

- 14.4.22 The revised proposed development will not cause a material reduction to amenity owing to reflected light.
- 14.4.23 Under conservative assumptions, as mentioned in paragraph 14.5.16, the revised proposed development is predicted to create shadow flicker for one property within the 2,100 m assessment area. Should it be required, mitigation can be provided, including shutting down individual wind turbines during periods when shadow flicker could theoretically occur.

14.5 Climate and Carbon Balance

Results

- 14.5.1 This section presents a summary of the carbon assessment which has been undertaken in respect of the revised 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 revised proposed development after an illustrative 50 years.
- 14.5.2 The carbon calculations spreadsheet is provided in **AEI Technical Appendix 14.2: Carbon Balance Assessment**. A summary of the anticipated carbon emissions and carbon payback of the original and revised proposed developments relative to the current Department for Business, Energy & Industrial Strategy published figures is provided in **AEI Table 14.3**.

AEI Table 14.3: Anticipated carbon emissions and payback

Results	Original Proposed Development			Revised Proposed Development		
	Exp.	Min.	Max.	Exp.	Min.	Max.
Net emissions of carbon dioxide (t CO ₂ eq.)	218,151	201,852	277,377	121,429	26,353	175,778
Carbon payback time						
Coal-fired electricity generation (years)	0.4	0.4	0.5	0.4	0.1	0.5
Grid-mix of electricity generation (years)	2.2	2.0	2.8	2.0	0.4	2.8
Fossil fuel - mix of electricity generation (years)	1.0	0.9	1.3	0.9	0.2	1.3
Ratio of CO ₂ eq. emissions to power generation (g / kWh) (TARGET ratio by 2030 (electricity generation) < 50 g /kWh)	8.52	7.87	10.86	7.54	1.63	10.94

Interpretation of results

- 14.5.3 The calculations of total carbon dioxide emission savings and payback time for the revised proposed development indicates the overall payback period of a development with 12 wind turbines with an average (expected) installed capacity of around 6.6MW each would be approximately 0.9 years, when compared to the fossil fuel mix of electricity generation.
- 14.5.4 This means that the revised proposed development is expected to take around 11 months to repay the carbon exchange to the atmosphere (the CO₂ debt) through construction of the revised proposed development. The revised proposed development would in effect be in a net gain situation following this time period and would contribute to national CO₂ reduction targets.