Chapter 14: Other Issues

Creag Riabhach Wind Farm Extension

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Contents

14: Other Issues

14.1 Introduction

This chapter assesses the effects on other environmental issues, Forestry and Carbon Assessment. It also addresses the issues scoped out of environmental impact assessment (EIA), as agreed with consultees during the Scoping process.

14.2 Issues Scoped Out

The Scoping Opinion, issued by the Scottish Ministers' Energy Consents Unit (ECU), stated that they were content with the proposed Scope of the EIA in relation to the topic areas subject of this chapter, as set out in the Scoping Report. Therefore, in addition to the Scoping Opinion and further design mitigation, the following environmental factors have been scoped out of the EIA Report because of the limited potential for environmental effects to arise:

- Climate Change;
- Aviation;
- Telecommunications, TV and Radio Links;
- Air quality;
- Shadow flicker;
- Ice throw, and
- Accidents and Disasters.

14.2.1 Climate Change

In the context of the EIA process, climate change is considered both in relation to the contribution of the proposed development to increasing or decreasing gaseous emissions with global warming potential (GWP), and in relation to climate change adaptation:

- Emissions associated with the proposed development will be limited to temporary and short term emissions of exhaust gases from vehicles and construction plant, and the potential for the release of carbon dioxide as a result of dewatering and exposing peat and peat soils during construction. Neither source is predicted to be significant in terms of GWP. The proposed development would contribute renewable electricity generation capacity, displacing fossil fuel based electricity generation and associated emissions with GWP. The EIA Report will provide further information on the potential carbon dioxide emissions and 'payback' timescales as part of the description of the proposed development, with reference to the Scottish Government Carbon Calculator tool (**Section 14.4**); and
- With regard to climate adaptation, consideration will be given the potential implications of climate change on the wind farm design (e.g. design for increased flood risk and adverse weather); however, no potential for significant impacts have been identified and no further assessment is proposed (**Section 14.2.7**).

On this basis, this matter is scoped out of the EIA Report.

14.2.2 Aviation

In the EIA Report for the existing Creag Riabhach Wind Farm (CRWF), no significant impacts were identified with regards to aviation. For the proposed development, all of the turbines would be located in places which result in tip heights lower than those of the existing CRWF. Furthermore, no proposed turbine would have a base to tip height of more than 149.9m.

Civil Aviation

The Scoping responses received from Edinburgh Airport and the Highlands and Islands Airports Limited both confirm that the proposed development is outwith the aerodrome safeguarding zones (for Edinburgh, Wick and Inverness Airports) and does not infringe safeguarding criteria. The Scoping response from National Air Traffic Service confirmed the proposed development does not conflict with their safeguarding criteria.

Military Aviation

In its scoping response, the Defence Infrastructure Organisation confirmed that *"the MOD* [Ministry of Defence] *has concerns about the proposal."*

The response further stated that, *"The proposed development will occupy Low Flying Area 14 within which military fixed wing aircraft are permitted to fly down to 250 feet (76.2 metres) above terrain features… the MOD would request that the turbines be fitted with MOD accredited aviation safety lighting."*

The proposed development turbines would be fitted with MOD accredited lighting as necessary.

14.2.3 Telecommunications, Television and Radio Links

Wind turbines have the potential to interfere with electromagnetic signals, due to their size and operation. In the existing CRWF EIA Report, no issues were raised for telecommunications, TV and radio links.

There is an existing microwave link owned and operated by EE/3 near to the proposed development. The proposed development turbines would have a separation distance from the centre line of the microwave of 50m. EE/3 have confirmed that the separation distance is acceptable.

At Scoping, Joint Radio Company confirmed that the proposed development is *"cleared"* with respect to radio link infrastructure operated by Scottish Hydro & Scottish Gas Networks. No other issues were identified by consultees.

14.2.4 Air Quality

The proposed development is unlikely to have significant effects on air quality. There could be some localised and temporary construction-related air quality effects associated with dust (foundation construction, passage of vehicles along access tracks) and construction plant and traffic exhaust emissions. However, the construction activities would be relatively short term, intermittent and controllable through the application of good construction practice and also at sufficient distance from sensitive receptors to be considered

negligible impact. The potential for nuisance effects on residential or recreational amenity would be limited and strictly controlled in accordance with a Construction Environmental Management Plan (CEMP). An Outline CEMP is provided in **Technical Appendix 3.1**. The CEMP would include a Construction Traffic Management Plan, which is discussed further in in **Chapter 10: Transport and Access**.

On this basis, air quality was scoped out of the EIA Report.

14.2.5 Shadow Flicker

Shadow flicker can occur from the moving shadow of the turbine rotor blade passing over a narrow opening such as the window of a nearby residence. The likelihood and duration of shadow flicker depends upon the positioning of the sun, turbine and window locations, turbine orientation, time of day and year and weather conditions.

The design of the proposed development has avoided turbine placement within the Zone of Potential Shadow Flicker, which was defined a 10x rotor diameter buffer (as per Scottish Government guidance[1]) from the turbine locations and 130º either side of north (as per Department of Environment and Climate Change studies[2]). However, the scoping response provided to the ECU by The Highland Council (THC) requested that shadow flicker be assessed for all residential properties within 11 rotor diameters of each turbine, in line with THC's Onshore Wind Energy Supplementary Guidance (2016). There are no occupied properties within the shadow flicker zone.

On this basis, shadow flicker is scoped out of the EIA.

14.2.6 Ice Throw

There are two types of risks associated with ice collecting on turbines:

- Fragments are thrown off from the operating turbine due to aerodynamic and centrifugal forces; or
- Ice falls down from the turbine when the blades are stationary.

Given the remote location of the proposed development, ice throw affecting members of the public is considered to be extremely low. This risk is reduced even further because of the vibration sensors which would be fitted to the turbines. These sensors detect any imbalance that might be caused by icing, which leads to the affected turbines being shut down.

On this basis, ice throw is scoped out of the EIA.

[1] Scottish Government (2014), web-based guide: Onshore wind turbines: planning advice.
[2] Department of Energy and Climate Change (2011), Update of UK Shadow Flicker Evidence Base.

14.2.7 Accidents and Disasters

The vulnerability of the development to risks of major accidents and disasters are defined in Institute of Environmental Management and Assessment (IEMA)[3] guidance as man-made or natural events with the potential to endanger human health or the environment (such as lightning strike and structural failures). This requirement is interpreted as requiring the consideration of high consequence events (even if of low likelihood) which would result in serious harm or damage to environmental receptors. In this case, this risk would be minimised through proper design of the proposed development and compliance with relevant legislation and best practice. For instance, braking mechanisms installed on turbines allow their operation only under specific wind speeds and should severe windstorms be experienced, turbines would be shut down.

Given the nature of the proposed development, the potential for effects related to the vulnerability to accidents and disasters is likely to be limited to those effects associated with extreme weather, mechanical failure or structural damage. Relevant types of accident/disaster, given the predominantly rural context of the proposed development, include:

- Severe weather events, including high winds, high rainfall leading to flooding, or extreme cold leading to heavy snow and ice loading;
- Fire;
- Traffic related accidents; and
- Mass movement associated with ground instability.

Severe weather resilience will be a core component of the wind farm design, and includes consideration of flooding resilience and the ability to manage the site remotely in the event that it is inaccessible due to hazardous weather conditions. The wind farm design will include consideration of designing out health and safety risks associated with construction and operation (including accidents and disasters associated with fire and traffic movements) in accordance with the duties under The Construction (Design and Management) Regulations 2015. Potential risks and hazards associated with mass movement (peat instability) will be assessed and presented as part of the EIA Report in the Peat Landslide Hazard Risk Assessment (**Chapter 9: Hydrology, Hydrogeology and Soils**).

There is also the requirement to consider vulnerability of the development to the risks of climate change. None of the following climate trends identified in UKCP18[4] would affect the proposed development with the exception of increased windstorms:

- Increased temperature;
- Wildfire;
- Changes in the frequency, intensity, and distribution of rainfall events (e.g., an increase in the contribution to winter rainfall from heavy precipitation events and decreases in summer rainfall);
- Increased windstorms; and

[3] IEMA (2020), Major Accidents and Disasters in EIA: A Primer.
[4] Met Office (2019), UKCP18 Science Overview Report.

- Sea level rise.

Braking mechanisms installed on turbines allow their operation only under specific wind speeds and should severe windstorms be experienced, turbines would be shut down.

As no significant effects would result from the proposed development in this regard, the topic is scoped out of the EIA Report.

14.3 Forestry

14.3.1 Introduction

The proposed development would require felling of part of the forestry resource onsite. The forestry resource onsite is considered to be of low quality and the felling requirement to be low. Therefore, it is not considered that potential impacts are likely to be significant. This section summarises the baseline conditions, identifies the potential impacts, and outlines the proposed compensatory planting proposals. This section is accompanied by **Technical Appendix 14.1: Forestry**, which contains the detailed forestry impact assessment.

14.3.2 Statutory and Policy Context

The felling of trees is regulated under the Forestry and Land Management (Scotland) Act 2018 except in cases when woodland removal is associated with wind farm development. In such cases, any significant environmental effects of woodland removal are assessed by the Scottish Government or the Local Authority depending on the capacity of the development. In this case it is the Scottish Government.

Scottish Government's Policy on Control of Woodland Removal (PCOWR)[5] and accompanying Implementation Guidance (2019) (Appendix A)[6] clearly sets out a strong presumption in favour of protecting Scotland's woodland resources. The first consideration for all woodland removal decisions should be whether the underlying purpose of the proposals can reasonably be met without resorting to woodland removal. In line with Scottish Government's wider objective to protect and expand Scotland's woodland cover, applicants are expected to develop their proposal with minimal woodland removal. Woodland removal should be allowed only where it would achieve significant and clearly defined additional public benefits.

It is not considered that the proposed development would qualify for change of land use without compensatory planting, as it could not contribute significantly to any of the relevant criteria detailed in Appendix C of The Scottish Government's PCOWR. However, the proposed development would meet the acceptability criteria for woodland removal as the change of land use with compensatory planting as it would contribute significantly to "helping Scotland to adapt to climate change" by providing facilities appropriate for the development of renewable energy projects and significantly reduce net greenhouse gas (GHG) emissions.

[5] Forestry Commission (2009), The Scottish Government's Policy on Control of Woodland Removal
[6] Scottish Forestry (2019), Scottish Government's policy on control of woodland removal: implementation guidance

PCOWR sets out the following criteria for determining the acceptability of woodland removal with compensatory planting:

- ***"Woodlands with a strong presumption against removal***
  Only in exceptional circumstances should the strong presumption against woodland removal be overridden. Proposals to remove these types of woodland should be judged on their individual merits and such cases will require a high level of supporting evidence. Where woodland removal is justified, the Compensatory Planting (CP) area must exceed the area of woodland removed to compensate for the loss of environmental value.
- ***Woodland removal with a need for compensatory planting***
  Design approaches that reduce the scale of felling required and/or converting the type of woodland to another type (such as from tall conifer plantation to low-height, slow growing woodland), must be considered from the earliest stages, rather than removing the woodland completely. The purpose of any required CP is to secure, through new woodland on site (replanting) or off site (on appropriate sites elsewhere), at least the equivalent woodland-related net public benefit embodied in the woodland to be removed."

Any compensatory planting required as a result of the proposed development, may also need to be considered under The Forestry (Environmental Impact Assessment) (Scotland) Regulations 2017; however, potential impacts from the compensatory planting measures outlined in **Technical Appendix 14.1** have been considered where appropriate within this EIA Report. The applicant would follow the process for preparing a woodland creation proposal, as set out in Scottish Forestry guidance booklet: Woodland Creation Application Guidance (Forestry Commission Scotland, 2017)[7].

Adopted and published by Scottish Ministers on Monday 13 February 2023, National Planning Framework 4[8] - Policy 6 Forestry, Woodlands and trees identifies several themes that should be considered relevant to this application:

"b) Development proposals will not be supported where they will result in:
i. Any loss of ancient woodlands, ancient and veteran trees, or adverse impact on their ecological condition;
ii. Adverse impacts on native woodlands, hedgerows and individual trees of high biodiversity value, or identified for protection in the Forestry and Woodland Strategy;
iii. Fragmenting or severing woodland habitats, unless appropriate mitigation measures are identified and implemented in line with the mitigation hierarchy;

c) Development proposals involving woodland removal will only be supported where they will achieve significant and clearly defined additional public benefits in accordance with relevant Scottish Government policy on woodland removal. Where woodland is removed, compensatory planting will most likely be expected to be delivered.

[7] Forestry Commission Scotland (2017), Woodland Creation Application guidance. Available at: https://forestry.gov.scot/support-regulations/woodland-creation [Accessed 5/06/2023]
[8] Scottish Government (2022), National Planning Framework 4. Available at Scottish Government (2023), National Planning Framework 4. Available at https://www.gov.scot/publications/national-planning-framework-4/

d) Development proposals on sites which include an area of existing woodland or land identified in the Forestry and Woodland Strategy as being suitable for woodland creation will only be supported where the enhancement and improvement of woodlands and the planting of new trees on the site (in accordance with the Forestry and Woodland Strategy) are integrated into the design."

14.3.3 Consultation Undertaken

Table 14.1 below summarises the forestry related consultation undertaken in relation to the proposed development and how they have been addressed.

Table 14.1: Consultation Matrix

Consultee	Response	Comment
Scottish Environmental Protection Agency (SEPA)	**Forest removal and forest waste** Key holing must be used wherever possible as large scale felling can result in large amounts of waste material and in a peak release of nutrients which can affect local water quality. The supporting information should refer to the current Forest Plan if one exists and measures should comply with the Plan where possible. Clear felling may be acceptable only in cases where planting took place on deep peat and it is proposed through a Habitat Management Plan to reinstate peat-forming habitats. The submission must include: a) A map demarcating the areas to be subject to different felling techniques. b) Photography of general timber condition in each of these areas. c) A table of approximate volumes of timber which will be removed from site and volumes, sizes of chips or brash and depths that will be re-used on site. d) A plan showing how and where any timber residues will be re-used for ecological benefit within that area, supported by a Habitat Management Plan. Further guidance on this can be found in Use of Trees Cleared to Facilitate Development on Afforested Land – Joint Guidance from SEPA, Scottish Natural Heritage and Forestry Commission Scotland.	The forestry resource onsite comprises low quality and stunted shrub. The height of the shrub is such that felling would only be required for the footprint of the development plus 15%. **Technical Appendix 14.1** describes the proposed felling and identify these areas on a plan accompanied by photography of the general timber conditions. The volume of timber would be di minimis and will likely be lifted along with the overburden or manually felled.
The Highland Council	Forestry If any areas of woodland are likely to be affected by the development (including its access) the Scottish Government's Control of Woodland	**Technical Appendix 14.1** describes the proposed felling and identify these areas on a plan accompanied by photography of the general timber

Consultee	Response	Comment
	removal Policy must be addressed and compensatory planting calculations provided in the EIA Report. The EIA Report should indicate all the areas of woodland / trees that will felled to accommodate the development, including any off site works / mitigation. Compensatory woodland is a clear expectation of any proposals for felling, and thereby such mitigation needs to be considered within any assessment. Generally, THC are content with the methodology and scope of the Forestry chapter of the EIA Report and we do not hold any further information that you do not already have access to.	conditions. This will include the estimated compensatory planting requirement.
Royal Society for the Protection of Birds	Lastly, any compensatory tree planting would need to be planned carefully and potential locations considered holistically within the landscape. Any woodland planting should avoid areas of deep peat over 50cm and avoid areas which are important for birds of open habitats such as waders. Breeding bird surveys should be undertaken on any the selected site to ensure that important areas such as these are avoided.	Any compensatory planting will be undertaken within relevant legal frameworks and following best practice guidance. Details relating to forestry are included in **Technical Appendix 14.1**. In relation to breeding birds, there are no territories in the proposed compensatory planting area in any of the historic datasets. There is a black grouse lek nearby, although this was not found again during post-consent monitoring for CRWF. Trees are unlikely to have a negative effect on these birds at this location.
Scottish Forestry	Applicants are expected to develop their proposal with minimal woodland removal. The Scottish Government's Policy on Control of Woodland Removal is considered relevant to this application. National Planning Framework 4 - Policy 6 Forestry, Woodlands and trees identifies several themes that should be considered relevant to this application. The development area contains woodland, including a scheme funded through the Woodland Grant Scheme (1996) scheme reference 30000976, typically this scheme will be a native woodland or contain a significant proportion of native woodland. Scottish Forestry advises the developer to include detailed information on the types and areas of	The forestry resource onsite comprises low quality and stunted shrub. **Technical Appendix 14.1** describes the proposed felling and identify these

Consultee	Response	Comment
	forestry to be felled and restocked as a result of the proposed development. Detailed information on any compensatory planting proposals should also be provided.	areas on a plan accompanied by photography of the general timber conditions. This will include the estimated compensatory planting requirement.

14.3.4 Baseline

The forestry resource onsite does not fall within any Designation, including Ancient Woodland, Sites of Specific Scientific Interest, National Nature Reserves, Ramsar sites, archaeological sites and historic points of interest or protected areas.

The existing woodland, Creag Riabhach Woodland, Altnaharra, is a native woodland planting scheme of Upland Birch planted circa 1996-1997 (reference 30000976). The woodland has established at variable stocking densities and shows slow growth rates over much of the site. The growth rate seen is typical of woodland planting schemes undertaken in such sites where, due to the poor soil conditions and exposure of the site, the trees initial establishment is slow. The rate of attrition is approximately 5-10%. These failed trees are predominantly within the wettest, peat areas, where drainage is poor and nutrition is low. The species present are; Downy Birch, Scots Pine, Rowan, Alder, Willow, Aspen and Juniper, planted at a density of 500 stems per ha.

14.3.5 Proposed Development

Extension Turbine 01 (EXT-01) and battery energy storage system (BESS) are positioned within open land where there is no impact on existing woodland. EXT-02 and EXT-03 are positioned within existing native woodland. The footprint of the turbine extension within the woodland area comprises of 1.98ha, plus a further 15% of woodland is considered affected by the extension installation so it is assumed that this area will require felling too. There is the potential for the following effects:

- The biodiversity and ecology of the woodland area will be temporarily disturbed (an assessment of the impact of woodland habitat loss is considered within **Chapter 6: Terrestrial Ecology**).
- Loss of woodland within the designated area for EXT02 and EXT03 will require compensatory planting as defined within the PCOWR.
- Though this loss of woodland is of low sensitivity and, will have a minimal effect on the landscape aesthetics of the area, it is visible from the A836, and so aesthetics must be considered in the compensatory planting design (an assessment of the landscape and visual impacts during construction, operation and decommissioning of the proposed development is included in **Chapter 5: Landscape and Visual Impact Assessment**).
- Tree clearance works may affect the nearby River Naver. Care must be taken and Forest and Water Scotland guidance adhered to. Waterways will be identified prior to felling. Machinery will be restricted to motor manual chainsaws and will be regularly checked to ensure no oil or fuel leaks. Fuel storage and refuelling will be a minimum of 10m from watercourses with spill kits available. Trees will be felled away from water courses.

There will be no operational ongoing effects on the current methods of woodland management within the project post construction.

Due to the PCOWR, it is reasonable to assume there will be no residual loss of woodland as the applicant will undertake compensatory planting for any areas of felling. As such the cumulative effect on forestry have been scoped out of detailed assessment.

14.3.6 Compensatory Planting

The area of compensatory planting will comprise of the 1.98ha turbine and track footprint, plus a further 15% of woodland is considered affected by the extension installation. The total area required of compensatory planting to deliver this mitigation against woodland removal area will be 2.28ha.

A potentially suitable area for the additional compensatory planting has been determined by peat and soil surveys on site (Appendix A, **Technical Appendix 14.1**). The area selected for compensatory planting suitable for planting comprises of a total of 3.81 ha. This area is adequate to incorporate the compensatory planting for the 2.28 ha footprint area within the Creag Riabhach woodland area, and allows for small swathes of open ground around the few small rock exposed areas within. A planting scheme on this location will aesthetically appear natural and will enhance the view from the A386 below. The existing deer fence line will be extended by 715m to enclose the compensatory planting area.

The planting should be of the same native species within the existing Creag Riabhach Woodland at a density of 500 stems per hectare. Replating of Native Upland Birch Scheme would be retained as Long-Term Retention and Nature Reserve to improve biodiversity to create a suitable habitat for wildlife.

Care would be taken during tree clearance to mitigate any potential impact on the hydrology of the River Naver. Compensatory planting will also aid in soil erosion protection off the hill towards the River Naver.

14.4 Carbon Balance Assessment

14.4.1 Introduction

Wind turbines and BESS provide an important mechanism for the reduction of carbon dioxide (CO_2), and other GHG emissions into the atmosphere by reducing the consumption of fossil fuel generated mains electricity. However, during their manufacture, construction and decommissioning, wind farms and BESS can themselves result in the emissions of GHGs, particularly in such instances as where natural carbon stores, such as peat, are present and potentially impacted by the development.

This chapter provides an approximation of the GHG emissions associated with the manufacture, construction and decommissioning of the proposed development. It further provides an estimate of the contribution which the proposed development would make towards the reduction of emissions, which would otherwise be produced by fossil fuel power generation. This provides an indication of the whole life carbon balance of the proposed development, together with an understanding of the emissions 'pay-back' period. Once emissions resulting from the manufacture, construction and decommissioning of the proposed development

have been paid back (offset) by the wind farm, then each subsequent unit of wind generated electricity would displace a unit of conventionally generated electricity, thereby contributing to the overall reduction in emissions into the atmosphere.

It is important to note that although often termed a 'carbon balance' assessment, the assessment includes all GHGs, and not just carbon. The results are presented as tonnes of CO_2 equivalent (tCO_2e), where equivalence means having the same warming effect as CO_2 over 100 years.

14.4.2 Scope and Methodology

Whilst the proposed development is expected to deliver GHG savings over its lifetime, it also has the potential to cause GHG emissions through the following pathways:

- Disturbance of peatland;
- Felling of woodland and trees; and
- Embodied carbon in turbines, BESS and other infrastructure.

The carbon balance assessment of the proposed development has been undertaken (reference - QO2G-BR4H-5W4) using the latest version (v1.7.0[9]) of the Scottish Government's Carbon Calculator Tool[10]. This tool uses project specific data relating to the characteristics of the proposed development (**Chapter 3: Description of Development**) and receiving environment (**Chapters 5-14**) to enable GHG losses and GHG savings to be quantified across the project lifecycle stages (construction, operation and decommissioning/site restoration). These losses and savings are combined to establish the overall (net) carbon effect of the proposed development, as well as its 'carbon payback period'.

Results from this assessment are reported below in accordance with IEMA's Environmental Impact Assessment guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022)[11]. Any project that causes GHG to be avoided, or removed from the atmosphere, has a beneficial effect that is always significant.

[9] Available at https://informatics.sepa.org.uk/CarbonCalculator/ [Accessed 25/05/23]

[10] This tool calculates payback time for windfarm sited on peatlands using methods given in Nayak et al, 2008 (http://www.gov.scot/Publications/2008/06/25114657/0) and revised equations for GHG emissions (Nayak, D.R., Miller, D., Nolan, A., Smith, P. and Smith, J.U., 2010, Calculating carbon budgets of wind farms on Scottish peatland. Mires and Peat 4: Art. 9. Online: http://mires-and-peat.net/pages/volumes/map04/map0409.php

[11] IEMA (2022), Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance.

14.4.3 Consultation Undertaken

Table 14.2 summarises the consultation undertaken in respect of carbon balance.

Table 14.2: Scoping Consultation Responses

Consultee	Response	Comment
The Highland Council	Carbon balance calculations should be undertaken and included within the EIA Report with a summary of the results provided focussing on the carbon payback period for the wind farm.	The SEPA Carbon Calculator tool has been used to estimate the carbon payback period.

14.4.4 Statutory and Planning Context

The climate change assessment has been undertaken in the context of the Scottish Government's current key climate change legislation and policy and the targets and aspirations set out within these, including:

- Climate Change (Scotland) Act 20093 as amended by The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019;
- Update to the Climate Change Plan 2018-2032: Securing a Green Recovery on a Path to Net Zero 2020;
- Onshore Wind Policy Statement (OWPS) 2022;
- Scotland's Energy Strategy Position Statement 2021; and
- Draft Energy Strategy and Just Transition Plan 2023.

Further details are provided within **Chapter 4: Statutory and Policy Framework**.

14.4.5 Predicted Impacts

The Scottish Government's Carbon Calculator Tool includes the embodied emissions due to turbines (the candidate extension turbines would have an indicative capacity of 12.6MW) and their foundations, but not for BESS. As such, a supplementary life cycle analysis (LCA) of BESS has been conducted and integrated within the calculator outputs.

Overall, LCA studies on BESS have found that the manufacturing stage has the greatest impact in terms of embodied carbon. Lithium-ion batteries are the most common choice of battery technology, with several examples of Lithium-ion BESS supporting wind and solar farms in the UK. A study undertaken by Romare and Dahllöf (2017)[12] indicates that the cradle to grave emissions of a lithium-ion battery is in the region of 150-200 kg CO_2e/kWh. Although this assessment was undertaken for batteries for light-duty vehicles, evidence suggests that there is a near-linear scale of GHG emissions when battery size increases. A 37.3 MW BESS is proposed as part of the proposed development which would likely have a duration of between one and four hours, for the purposes of this assessment it is assumed as a worst-case scenario the BESS has a one-hour duration (meaning the energy storage capacity would be 37.3 MWh). Based on these assumptions, the losses

[12] Romare and Dahllöf (2017). The Life Cycle Energy Consumption and Greenhouse Gas Emissions from Lithium-Ion Batteries – a Study with Focus on Current Technology and Batteries for Light-duty Vehicles. No. C 243, IVL Swedish Environmental Research Institute.

due to BESS manufacture, construction and decommissioning have been predicted as 7,460 t CO_2e for the purposes of this assessment. As the BESS will provide back up capacity for the wind farm this is reflected in the relevant section of the Carbon Calculator (i.e. back up capacity from the energy grid is assumed to be 0%).

The results of the carbon calculator show that the total GHG emissions associated with the Wind Farm element of the proposed development is 19,086 tCO_2e. Therefore the combined GHG emissions of the Wind Farm and the BESS are predicted to be 26,546 tCO_2e. The annual GHG savings of the proposed development over a fossil fuel energy mix would be 12,874 tCO_2e. Therefore, the predicted carbon payback time over a fossil fuel mix of electricity generation would be 1.5 years of it becoming operational.

The proposed development is anticipated to have an operational life of 40 years, after which it would be decommissioned, and the turbines dismantled and removed. With this in mind, total CO_2 emissions savings over the assumed lifetime of the proposed development is expected to be 495,649 tCO_2e. If the S36C application for an extension to the operational life of CRWF (**Chapter 1: Introduction**) is consented then the proposed development is likely to have a 37 year operational life. In this scenario the total CO_2 emissions over the assumed lifetime would be 457,027 tCO_2e.

The net GHG emissions effect of the proposed development would be **Significantly Positive** and contribute towards climate change mitigation and the UK's legally-binding emissions reduction targets.

Cumulative Effects

The Scottish government has set ambitious targets to reduce national GHG emissions to net-zero by 2045. Renewable energy is a fundamental part of this plan, and in 2021 the capacity of onshore wind increased by 3% compared to 2020 (DUKES, 2022[13]).

The proposed development, including the indicative capacity of the proposed turbines and BESS, would contribute up to 50MW of installed capacity and contribute to increasing renewable energy generation capacity across Scotland and the UK. Any other onshore wind-based energy generation projects in the Highlands, and Scotland as a whole, would be highly likely to result in total emissions savings by offsetting fossil fuel contributions to grid electricity. The cumulative effect of the proposed development, alongside other UK renewable energy projects, would be **Significantly Positive** and contribute towards climate change mitigation and the UK's legally-binding emissions reduction targets.

14.4.6 Summary of Effects

GHG emissions are predicted to arise from the manufacture, construction and decommissioning activities. In particular, the principal sources of emissions include turbine manufacture and the loss of peat and forestry from the construction of turbines and associated infrastructure. However, these GHG emissions are predicted to be offset 1.5 years after the proposed development becomes operational (against a fossil fuel mix of electricity). The proposed development is predicted to deliver total emissions savings of 495,649 tCO_2e

[13] Digest of UK Energy Statistics (DUKES) 2022, https://www.gov.uk/government/statistics/digest-of-uk-energystatistics-dukes-2022

over its maximum 40-year operational lifetime. Consequently, the proposed development contributes towards Scotland's emissions reduction targets as set out in the Climate Change (Emissions Reductions Targets) (Scotland) Act 2019, together with its renewable energy obligations as set out in the Scottish Climate Change Plan. The overall emissions impact is considered to represent a **Significant Positive** and long term climate change effect (both for the proposed development and cumulatively).

It has been assumed that all activities during the construction, operation and decommissioning would be conducted in accordance with best guidance and mitigation as outlined in the Outline CEMP (**Technical Appendix 3.1**). These commitments would be implemented in order to reduce environmental impacts, including GHG emissions, and improve effectiveness of restoration works.

14.5 References

Department of Energy and Climate Change (2011), Update of UK Shadow Flicker Evidence Base.
Digest of UK Energy Statistics (DUKES) 2022, https://www.gov.uk/government/statistics/digest-of-uk-energystatistics-dukes-2022
Forestry Commission (2009), The Scottish Government's Policy on Control of Woodland Removal
Forestry Commission Scotland (2017), Woodland Creation Application guidance. Available at: https://forestry.gov.scot/support-regulations/woodland-creation [Accessed 5/06/2023]
IEMA (2020), Major Accidents and Disasters in EIA: A Primer.
IEMA (2022), Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance.
Met Office (2019), UKCP18 Science Overview Report.
Nayak et al, 2008 (http://www.gov.scot/Publications/2008/06/25114657/0) and revised equations for GHG emissions (Nayak, D.R., Miller, D., Nolan, A., Smith, P. and Smith, J.U., 2010, Calculating carbon budgets of wind farms on Scottish peatland. Mires and Peat 4: Art. 9. Online: http://mires-and-peat.net/pages/volumes/map04/map0409.php)
Romare and Dahllöf (2017). The Life Cycle Energy Consumption and Greenhouse Gas Emissions from Lithium-Ion Batteries – a Study with Focus on Current Technology and Batteries for Light-duty Vehicles. No. C 243, IVL Swedish Environmental Research Institute.
Scottish Forestry (2019), Scottish Government's policy on control of woodland removal: implementation guidance
Scottish Government (2014), web-based guide: Onshore wind turbines: planning advice.
Scottish Government (2017). The future of energy in Scotland: Scottish energy strategy Accessed at: https://www.gov.scot/publications/scottish-energy-strategy-future-energyscotland-9781788515276/
Scottish Government (2020), Update to the Climate Change Plan 2018 – 2032 - Securing a Green Recovery on a Path to Net Zero. Available at: https://www.gov.scot/publications/securing-green-recovery-path-Net Zero-update-climate-change-plan-20182032/
Scottish Government (2022), National Planning Framework 4. Available at Scottish Government (2023), National Planning Framework 4. Available at https://www.gov.scot/publications/national-planning-framework-4/
Scottish Government (2022), The Onshore Wind Policy Statement, Available at Onshore wind: policy statement 2022 - gov.scot (www.gov.scot)

Scottish Government (2023), The Draft Energy Strategy and Just Transition Plan. Available at Draft Energy Strategy and Just Transition Plan - gov.scot (www.gov.scot)

The Climate Change (Emissions reduction targets) (Scotland) Act 2019. Available at Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 (legislation.gov.uk)

The Highland Council, Onshore Wind Energy Supplementary Guidance, November 2016 and December 2017 (Addendum).