13 CLIMATE CHANGE MITIGATION

13.1 Introduction

13.1.1 This chapter reports the outcome of the assessment of likely significant effects arising from the Proposed Development upon climate during construction, operation, and decommissioning.

13.1.2 This chapter is supported by the following appendix, presented in EIA Report **Volume 3**:

- **Technical Appendix 13.1**: The Scottish Government's Carbon Assessment Tool

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

13.1.4 For this reason, this chapter provides an estimation of:

- the GHG emissions associated with the manufacture, construction, and decommissioning of the Proposed Development; and
- the contribution which the Proposed Development would make towards the reduction of emissions, which would otherwise be produced by fossil fuel power generation.

13.1.5 Taken together, these two elements indicate the whole-life "carbon balance" of the Proposed Development, together with an understanding of the "emissions payback" period. Once emissions resulting from the manufacture, construction and decommissioning of the Proposed Development have been "paid back" (offset) by the electricity generated by the proposed wind turbines, all subsequent wind-generated electricity would displace a similar amount of conventionally generated electricity, thereby contributing to an overall GHG reduction.

13.1.6 Although often colloquially termed "carbon balance", the assessment includes all GHGs, not just carbon dioxide. The results are presented in tonnes of carbon dioxide equivalent (tCO_2e), where equivalence means having the same warming effect as CO_2 over 100 years.

13.2 Statutory and Planning Context

13.2.1 Planning and energy policy, including national and local policy objectives and requirements of legislation in relation to climate change, are summarised in **Chapter 4: EIA Process and Methodology** of the EIA Report and **Planning Statement**. Both national and local policy recognise that planning should consider the contributions a Proposed Development makes towards achieving the climate change targets. Guidance and legislation relating specifically to carbon and GHG emissions are listed below.

Legislation

13.2.2 Relevant legislation and guidance documents have been reviewed and taken into account as part of this assessment. Of particular relevance are:

- The 2015 Paris Agreement;
- The Electricity Works (Environmental Impact Assessment) (Scotland) (Regulations 2017 (as amended) (EIA Regulations); and
- The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 and the legally binding net zero target for 2045 and interim targets for 2030 and 2040.
- The Climate Change (Emissions Reduction Targets) (Scotland) Act 2024

Planning policy

13.2.3 Planning Policy is addressed in **Chapter 4** of the EIA Report, and includes recent publications including:

National

- National Planning Framework 4 (NPF4);
- Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017;
- Scottish Government (2019) The Climate Change (Emissions Reductions Targets) (Scotland) Act 2019;
- Scottish Government (2024) The Climate Change (Emissions Reduction Targets) (Scotland) Act 2024;
- The Scottish Energy Strategy (December 2017);
- The Scottish Government's declaration of a Climate Emergency (April 2019);
- Scottish Government (2018) Scottish Climate Change Plan (SCCP);
- The Scottish Climate Change Plan Update (December 2020);
- The Scottish Government's 'Programme for Government' (September 2022);
- The Onshore Wind Policy Statement (December 2022);
- The Draft Energy Strategy and Just Transition Plan (January 2023);
- The Future of Energy in Scotland: Energy Strategy (2017); and
- Scottish Planning Policy (2014).

The Climate Change (Scotland) Act (2009)Local

- The Highland Council Net Zero Strategy (2023)

Guidance

13.2.4 Recognisance has been taken of the following best practice guidelines / guidance etc:

- Institute of Environmental Management and Assessment (IEMA), now known as the Institute of Sustainability and Environmental Professionals (ISEP) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022); and
- Good Practice During Wind Farm Construction, NatureScot et al. (2019).

13.3 Consultation Undertaken

13.3.1 **Table 13.1** summarises the consultation responses regarding Climate matters and provides information on where and/or how they have been addressed in this assessment. The following regulatory bodies made comment on climate matters.

Table 13.1: Other Issues Consultation Summary

Consultee and Date received	Summary of key comments	Action Taken
The Highland Council (13.03.2024)	The assessment should highlight sustainable development attributes including for example assessment of carbon emissions / carbon savings.	This chapter includes a carbon balance assessment to determine carbon savings.
SEPA (21.02.2024)	The EIA should demonstrate environmental impact including effective mitigation of environmental risk (including climate change).	This chapter includes mitigation measures for the Proposed Development relevant to climate change.

13.4 Scope and Methodology

Scope of Assessment

13.4.1 The scope of this assessment has been established through an ongoing EIA scoping process. Further information can be found in **Chapter 4.**

13.4.2 This section provides an update to the scope of the assessment and re-iterates/updates the evidence base for scoping out matters following further iterative assessment.

Receptors/matters scoped into further assessment

13.4.3 **Table 13.2** presents the receptors/matters that are scoped into further assessment, together with appropriate justification. No change to the proposed scope of the assessment has occurred since EIA scoping.

Table 13.2: Receptor/matters scoped into further assessment

Receptor/matter	Phase	Justification	Change since EIA Scoping?
GHG emissions	Construction	Embodied carbon of wind turbines and any ancillary developments can potentially be significant. It is important to include construction-related emissions when considering the overall lifecycle emissions of the proposed development, to determine an accurate 'carbon-payback' time of the scheme.	No
GHG emissions	Operation	Aligned with ISEP guidance, a project that causes GHG emissions to be avoided has a beneficial effect that is significant.	No
GHG emissions	Decommissioning	The decommissioning process is likely to result in GHG emissions, particularly from the removal or renewal of turbines. It is important to include all emissions when considering the overall lifecycle emissions of the proposed development, to determine an accurate 'carbon-payback' time of the scheme.	No

Study Area

13.4.4 The sensitive receptor for GHG emissions is the global atmosphere, which is considered highly sensitive to GHG fluctuations. By proxy, the sensitive receptor can also be extended to the UK's commitments under the UK Climate Change Act 2008 (amended 2019), which aligned with the goals of the Paris Agreement, to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C.

13.4.5 The Proposed Development comprises an extension to the existing Millennium Wind Farm, which is located west of Fort Augustus, southwest of Invermoriston and north of Invergarry.

Baseline Methodology

Survey Methodology

13.4.6 No surveys have been undertaken to inform the climate assessment.

Desk Study

13.4.7 The assessment has been based on the methodology stated below (paragraph 13.5.10 to 13.4.16), with data inputs provided by the relevant disciplines as referenced in **Appendix 13.1**, and the outputs of the calculations also displayed within that same appendix. As this assessment relies on a specific methodological approach and internally derived data rather than external datasets or literature, confirmation of additional datasets is not applicable.

Field Study

13.4.8 All baseline surveys and data collection were carried out by the respective discipline teams, primarily the teams responsible for collecting data relating to peat. The data sources for the inputs for the carbon calculator are shown in **Appendix 13.1.**

Assessment Methodology

13.4.9 Whilst the Proposed Development is expected to deliver GHG savings over its lifetime, it could also cause GHG emissions through:

- Disturbance of peatland and other construction effects; and
- Lifecycle emissions from turbines, and other Proposed Development infrastructure.

13.4.10 The GHG assessment of the Proposed Development has been undertaken using version 2.14.1 of the Scottish Government's Carbon Assessment Tool, which is the standard way of assessing GHG emissions and savings from onshore wind farm developments. The latest online version of the Scottish Government Carbon Calculator Tool (V1.8.1) was unavailable during the course of this assessment, owing to maintenance and a server upgrade. Version 2.14.1 of the Calculator was provided (as an Excel spreadsheet calculator) by the Scottish Government's Energy Consents Unit as a suitable alternative. Despite the numbering convention, Version 2.14.1 is an older version of the tool, as the version numbering reset once the tool was moved online.

13.4.11 A detailed explanation of the Scottish Government's Carbon Assessment Tool methodology is found within **Appendix 13.1**. In brief, the calculator uses project-specific data from the construction of the Proposed Development (**Chapter 2: Proposed Development**) and the receiving environment (**Chapter 5 to Chapter 14**), particularly with regards to peat disturbance. This allows GHG emissions and avoidance to be quantified across the project lifecycle phases (construction, operation, and decommissioning/site restoration). Specific information concerning the embodied emissions of materials, which would account for turbine manufacture and delivery, is assumed directly through the Carbon Assessment Tool.

13.4.12 Calculations are provided for minimum, maximum and expected scenarios, whereby the minimum scenario assumes the lowest energy output and the lowest carbon losses from the Proposed Development, and the maximum assumes highest energy output and highest carbon losses.

13.4.13 The GHG emissions and savings are combined to establish the overall (net) GHG effect of the Proposed Development, as well as its carbon payback period.

13.4.14 Results from this assessment are reported below in accordance with ISEP's Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (IEMA, 2022).

Significance

13.4.15 Given the international urgency of climate change, the sensitivity of the receptor (i.e. global atmosphere) to fluctuations in GHG emissions is considered 'Very High'. The magnitude of the impact is linked to the volume of GHG emissions emitted or avoided. However, in accordance with ISEP guidance, it is not considered necessary to determine the sensitivity of the receptor or the magnitude of the impact in order to assess the significance of the effects of GHG emissions. Therefore, no further reference to receptor sensitivity or impact magnitude has been made in this chapter. The level of the effect, and whether or not it is significant, has been determined through consideration of the quantity, and timing, of GHG emissions and the likelihood of avoiding severe climate change. **Table 13.3** presents the significance criteria used for the assessment.

13.4.16 Aligned with Assessing Greenhouse Gas Emissions and Evaluating their Significance (ISEP, 2022), any project that causes greenhouse gases to be avoided, or removed from the atmosphere, has a beneficial effect that is always significant. In such a scenario, the project substantially exceeds the national net zero requirements and is thus aligned with the goal of the Paris Agreement to limit temperature rise to well below 2°C, aiming for 1.5°C.

Table 13.3: ISEP Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022) Framework for assessment of significant effects

Significance	Level	Criteria
Significant	Major adverse	Project adopts a business-as-usual approach, not compatible with the national Net Zero trajectory, or aligned with the goals of the Paris Agreement (i.e., a science-based 1.5°C trajectory). GHG impacts are not mitigated or reduced in line with local or national policy for projects of this type.
	Moderate adverse	Project's GHG impacts are partially mitigated, and may partially meet up-to-date policy; however emissions are still not compatible with the national Net Zero trajectory or aligned with the goals of the Paris Agreement.
Not significant	Minor adverse	Project may have residual emissions, but the project is compatible with the goals of the Paris Agreement, complying with up-to-date policy and good practice.
	Negligible	Project has minimal residual emissions and goes substantially beyond the goals of the Paris Agreement, complying with up-to-date policy and best practice.

Significance	Level	Criteria
Significant	Beneficial	Project causes GHG emissions to be avoided or removed from the atmosphere, substantially exceeding the goals of the Paris Agreement with a positive climate impact.

Assessment Limitations

13.4.17 The inputs to the Scottish Government Carbon Calculator Tool were obtained from the relevant topic specialists. The accuracy of a GHG assessment depends on the quality of the data provided. Primary data should always be used where available. Where it is not possible to collect this data, in view of the fact that this assessment represents a forecast of emissions and some information may not yet be known, secondary data will be used. Such as: estimates, extrapolations, benchmarks and proxy data from default values provided by the Scottish Government Carbon Calculator Tool, professional judgement from technical specialists and scientific literature. See **Appendix 13.1** for further detail on data sources.

13.4.18 Any further assumptions and limitations would relate to the data collection process carried out by the discipline teams, which will be expanded upon in the respective chapter.

Receptors / Matters Scoped Out of Assessment

13.4.19 In Scotland, climate change is projected to result in warmer temperatures, increased rainfall and sea level rise. None of these trends are anticipated to have a likely significant effect upon the Proposed Development by virtue of its in-built resilience (with respect to temperature) and the elevated position and general in-land location of turbines (with respect to both rainfall and sea level rise).

13.4.20 A further variable with respect to the changing climate is sea level pressure which contributes towards wind speed. Projections relating to sea level pressure show considerable uncertainty. As braking mechanisms on turbines allow for operation only under specific wind speeds, should severe windstorms be experienced, then the turbines would shut down. Overall, it is unlikely that significant effects upon the Proposed Development will arise as a result of climate change, and the 'Climate Resilience' topic can be scoped out of further assessment.

13.5 Existing Environment

Existing Baseline Conditions

13.5.1 The baseline conditions describe the conditions of a business-as-usual scenario whereby the Proposed Development is not undertaken. The baseline comprises existing carbon stock and sources of GHG emissions of the existing activities within the Site boundary.

13.5.2 The land within the Site is dominated by heather moorland with areas of grassland, sedges, and reeds in wetter areas. The land comprises of a range of peat depths, the majority from 0 - 1.5 m. There are also small pockets of 2 - 3 m peat depth. For further information on the

peatland habitat within the Site, refer to **Chapter 8: Hydrology, Geology, Hydrogeology and Peat**.

13.5.3 Given these baseline characteristics, it is likely that the Site presently sequesters carbon. No significant GHG emissions are expected to occur from the Site.

Sensitive Receptors

13.5.4 The sensitive receptor for GHG emissions is the global atmosphere, which is considered highly sensitive to GHG fluctuations.

13.6 Future Baseline

13.6.1 No change is expected for the future baseline when compared to the current baseline. It is unlikely that under a future 'business-as-usual' scenario there would be any significant changes to the amount of GHG emissions from the Site, either positive or negative.

13.7 Design Considerations

13.7.1 This assessment has been based on the principle that measures have been 'embedded' into the design of the Proposed Development to remove potential significant effects as far as practicable, for example by the considered placement of infrastructure. **Chapter 2** identifies the project principles and design mitigation that has been embedded into the design of the Proposed Development.

13.8 Assessment of Effects

Net GHG Effect

13.8.1 Given the Proposed Development's projected operational life of 35 years, its total GHG savings are expected to be 2,479,023 tCO_2e, inclusive of construction, operation, and decommissioning against a fossil fuel mix electricity generation, and 1,188,724 tCO_2e against grid-mix electricity generation.

13.9 Embedded Mitigation

13.9.1 It has been assumed that all activities during construction, operation and decommissioning would be conducted in accordance with good practice guidance.

13.9.2 Relevant guidance includes:

- Good Practice During Wind Farm Construction, NatureScot et al. (2019); and
- Life Extension and Decommissioning of Onshore Windfarms, SEPA (2016).

13.9.3 Further, it is assumed that mitigation outlined in the Schedule of Environmental Commitments (**Technical Appendix 2.2**) would be implemented to reduce environmental impacts, including GHG emissions, and improve effectiveness of restoration works.

Design Considerations

13.9.4 Peat disturbance has been considered during the design process, which has sought to avoid areas of deep peat. In addition, no felling is required by design. The site design process is described in **Chapter 2** whilst specific details relating to peat depth (**Chapter 8**) are included in elsewhere in the EIA.

Best Practice measures

13.9.5 Best practice measures are outline in the guidance included above.

13.10 Potential effects

13.10.1 The results of the carbon balance assessment (Scottish Government Carbon Calculator Tool, 2023) carried out for the Proposed Development are presented below for each project stage. The project-specific input and output data is contained within **Appendix 13.1**, alongside the detailed methodology of the calculator.

Construction and Decommissioning

13.10.2 **Table 13.4** presents the results of the GHG balance assessment for the manufacture, construction, and decommissioning phases of the Proposed Development. The lack of significant peat on Site results in minimal predicted GHG emissions from soil organic matter, and no emissions are predicted from the felling of forestry because it is not relevant for this Proposed Development. Total projected emissions are 81,315 tCO_2e.

Table 13.4: Predicted GHG emissions from wind farm manufacture, construction, and decommissioning

Source of GHG Emissions/Savings	GHG Emissions (tCO_2e)	% of Total Emissions
Losses due to turbine manufacture, construction, and decommissioning	43,698	54%
Losses due to back-up power generation	32,240	40%
Losses due to reduced carbon fixing potential	214	0.3%
Losses from soil organic matter	5,017	6%
Losses due to Dissolved Oxygen Content and Portable Oxygen Content	146	<0.1%
Losses due to forestry felling	0	0
Total	**81,315**	**100%**

13.10.3 Any post-decommissioning site restoration and enhancement work, such as blocking drainage ditches to promote re-wetting, would be aligned with **Technical Appendix 6.7: Outline Biodiversity Enhancement Management Plan**. Such activities can incur GHG savings by promoting growth of peat or other natural carbon stores. Other management options may occur during the Habitat Management Planning stage.

13.10.4 **Table 13.5** shows the total CO_2 gains due to site improvement during post-decommissioning (tCO_2e).

Table 13.5: Total CO_2 savings due to Improvement of the Site (tCO_2e)

Improvement	GHG Emissions (tCO_2e)	% of total
Change in emissions due to improvement of degraded bogs	-39,201	100%
Change in emissions due to improvement of felled forestry	0	0
Change in emissions due to restoration of peat from borrow pits	0	0
Change in emissions due to removal of drainage from foundations and hardstanding	0	0
Total change in emissions due to improvements	-39,201	100%

13.10.5 Taking into account the predicted GHG emissions from wind turbine manufacture, construction and decommissioning alongside those savings from the improvement of the Site, the total net GHG emissions from the Proposed Development are expected to be 42,114 tCO_2e (**Table 13.6**).

Table 13.6: Total net GHG emissions from the Proposed Development

	GHG emissions (tCO_2e)	GHG Savings (tCO_2e)
Predicted GHG emissions from wind turbine manufacture, construction, and decommissioning	81,315	-
Total CO_2 gains/savings due to improvement of the Site	-	39,201
Total net GHG emissions from wind farm manufacture, construction, decommissioning and improvement of site	**42,114**	

Operation

13.10.6 The operational phase of the Proposed Development (35 years) has the greatest potential for GHG savings. At this phase, GHG emissions from construction activities would have

ceased and operation of the turbines would generate zero-carbon electricity for the remainder of their lifespan.

13.10.7 **Table 13.7** presents projected annual emissions savings as measured against the fossil fuel-mix (electricity that is sourced through the combustion of fossil fuels alone) and grid-mix (electricity from the National Grid; this could include be sourced from fossil fuels, renewable energy, nuclear, etc) of electricity.

Table 13.7: Annual Emissions Savings Against Fossil Fuel Electricity Generation Mix

GHG savings*	GHG savings (tCO_2e)		
	Expected value	Minimum value	Maximum value
Grid mix electricity generation			
GHG savings per year	35,167	31,587	36,252
Lifetime GHG savings*	1,188,724	1,002,266	1,262,171
Fossil fuel mix electricity generation			
GHG savings per year	72,032	64,699	74,255
Lifetime GHG savings*	2,479,023	2,161,203	2,592,282
***GHG savings based over a lifetime of 35 years, and taking into account those emissions caused by the Proposed Development (Table 13.6)**			

Emissions Payback Period

13.10.8 The emissions payback period is calculated by dividing the total expected emissions caused by the Proposed Development for the manufacture, construction and decommissioning phases (81,315 tCO_2e: **Table 13.4**) by expected annual savings from operation (**Table 13.5**). This gives a predicted emissions payback of 1.2 years against grid-mix electricity generation, and 0.6 years against a fossil-fuel mix electricity generation.

Table 13.8: Carbon Payback Period of the Proposed Development for a Range of Capacity Factors

	Carbon payback time (years)		
	Expected value	Minimum value	Maximum value
Grid mix electricity generation	1.2	0.2	3.3
Fossil fuel mix electricity generation	0.6	0.1	1.6

13.11 Additional Mitigation and Residual Effects

Additional Mitigation

As no adverse effects are predicted, no additional mitigation measures are proposed.

Residual effects

13.11.1 GHG emissions will arise from the manufacture, construction and decommissioning activities, including the loss of peat, from the construction of turbines and associated infrastructure.

13.11.2 These emissions are projected to be offset 0.6 years after the Proposed Development becomes operational against a fossil fuel mix of electricity, or 1.2 years against a grid-mix of electricity. The Proposed Development is predicted to deliver total emissions savings of 2,479,023 tCO_2e over its 35-year operational lifetime, against a fossil fuel mix electricity generation, and emissions savings of 1,188,724 tCO_2e over its 35-year operational lifetime, against a grid-mix electricity generation.

13.11.3 The overall effect is considered to be **Significant** and **Beneficial**, and would contribute to long-term climate change mitigation. Consequently, the Proposed Development would contribute towards Scotland's emissions reduction targets as set out in the Climate Change (Emissions Reductions Targets) (Scotland) Act 2024, together with its renewable energy obligations as set out in the Scottish Climate Change Plan.

13.12 Summary of Effects

13.12.1 A summary of effects for each project phase is presented in **Table 13.9**. ISEP's Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022) Framework for assessment of significant effects, which forms the significance criteria used throughout this chapter, is intended to assess the significance of a project as a whole, as opposed to individual project phases. The overall significance of effects for the Proposed Development is **Significant** and **Beneficial**.

Table 13.9: Summary of Climate Change Effects

Receptor	Phase	Assessment Consequence	Assessment Significance
Global Atmosphere	Whole Lifecyle (Construction, Operation, and Decommissioning)	The Proposed Development is anticipated to result in GHG Savings of 1,188,724 tCO_2e against a grid-mix electricity generation over its 35-year lifespan, and 2,479,023 tCO_2e against a fossil fuel mix electricity generation.	**Significant** and **Beneficial**

13.13 References

ISEP (2022) Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance.

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