March 2025

Glen Earrach Pumped Storage Hydro

Environmental Impact Assessment Report

Volume 2: Main Report
Chapter 17: Climate

Glen Earrach Energy Ltd

Glen Earrach AECOM

Quality information

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1	March 2025	Submission	DL	DL	Technical Director – Renewable Energy

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Appendices (Volume 5)

17. Climate

17.1 Introduction

17.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) identifies the potential impacts and effects of the proposed Glen Earrach Pumped Storage Hydro (PSH) scheme (hereafter referred to as the Proposed Development) on the climate, as well as the impacts and effects of climate change on the Proposed Development that are to be considered as part of the EIAR. For a description of the Proposed Development, refer to **Chapter 2: Description of the Project (Volume 2: Main Report)**.

17.1.2 This Chapter sets out the scope and methodology for the assessment of effects of the Proposed Development on the climate and the impact of climate change on the Proposed Development. This has been informed by an overview of the environmental baseline conditions and projections of future variance in identified key climatic variables.

17.1.3 This chapter is supported by technical appendices:

- **Appendix 17-1: Climate Change Risk Assessment;** and
- **Appendix 17-2: In-combination Climate Change Impact Assessment**.

17.1.4 To align with the requirements of The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017[1] and guidance from the Institute of Environmental Management and Assessment (IEMA) on Assessing Greenhouse Gas (GHG) Emissions and Evaluating their Significance[2] and Climate Change Resilience and Adaptation[3], this chapter undertakes and presents three separate assessments:

1. Lifecycle GHG Impact Assessment: the impact of GHG emissions arising from the Proposed Development on the climate over its lifetime (Regulation 4(4)(c) and Schedule paragraph 4(4) and 4(5) of the EIA Regulations);
2. Climate Change Risk Assessment (CCRA): the resilience and vulnerability of the Proposed Development to potential impacts of climate change (Schedule 4 paragraph 5(f) of the EIA Regulations); and
3. In-combination Climate Change Impact (ICCI) Assessment: the combined impact of the Proposed Development and future climate change on the surrounding environment and sensitive receptors, as identified by the technical disciplines (Regulation 4(2) of the EIA Regulations).

17.1.5 This chapter should be read in conjunction with:

- **Chapter 2: Project and Site Description;**
- **Chapter 5: Policy and Legislation;**
- **Chapter 6: Landscape and Visual;**
- **Chapter 7: Terrestrial Ecology;**
- **Chapter 8: Ornithology;**
- **Chapter 9: Aquatic and Marine Ecology;**
- **Chapter 10: Water Environment;**
- **Chapter 11: Flood Risk and Water Resources;**
- **Chapter 12: Cultural Heritage;**
- **Chapter 13: Access, Traffic & Transport;**

[1] UK Government (2017). *The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017.* Available at: https://www.legislation.gov.uk/ssi/2017/101/contents [Accessed 29th October 2024]
[2] IEMA (2022). Assessing Greenhouse Gas Emissions and Evaluating their Significance. Available at: https://www.iema.net/resources/blogs/2022/02/28/iema-launch-of-the-updated-eia-guidance-on-assessing-ghg-emissions-february-2022/ [Accessed 29th October 2024]
[3] IEMA (2020). Climate Change Resilience and Adaptation. Available at: https://www.iema.net/content/iema-eia-guide-to-climate-change-resilience-and-adaptation-2020/ [Accessed 29th October 2024]

- **Chapter 15: Geology & Ground Conditions;**
- **Chapter 16: Socioeconomics, Tourism and Recreation**; and
- **Chapter 18: Forestry.**

17.1.6 These chapters set out the specifications of the Proposed Development, the scope of the EIAR, the policy context and related technical assessments.

17.1.7 As described within **Chapter 2 Project and Site Description** and summarised within **Chapter 3 Evolution of Design and Alternatives (Volume 2: Main Report)**, the Proposed Development presents two options, Option A and Option B. The differences between these options involve the location of the below ground works and the associated positioning of the Upper Control Works within the Headpond footprint. This assessment has considered both Options A and B; regardless of which option is taken forward, the conclusions of the Climate assessment remain the same for both.

17.2 Legislation and Policy

Legislation

17.2.1 A brief overview of the international and national legislation and commitments relevant to the climate assessments in this chapter has been given in **Table 17-1: Legislation relevant to the climate assessments.**

Table 17-1: Legislation relevant to the climate assessments

Policy Reference	Policy Context
International	
United Nations Framework Convention on Climate Change Paris Agreement[4]	The Paris Agreement requires all signatories to strengthen their climate change mitigation efforts to keep global warming to below 2°C this century and to pursue efforts to limit global warming to 1.5°C. Within the UK's ratification of this agreement, it has committed to reducing GHG emissions by at least 81% by 2035 compared to 1990 levels under its Nationally Determined Contribution[5]. This target was published in January 2025.
National	
The Climate Change Act 2008[6]	The Climate Change Act 2008 makes it the duty of the Secretary of State to reduce net greenhouse gas emissions in order to mitigate climate change. It set the original legally binding goal for reducing UK greenhouse gas emissions by 2050, a target of an at least 80% reduction below 1990 levels.
The Climate Change Act 2008 (2050 Target Amendment) Order 2019[7]	Building on the Climate Change Act 2008, amendments were made in 2019 to legislate a long-term economy-wide target to reach net zero greenhouse gas emissions by 2050, as advised by the Climate Change Committee (CCC). It reflects the increased ambition of the 2015 UN Paris Agreement.
The Climate Change (Scotland) Act 2009[8]	The Climate Change (Scotland) Act 2009 originally set a legally binding target for Scotland to reduce its greenhouse gas (GHG) emissions from 1990 levels by at least 80% by 2050 to help ensure the delivery of these targets. This part of the Act also requires that the Scottish Ministers set annual targets, in secondary legislation, for Scottish emissions from 2010 to 2050.
Climate Change (Emissions Reduction Targets) (Scotland) Act 2019[9]	In 2019, The Climate Change (Scotland) Act 2009 was amended by the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, increasing the ambition of Scotland's emissions reduction targets to net zero by 2045 and revising interim and annual emissions reduction targets. The amendments also update arrangements for Climate Change Plans to meet the targets.

[4] UNFCCC (2015). *The Paris Agreement*. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement [Accessed 29th October 2024]
[5] UK Government (2022). UK's Nationally Determined Contribution. Available at: https://www.gov.uk/government/publications/uks-2035-nationally-determined-contribution-ndc-emissions-reduction-target-under-the-paris-agreement [Accessed 19th March 2025]
[6] UK Government (2008). Climate Change Act 2008. Available at: https://www.legislation.gov.uk/ukpga/2008/27/contents [Accessed 19th March 2025].
[7] UK Government (2019). The Climate Change Act 2008 (2050 Target Amendment) Order 2019. Available at: https://www.legislation.gov.uk/ukdsi/2019/9780111187654 [Accessed 19th March 2025]
[8] Scottish Government (2019). Climate Change (Scotland) Act 2009. Available at: https://www.legislation.gov.uk/asp/2009/12/contents [Accessed 25th October 2024]
[9] Scottish Government (2019). *Climate Change (Emissions Reduction Targets) (Scotland) Act 2019*. Available at: https://www.legislation.gov.uk/asp/2019/15/contents [Accessed 25th October 2024]

Policy Reference	Policy Context
Climate Change (Emissions Reduction Targets) (Scotland) Act 2024[10]	The Scottish Government has acknowledged that the UK is substantially off track for 2030 commitments, issuing a new Climate Change (Emissions Reduction Targets) (Scotland) Act in November 2024. While 2030 interim targets are out of reach, the legal commitment to net zero 2045 is retained. This new legislation will replace the existing annual targets with multi-year budgets however, these budgets will not be set until 2025. The Climate Change Committee (CCC) will advise on these alongside their advice on the UK's national 7th Carbon Budget period. Until this occurs, the existing annual targets remain in force.
The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017[1]	The EIA Regulations state that an EIA (where relevant) must include: *"a description of the likely significant effects of the development on the environment resulting from... the impact of the development on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the development to climate".*

National Planning and Energy Policy

17.2.2 National Planning Policy and energy-specific guidance and frameworks relevant to the climate assessments in this chapter is detailed in **Table 17-2: National Planning and Energy Policy relevant to the climate assessments**.

Table 17-2: National Planning and Energy Policy relevant to the climate assessments

Policy Reference	Policy Context
Securing a green recovery on a path to net zero: climate change plan 2018 – 2030 – update[11]	This document updates the 2018 Climate Change Plan to reflect new targets set by the Climate Change Act 2019, as well as Scotland's green recovery from COVID-19. This recognises that there is a chance to rebuild the economy to deliver a greener and more equal society. In line with the 2018 plan, the focus is on the period up to 2032.
Infrastructure Investment Plan[12]	The 2021 Infrastructure Investment Plan (IIP) covers the delivery of the National Infrastructure Mission commitment to boost economic growth over 2021 – 2026. The definition of infrastructure in Scotland is defined more widely than other parts of the UK, to include digital and social infrastructure and, for the first time, natural infrastructure. The Plan recognises new challenges that Scotland faces since the 2015 IIP like economic, health, and social harm from COVID-19, the UK's exit from the European Union, and several other long-term trends e.g. climate change, technological advancements, and demographic changes. The IIP adopts a single vision for infrastructure investment choices: *"Our infrastructure supports Scotland's resilience and enables inclusive, net zero, and sustainable growth"* (page 21). In supporting this vision, the Plan focuses on three key themes. The three themes in the IIP for guiding investment decisions are directly linked to Scotland's National Performance Framework, which sets out the Government's overall purpose: *Enabling the transition to net zero emissions and environmental sustainability*: Public infrastructure investment has a critical role to play in tackling the twin crises of climate change and biodiversity loss. We will increase spending on low-carbon measures, climate resilience, and nature-based solutions. *Driving inclusive economic growth:* We can boost productivity and competitiveness and create good jobs and green jobs by enhancing our transport and digital connectivity and capacity in all areas of Scotland and by stimulating innovation. We will embed fairness and inclusion, seeking to ensure no one is left behind. *Building resilient and sustainable places*: Delivering on our ambition for a fairer Scotland starts at the local community level. We will invest in housing and improve local service delivery. With our partners, we will meet the diverse economic, social, and environmental needs of urban, rural, and island areas (page 21). Climate change is recognised as a long-term trend which impacts on the provision of infrastructure. In response, it is noted that there is a need to adapt current infrastructure and design future assets to be more resilient to the effects of climate change, alongside investing in natural infrastructure and nature-based solutions which help tackle the biodiversity crisis and create wider socioeconomic benefits.
National Planning Framework 4 (NPF4)[13]	The National Planning Framework 4 (NPF4) was adopted by Scottish Ministers on 13th February 2023. NPF4 sets out how the Scottish Governments' approach to planning and development will help to achieve a net zero, sustainable Scotland by 2045.

[10] Scottish Parliament (2024). Climate Change (Emissions Reduction Targets) (Scotland) Act. Available at: https://www.parliament.scot/bills-and-laws/bills/s6/climate-change-emissions-reduction-targets-scotland-bill [Accessed 19th December 2024]
[11] Scottish Government (2020). Securing a green recovery on a path to net zero: climate change plan 2018-2032 – update. Available at: https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/pages/2/ [Accessed 25th October 2024]
[12] Scottish Government (2021). A National Mission with Local Impact: Infrastructure Investment Plan for Scotland 2021-22 to 2025-26. Available at: https://www.gov.scot/publications/national-mission-local-impact-infrastructure-investment-plan-scotland-2021-22-2025-26/ [Accessed 25th October 2024]
[13] Scottish Government (2023). National Planning Framework 4 (NPF4). Available at: https://www.gov.scot/publications/national-planning-framework-4/ [Accessed 25th October 2024]

Policy Reference	Policy Context
	With regards to climate change, NPF4 aims to deliver 'Sustainable Places' where *"we reduce emissions, restore and better connect to biodiversity*" (page 4). One of the six overarching principles set out in NPF4 to support the delivery of future places is 'Just Transition,' which states that "*we will empower people to shape their places and ensure the transition to net zero is fair and inclusive".* Sustainable Places Policy 1 'Tackling the Climate and Nature Crises' encourages, promotes and facilitates "*development that addresses the global climate emergency and nature crisis*" (page 37). Sustainable Places Policy 2 'Climate Mitigation and Adaption' aims to "*encourage, promote and facilitate development that minimises emissions and adapts to the current and future impacts of climate change*". NPF4 goes on to state that "*development proposals will be sited and designed to adapt to current and future risks from climate change*" (page 37). Pumped hydro is discussed within the framework's section on energy systems, aligning with Scotland's broader energy strategy to develop renewable energy generation and storage solutions. NPF4 also highlights in Policy 5d that developments on peatlands need to assess the net effect of that development on climate emissions and loss of carbon.
Overarching National Policy Statement for energy (EN-1)[14]	This National Policy Statement (NPS) policy paper provides planning guidance for developers of nationally significant energy infrastructure projects. It highlights the urgency of decarbonizing the power sector as a critical step toward mitigating climate change and prioritises the development of low-carbon energy sources. Projects must demonstrate resilience to the impacts of climate change with adaptation measures being required to ensure long-term sustainability and operational reliability of energy infrastructure. While planning is devolved to Scottish Ministers, energy policy is generally a matter reserved to UK Ministers, and this NPS may therefore be a relevant consideration in planning decisions in Wales and Scotland.
National Policy Statement for renewable energy infrastructure (EN-3)[15]	The NPS sets out the national policy for energy infrastructure required to ensure the UK can provide a secure, reliable and affordable energy supply. EN-3 specifically discussed the role of pumped hydro storage in section 2.9, stating that few technologies are able to provide storage services at the scale of PHS. With increasing needs for storage with renewable generators like offshore wind, PHS could be a key piece of infrastructure for enabling increased use of renewable generation.
Clean Power 2030 Action Plan: A new era of clean electricity[16]	In December 2024, the UK Government issued an action plan to set out a pathway to a lean power system by 2030. It aims to tackle three major challenges: the need for a secure and affordable energy supply, the creation of essential new energy industries, and the need to reduce GHG emissions. This Plan explicitly highlights the need for scaling up PSH developments to provide low carbon long-duration flexibility.
Draft Energy Strategy and Just Transition Plan[17]	To prepare for a just energy transition, the Scottish Government has produced the Draft Energy Statement and Just Transition Plan which sets out the scale of opportunity from transforming the way Scotland generates, transports, and uses energy. The plan includes goals like adding 20 GW of renewable electricity by 2030, accelerated decarbonisation of industry, transport, and heat, and the establishment of a national public energy agency. The plan also focuses on ensuring a just transition by maximising employment, manufacturing, and export opportunities in the energy sector. Again, this document specifically discusses the importance of pumped storage hydro as an essential storage solution for facilitating the connection of more renewable energy to the national grid.

Local Planning Policy

17.2.3 A summary of the local planning policy relevant for the climate assessments in this chapter is given in **Table 17-3: Local Planning Policy relevant to the climate assessments.**

[14] UK Government (2024). Overarching National Policy Statement for energy (EN-1). Available at: https://www.gov.uk/government/publications/overarching-national-policy-statement-for-energy-en-1 [Accessed 19th December 2024]
[15] Department for Energy Security and Net Zero (DESNZ) (2023). National Policy Statement for renewable energy infrastructure. Available at: https://www.gov.uk/government/publications/national-policy-statement-for-renewable-energy-infrastructure-en-3 [Accessed 25th October 2024]
[16] UK Government (2024). Clean Power 2030 Action Plan. Available at: https://www.gov.uk/government/publications/clean-power-2030-action-plan [Accessed 19th December 2024]
[17] Scottish Government (2023) Draft Energy Statement and Just Transition Plan. Available at: https://www.gov.scot/publications/draft-energy-strategy-transition-plan/ [Accessed 29th October 2024]

Table 17-3: Local Planning Policy relevant to the climate assessments

Policy Reference	Policy Context
The Highland Council Net Zero Strategy[18]	The Highland Council strategy sets out the Council's approach to addressing the climate emergency and contributing towards Scotland's national legally binding target to become net zero by 2045. The council adopts this target and aims to achieve key interim targets – reduce emissions by at least 75% by 2030 and by at least 90% by 2040.
Highland-wide Local Development Plan (HwLDP)[19]	This is the vision for the entire Highland area, setting out how land can be used by developers for the next 20 years. The HwLDP should be read in conjunction with NPF4 as it is currently under review, seeking to combine three area Local Development Plans into a new, single Highland Local Development Plan expected by the end of 2027[20].
Highland Nature Biodiversity Action Plan 2021 - 2026[21]	The Highland region supports over 75% of UK priority habitats and is recognised for its nature, specialised biodiversity, and carbon sequestration in peat layers. This action plan aims to protect biodiversity in the Highlands as a means of both conserving local ecosystems and addressing climate change. It is supported by over 40 local and national partners and includes specific actions that emphasise habitat restoration and species protection. One of the primary focuses is the restoration of peatlands and wetlands, which are highly effective carbon sinks.

17.3 Consultation

17.3.1 A scoping exercise was undertaken to establish the content of the assessment and the approach and methods to be followed.

17.3.2 The Scoping Report found in **Appendix 4.1: Glen Earrach Pumped Storage Hydro Scoping Report (Volume 5: Appendices)**, was issued on 26 April 2024 and records the findings of the scoping exercise. It also details the technical guidance, standards, best practice, and criteria to be applied in the assessment to identify and evaluate the likely significant effects of the Proposed Development on climate change.

17.3.3 The Scoping Opinion was received on 17 December 2024 and can be found in **Appendix 4.2: Scoping Opinion (Volume 5: Appendices).** No feedback in relation to climate was received from stakeholders at scoping.

17.4 Lifecycle Greenhouse Gas Impact Assessment

Study Area

17.4.1 The Study Area for the lifecycle GHG impact assessment covers all direct GHG emissions arising from activities undertaken at the Proposed Development Site during the Pre-Construction and Enabling, Construction, and Operational (including maintenance) phases of the Proposed Development. It includes indirect emissions outside of the Proposed Development Site, including emissions embedded within the construction products and materials arising as a result of the energy used for their production, and emissions from the transportation of products and materials, waste, and site workers.

17.4.2 The environmental impact associated with GHG emissions is a national and global issue. Consequently, the significance of the Proposed Development's lifecycle GHG emissions will be assessed by comparing the estimated GHG emissions from the Proposed Development against the reduction targets defined in the Climate Change (Scotland) Act 2009[22] and Scotland's forecast trajectory towards net zero by 2045.

[18] The Highland Council (2023). Net Zero Strategy. Available at: https://www.highland.gov.uk/info/1210/environment/321/climate_change/2 [Accessed 13th November 2024]
[19] The Highland Council (2012). Highland-wide Local Development Plan. Available at: https://www.highland.gov.uk/info/178/development_plans/199/highland-wide_local_development_plan [Accessed 13th November 2024]
[20] The Highland Council (2024). Highland Local Development Plan. Available at: https://www.highland.gov.uk/info/178/development_plans/1101/highland_local_development_plan_hldp [Accessed 13th November 2024]
[21] The Highland Council (2021). Highland Nature Biodiversity Action Plan 2021 to 2026. Available at: https://www.highland.gov.uk/downloads/file/27148/highland_nature_biodiversity_action_plan_2021_%E2%80%93_2026 [Accessed 13th November 2024]
[22] Scottish Government (2019) Climate Change (Scotland) Act 2009. Available at: https://www.legislation.gov.uk/asp/2009/12/contents [Accessed 25th October 2024]

Methodology

17.4.3 The methodology described in the following section has been developed in line with the relevant EIA Regulations (see **Section 17.2 Legislation and Policy**) and IEMA guidance on assessing GHG emissions and their significance in EIA terms[2].

Guidance and Standards

17.4.4 The potential effects of the Proposed Development on the climate are calculated in line with PAS2080: 2023 guidance[23] and the GHG Protocol[24]. These guidance documents have also been used to identify GHG 'hotspots' i.e. materials and activities likely to generate the largest proportion of emissions, which has enabled priority areas for mitigation to be identified. This approach is consistent with the principles set out in IEMA's guidance for assessing GHG emissions and evaluating their significance, the most central guidance for the lifecycle GHG impact assessment.

17.4.5 In addition, peatland emission factors were taken from the Scottish Government Wind Farm Carbon Calculation Tool[25] to understand potential land use change emissions.

Assessment Scope

17.4.6 The assessment considers the effects during the three phases of the Proposed Development's lifespan as identified in **Section 2.16 – 2.20 of Chapter 2: Project and Site Description.** These are the Pre-construction and Enabling, Construction, and Operational Phases.

17.4.7 The decommissioning phase has been scoped out of this assessment due to the long operational lifespan of the facility. Subsequent refurbishment or decommissioning plans would be prepared as required for planning.

Baseline Data Collection

Desk Study

17.4.8 In preparation of the baseline data for the lifecycle GHG impact assessment, the following sources of published information have been used:

- Civil Engineering Standard of Measurement 4 (CESMM 4) Price Book[26]: emissions factors to determine the GHG emissions for the underground excavations;
- Bath Inventory of Carbon and Energy (ICE V4.0)[27]: emission factors to determine the carbon emissions from building materials;
- Department of Energy Security & Net Zero (DESNZ) 2024[28]: emission factors to determine the GHG emissions from fuel usage and waste;
- Scottish Government Wind Farm Carbon Calculator[24]: to determine the GHG emissions associated with the excavation of peat; and
- UK Government Greenbook[29]: for determining the GHG impact of grid decarbonisation.

Assessment Methodology

Sensitivity

17.4.9 Where activity data has allowed, expected GHG emissions arising from the Pre-construction and Enabling, Construction and Operational activities, and embodied carbon in materials of the Proposed Development, have been quantified using a calculation-based methodology as per the following equation in line with the GHG Protocol[21], accompanied with the conversion factors for company reporting published by DESNZ[25]:

[23] British Standards Institute (2023). PAS Standard: Carbon Management in Infrastructure and Built Environment. Available at: https://www.bsigroup.com/en-GB/insights-and-media/insights/brochures/pas-2080-carbon-management-in-infrastructure-and-built-environment/ [Accessed 29th October 2024]
[24] Greenhouse Gas Protocol (n.d.). Standards. Available at: https://ghgprotocol.org/standards [Accessed 29th October 2024]
[25] Scottish Government (2014). Scottish Government Windfarm Carbon Assessment Tool – Version 2.9.0. [Accessed 13th November 2024]
[26] Mott Macdonald (2013). CESMM4 Carbon & Price Book 2013. Available at: https://www.icevirtuallibrary.com/doi/book/10.1680/ccpb2013.58125 [Accessed 29th October 2024].
[27] University of Bath (2024) Bath Inventory of Carbon and Energy (ICE). Available at: https://circularecology.com/embodied-carbon-footprint-database.html [Accessed 15th December 2024]
[28] DESNZ (2024). Conversion Factors 2024: Methodology. Available at: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024 [Accessed 13th November 2024]
[29] DESNZ (2012). Green Book supplementary guidance: valuation for energy use and greenhouse gas emissions for appraisal. Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal [Accessed 13th November 2024]

Activity data x GHG emissions factor = GHG emissions value

17.4.10 In line with the GHG Protocol, when defining potential impacts (or 'hot spots'), the seven Kyoto Protocol GHGs have been considered, namely:

- Carbon dioxide (CO2);
- Methane (CH4);
- Nitrous oxide (N2O);
- Sulphur hexafluoride (SF6);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and
- Nitrogen trifluoride (NF3).

17.4.11 These GHGs are broadly referred to in this chapter under an encompassing definition of 'GHG emissions', with the unit of tCO_2e (tonnes CO_2 equivalent) or $MtCO_2e$ (Million tonnes of CO_2 equivalent).

17.4.12 Where data is not available, a qualitative approach to addressing GHG impacts has been followed, in line with the IEMA guidance for assessing GHG emissions in EIA.

17.4.13 **Table 17-4: Potential sources of GHG emissions** summarises the key anticipated GHG emissions sources associated with the Proposed Development, in line with the 'Publicly Available Standard (PAS) 2080 – carbon management in infrastructure'.

Table 17-4: Potential sources of GHG emissions

Lifecycle stage	Activity	Primary emission sources
Pre-construction Stage	Any enabling works, land clearance, and disposal of waste generated during the enabling works	Material GHG emissions are expected from fuel use, electricity use, loss of carbon sink and waste disposal.
Construction Stage	Raw material extraction, product manufacture of construction materials, electricity use, on-site fuel use, waste disposal, and transport	Material GHG emissions are expected from embodied carbon of materials, electricity use, fuel use, and waste disposal
Operation Stage	Raw material extraction, product manufacture for operational materials, electricity use, fuel use onsite, waste disposal, landscaping or other offsets	Material GHG emissions are expected from embodied carbon of materials, electricity use, fuel use, waste disposal, gain of carbon sinks
Decommissioning Stage	Emissions for this lifecycle stage have been excluded from the climate chapter on the assumption that the infrastructure will remain in situ beyond the operational life of the Proposed Development. The end of life of the Proposed Development is too far into the future to make a meaningful assessment of decommissioning activities.	

17.4.14 The sensitivity of the receptor (global climate) to increases in GHG emissions is always defined as 'high'" as any additional GHG impacts could compromise Scotland's ability to reduce its GHG emissions and therefore meet its future carbon budgets. Also, the extreme importance of limiting global warming to below 2°C this century is asserted by the international Paris Agreement and the climate science community.

Magnitude of Impact

17.4.15 For the lifecycle GHG impact assessment, the significance of the impact is determined by evaluating the results of the GHG quantification process—specifically, the Proposed Development's GHG lifecycle footprint. This assessment considers its contribution to the UK and Scotland's carbon budgets and its potential effect on achieving net zero targets. Additionally, GHG emissions will be assessed in relation to sectoral budgets outlined in the Carbon Budget Delivery Plan[30].

17.4.16 According to the IEMA guidance on assessing GHG emissions in EIA, *"GHG emissions have a combined environmental effect that is approaching a scientifically defined environmental limit, as such any GHG emissions or reductions from a project might be considered to be significant"*.

[30] UK Government (2023). Carbon budget Delivery Plan. Available at: https://www.gov.uk/government/publications/carbon-budget-delivery-plan [Accessed 25th October 2024]

17.4.17 The IEMA guidance also states it is down to the professional judgement of the practitioner, to determine how best to contextualise a project's GHG impact and assign the level of significance. It is suggested that sectoral, local, or national carbon budgets can be used, as available and appropriate, to contextualise a project's GHG impact and determine the level of magnitude. The approach adopted for the purposes of this assessment is outlined below.

17.4.18 The UK and Scottish carbon budgets are in place to restrict the amount of GHG emissions they can legally emit in a five-year period. The UK is currently in the 4th Carbon Budget period, which runs from 2023 to 2027, as detailed in **Table 17-5: UK national and sectoral carbon budgets and indicative carbon budgets based upon the CCC's Balanced Net-Zero Pathway.** The 3rd, 4th, and 5th Carbon Budgets reflect the previous 80% reduction target by 2050. The 6th Carbon Budget is the first to align with the legislated 2050 net zero commitment.

Table 17-5: UK national and sectoral carbon budgets and indicative carbon budgets based upon the CCC's Balanced Net-Zero Pathway

Carbon budget	Power Budget based upon the Carbon Budget Delivery Plan ($MtCO_2e$)	UK Carbon Budget ($MtCO_2e$)	Indicative Carbon Budgets based upon the CCC's balanced net-zero pathway ($MtCO_2e$)
3rd (2018-2022)	-	2,544	-
4th (2023-2027)	143	1,950	-
5th (2028-2032)	63	1,752	-
6th (2033-2037)	42	965	-
7th (2038-2042)	23	-	535
8th (2043-2047)			220
9th (2048-2050)			23

17.4.19 To illustrate the Proposed Development's trajectory towards net zero by 2050, it is recommended that the CCC's Balanced Net Zero Pathway is utilised post-2037 in the absence of any nationally legally binding carbon budgets after using the 6th Carbon Budget. The CCC has recently advised the UK on the level of its 7th Carbon Budget in early 2025, but this has not yet been secured[31]. Beyond 2050, it is implied that the UK will remain at net zero.

17.4.20 The CCC Balanced Net-Zero Pathway has been divided into 5-year periods post-2037 to match the previous six legally binding UK national carbon budgets. The proposed carbon budget periods derived from the net-zero pathway encompass the 7th, 8th, and 9th indicative budget periods up to 2050 in line with the UK's 1.5-degree trajectory as detailed in **Table 17-5: UK national and sectoral carbon budgets and indicative carbon budgets based upon the CCC's Balanced Net-Zero Pathway.**

17.4.21 However, it should be noted that carbon budgets beyond 2037 have not yet been formally adopted by the UK government or ratified by parliament. Therefore, the carbon budgets can only be used as an indicative measure to contextualise the Proposed Development's progress toward the national net-zero trajectory.

17.4.22 The Climate Change Emissions Reduction Targets (Scotland) Act 2024[32] has recently been passed by the Scottish Government. The Act requires secondary legislation to be brought forward to amend the previous annual targets into five-year budget periods, beginning with a carbon budget for 2026 to 2030, based on recommendations from the CCC. As these are not yet available, the original annual targets have been detailed in **Table 17-5: UK national and sectoral carbon budgets and indicative carbon budgets based upon the CCC's Balanced Net-Zero Pathway.** The Scottish Government's interim targets for 2030 and 2040 have recently been withdrawn, but the net zero target date is still set for 2045 and will remain so thereafter. The Scottish

[31] Climate Change Committee (2025). The Seventh Carbon Budget. Available at: https://www.theccc.org.uk/wp-content/uploads/2025/02/The-Seventh-Carbon-Budget.pdf [Accessed 17th March 2025]
[32] The Scottish Parliament (2024) Climate Change (Emissions Reduction Targets) (Scotland) Act 2024. Available at: https://www.legislation.gov.uk/asp/2024/15/enacted [Accessed 8th November 2024]

Government is strongly committed to this net zero target, which would require projects like the Proposed Development to be brought forward to achieve reductions to the national grid carbon intensity[33].

Table 17-6: Scottish Government emissions reduction targets

Budget Period	Scotland Target ($MtCO_2e$)
2024	31
2025	29.4
2026	27.8
2027	26.1
2028	24.5
2029	22.9
2030	21.3
2031	20
2032	18.7
2033	17.4
2034	16.2
2035	14.9
2036	13.6
2037	12.3
2038	11.1
2039	9.8
2040	8.5
2041	6.8
2042	5.1
2043	3.4
2044	1.7
2045	0

Significance of Effects

17.4.23 When evaluating the significance of the GHG emissions, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative, or negligible. The crux of significance therefore is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone as compared to the carbon budgets described above, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050.

17.4.24 **Table 17-7: Definition of levels of significance for the lifecycle GHG impact assessment** presents the different significance levels as per the latest version of the IEMA guidance, which emphasises that *"…a project that follows a 'business-as-usual' or 'do minimum' approach and is not compatible with the UK's net zero trajectory or accepted aligned practice or area-based transition targets, results in a significant adverse effect. It is down to the practitioner to differentiate between the 'level' of significant adverse effects e.g. 'moderate' or 'major' adverse effects"*. Major or moderate adverse effects and beneficial effects are considered to be significant. Minor adverse and negligible effects are not considered to be significant.

[33] The Scottish Parliament (2024). Stage 1 report on the Climate Change (Emissions Reduction Targets) (Scotland) Bill. Available at: https://bprcdn.parliament.scot/published/NZET/2024/10/4/b3162b1a-4d95-4438-a5d2-6761dc7d87f0/NZET-S6-24-11.pdf [Accessed 18th March 2025]

Table 17-7: Definition of levels of significance for the lifecycle GHG impact assessment

Significance level	Effect	Description in the IEMA guidance
Significant adverse	Major adverse	The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards Net Zero.
	Moderate adverse	The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards Net Zero.
Not significant	Minor adverse	The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards Net Zero.
	Negligible	The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or Net Zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards Net Zero and has minimal residual emissions.
Significant beneficial	Beneficial	The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds Net Zero requirements with a positive climate impact.

Limitations and Assumptions

17.4.25 The lifecycle GHG impact assessment has been based on the parameters outlined in **Chapter 2: Project and Site Description (Volume 2: Main Report)**.

17.4.26 The energy generation figures used to assess the carbon savings from use of the Proposed Development are based on data provided by LCP-Delta from an economic study commissioned by the Applicant. The lowest potential generation figures for each year (2030, 2040, and 2050) have been applied to the corresponding decade, with 2050 generation projections being applied for the remainder of the expected operational period (out to 2158), with a consistent efficiency rating of 81%. The carbon intensity of the electricity used for pumping was assumed to be the same as the UK Grid. The UK Government Greenbook Grid decarbonisation[26] data was used to factor forecast grid decarbonisation for the lifecycle GHG impact assessment. This is considered to be a conservative assumption as the actual carbon intensity of electricity used for pumping is likely to be lower carbon than the grid average as the function is largely to use renewable electricity at excess generation periods. The carbon intensity of the Proposed Development is then the carbon cost of pumping divided by the expected generation figures provided by LCP-Delta.

17.4.27 The GHG emissions emitted due to peatland excavations to make way for the Proposed Development were calculated using the Scottish Government Wind Farm Carbon Calculator. It has been assumed that no mitigating measures are taken to reduce the amount of peatland lost in the construction of the Proposed Development. This is a worst-case scenario as **Appendix 15.2: Peat Management Plan (Volume 5: Appendices)** includes measures that are likely going to significantly reduce the GHG impact of peatland loss due to the Proposed Development, like alternative construction methodologies to mitigate impacts on deep peat, the layout being developed to minimise infrastructure in areas of peat > 1.0m where practical, and adhering to appropriate peat guidance. It is noted that the Proposed Development would be required to restore approximately 13 km^2 of degraded blanket bog which has the potential to deliver net carbon sequestration, however, research suggests that even after decades of restoration efforts these areas may never return to previous conditions[34].

17.4.28 It is assumed that all carbon stored in the peat within the Headpond area will be lost due to the establishment of the Headpond as it is drained and re-filled. Emissions from the degradation of peat within the Headpond area has been presented as a lump sum of carbon lost in the construction period, due to limited availability of research regarding degradation rates and likely timelines. This decision was made based on professional judgement to assess a worst-case scenario.

[34] Loisel, J. and Gallego-Sala, A. (2022). Ecological resilience of restored peatlands to climate change. *Communications Earth & Environmental,* Vol 3, 208.

17.4.29 The largest single source of GHG emissions from the Proposed Development is the construction activities and manufacture of materials necessary to construct the Proposed Development. The lifecycle GHG impact assessment is based on a high-level materials assessment undertaken by the Design Team.

17.4.30 Transportation emissions were calculated under the assumption that materials and waste would be transported by Heavy Goods Vehicles (HGVs), with distances based on RICS[35] assumptions for transport distances based on material types. Worker transportation emissions were calculated based on information provided by the Design Team regarding the number of workers on site, distances transported, and modes. It was assumed that all workers would be transported by coach.

17.4.31 The IEMA 'Environmental Impact Assessment Guide to: Assessing Greenhouse Gas Emissions and Evaluating their Significance' states that a comparable baseline must be used as a reference point against which the impact of a new project can be assessed, which may be *"GHG emissions arising from an alternative project design for a project of this type"*. Currently, marginal load-following generation capacity is predominantly provided by gas-fired Combined Cycle Gas Turbine (CCGT). The benefit of any renewable electricity scheme is to displace fossil-fuelled power sources. It is reasonable to assume that as additional renewable energy generation capacity becomes available, such as from the Proposed Development, it will reduce demand for the marginal generator, i.e., directly displace the use of CCGT. On this basis, the GHG assessment has used the operational emissions of an CCGT as the future baseline. It is unlikely that CCGT will still be providing energy to the national grid by 2158, so this assessment looks at the carbon benefits of the Proposed Development against CCGT up until 2040. This is discussed in **Section 17.4 Lifecycle Greenhouse Gas Impact Assessment, sub-section Assessment of Effects**.

17.4.32 To estimate the overall GHG impact and assess the significance of operational emissions against the future baseline conditions of an unabated CCGT, it has been assumed that the Proposed Development will operate at an efficiency of 81%. That is to say that it will generate 81% of the electricity required to pump water from the Tailpond to the Headpond.

17.4.33 Emissions from maintenance, repair, and replacement have all been calculated based on RICS assumptions. An industry standard percentage of the emissions values calculated in the Pre-Construction and Enabling and Construction lifecycle stage is taken to estimate operational emissions from the first two categories.

17.4.34 Emissions from the replacement of materials includes RICS assumptions for expected material lifespans. This includes emissions from the transportation of the replacement materials and waste disposal of replaced materials. The lifespan of aggregate, geotextiles, and concrete is assumed to be 60 years with one replacement as it is unlikely that the infrastructure would be replaced again at 120 years with an assessed 125-year operational life. Similarly for rebar and steel, a 40-year expected lifespan has been applied, with two full replacements expected over the operation of the Proposed Development. The average laden factor for HGVs was applied for transportation, with materials assumed to be sent to landfill as a worst-case scenario. The figures presented for replacement emissions have used 2024 UK government emissions factors as the most recent available source, and are likely an overestimation as material production, transport, and waste disposal processes are likely to decarbonise over the lifespan of the Proposed Development. Furthermore, the full replacement of materials like concrete in below ground structures is unlikely, so this assessment estimates a robust worst-case scenario.

17.4.35 It should be noted that a general emissions factor for concrete from ICE DB v4.0 has been applied to the entire volume of concrete supplied in the materials assessment. This contributes to a significant proportion of embodied emissions in the materials and could be an overestimation depending on the specifications of the concrete procured.

Baseline Environment

Existing Baseline

17.4.36 For the lifecycle GHG impact assessment, the existing baseline is the current conditions at the Proposed Development Site. The existing baseline comprises of the carbon stock and sources within the boundary of the existing activities on-site.

17.4.37 The current land use within the Proposed Development Site and local area is generally characterised as land capable for use as forestry and rough grazing with low quality flora. There is no woodland within the proposed

[35] RICS (2024) Whole life carbon assessment for the built environment. Available at: https://www.rics.org/content/dam/ricsglobal/documents/standards/Whole_life_carbon_assessment_PS_Sept23.pdf [Accessed 25th October 2024]

Headpond area in the Proposed Development Site, with woodland pockets restricted to the eastern, southern, and southwest boundaries of the Proposed Development Site. There are commercial forestry blocks within the Proposed Development Site adjacent to access tracks, as well as the Allt Saigh watercourse, which is fed by several smaller streams. The Loch Ness catchment covers the Tailpond area and the Lower Control Works.

Future Baseline

17.4.38 The future baseline provides an estimate of the emissions that would occur at the Proposed Development Site in the future if the Proposed Development does not proceed. It also accounts for other predicted grid energy generation sources that would be displaced by the Proposed Development, as described in **Section 17.4 Lifecycle Greenhouse Gas Impact Assessment, sub-section Assessment of Effects**.

Embedded Mitigation

17.4.39 Where possible, mitigation measures have been incorporated into the Proposed Development design and construction. Through iterative assessment, potential impacts have been predicted and opportunities to mitigate them identified with the aim of preventing or reducing impacts as much as possible. This approach provides the opportunity to prevent or reduce potential adverse impacts from the outset. This embedded mitigation approach has been taken into account when evaluating the significance of the potential impacts.

17.4.40 Once these measures are incorporated into the design, they are termed ‘embedded measures’. Embedded measures relevant to the Construction Phase are described within each technical chapter of this EIAR. For the Operational Phase, such embedded measures will be represented primarily in the design, e.g., the choice of infrastructure components. Embedded measures are therefore either incorporated into the design from the outset or identified through the assessment process.

17.4.41 Along with any measures required for legislative compliance, the Proposed Development will also incorporate industry standard control measures, which are common practice on construction sites, into the embedded measures. These are described in each technical chapter of this EIAR (**Chapters 6 – 16 and 18**). Embedded measures include (but are not limited to) the monitoring of weather forecasts and receipt of Scottish Environmental Protection Agency (SEPA) flood alerts by Contractors to allow works to be planned and carried out accordingly to manage extreme weather conditions, such as storms and flooding, infrastructure design, and flood resilience measures.

17.4.42 An outline Construction Environmental Management plan (oCEMP) is included within the Section 36 application, under the Electricity Act 1989 **(Appendix 3.1: Outline Construction Environmental Management Plan (Volume 5: Appendices).** This identifies various mitigation measures to be embedded within the Proposed Development to reduce the GHG impact, including:

- Adopting the Considerate Constructors Scheme (CCS) to assist in reducing pollution, including GHG emissions, from the Proposed Development by employing good industry practice measures which go beyond statutory compliance;

17.4.43 Implementing a Construction Traffic Management Plan (CTMP) to reduce the volume of construction trips to the Proposed Development Site. A Framework CTMP can be found within **Appendix 13.1: Transport Assessment (Volume 5: Appendices):**

- Switching vehicles and plant off when not in use and ensuring construction vehicles conform to European Union (EU) vehicle emissions standards for the types of plant and vehicles to be used;
- Conducting regular planned maintenance of the plant and machinery to optimise efficiency;
- Increasing recyclability by segregating construction waste to be re-used and recycled where reasonably practicable;

17.4.44 Designing, constructing and implementing the Proposed Development in such a way as to minimise the creation of waste; and

17.4.45 Where practicable, maximise the use of alternative materials with lower embodied carbon, such as locally sourced products and materials with a higher recycled content.

17.4.46 An outline Peat Management Plan (oPMP) has been developed for the Proposed Development Site **(Appendix 15.2: Outline Peat Management Plan (oPMP) (Volume 5: Appendices).** This contains measures to reduce the impact on peat as a result of the Proposed Development and will be finalised post-submission under the relevant planning conditions.

Assessment of Effects

17.4.47 Within this section, GHG emissions arising as a result of the Proposed Development are identified and assessed for each lifecycle stage (Pre-Construction and Enabling, Construction and Operations).

17.4.48 It is important to understand the GHG impacts at each individual lifecycle stage, but it is also important to understand the net lifecycle GHG impact of the Proposed Development due to the long-term, cumulative nature of GHG emissions over their lifetime.

17.4.49 Therefore, the net impact of the Proposed Development is also identified and assessed, taking into account the renewable energy generation and the benefit of this in the context of the wider energy generation sector and the national grid average GHG intensity. The overall assessment, which will account for all GHG emissions over the lifetime of the Proposed Development, has also compared the GHG intensity of the Proposed Development with the GHG intensity of other predicted grid energy generation sources.

Pre-construction and Construction Effects

17.4.50 The GHG emissions emitted during the Pre-construction and Enabling and Construction Phases are detailed below in **Table 17-8:GHG emissions arising from the Pre-Construction and Enabling and Construction.**

17.4.51 The greatest GHG impacts during the Pre-Construction and Enabling and Construction Phase (2026 – 2033) occur as a result of embodied emissions in the materials required for the construction of the Proposed Development, contributing to 32% of emissions.

17.4.52 Land use change emissions through the excavation of peat to make way for the Proposed Development were calculated using bespoke peatland emission factors within the Scottish Government Windfarm Carbon Assessment Tool. Commissioned under the guidance of the Scottish Government, SEPA, Scottish Natural Heritage, and Forestry Research, this tool estimates changes in carbon stored in the given area of peatland based on standard factors for the carbon content of dry peat and dry soil bulk density, and the assumed percentage of carbon that is lost as carbon dioxide (in this case, 100%)[36]. It gives an approximate emissions factor of 0.37 tCO_2 lost per m^3 of removed peat. The reported GHG impacts for land use change are a worst-case scenario (128,499 tCO_2e) as it was assumed in the lifecycle GHG impact assessment that no measures are taken to reduce peatland loss. The preliminary Peat Management Plan includes measures that are likely to significantly reduce the GHG impact of peatland loss due to the Proposed Development through restoration and management.

17.4.53 In addition, the carbon lost from the degradation of the peat within the Headpond area is presented as a lump sum during the pre-construction and Construction Phase, accounting for 174,040 tCO_2e. Again, this is calculated using peatland emission factors within the Scottish Government Windfarm Carbon Assessment Tool.

17.4.54 Other significant GHG impacts arise from the enabling works (e.g. underground excavations) required for the construction of the Proposed Development (17% of the pre-construction and construction footprint). Construction material quantities were provided by the design team and the GHG emissions were calculated using emission factors from ICE DB v4.0 and the CESSM 4 Pricebook. The Pre-Construction and Enabling and Construction Phase is estimated to account for 1,009,664 tCO_2e, as summarised in **Table 17-8:GHG emissions arising from the Pre-Construction and Enabling and Construction**.

17.4.55 The Pre-Construction and Enabling period is expected to take approximately one year, with the Construction Phase lasting approximately seven years. Emissions from each source have been assumed to arise equally over these phases and apportioned annually as an estimate. As a result, Pre-Construction and Enabling emissions constitute 126,208 tCO_2e while Construction period emissions contribute 883,456 tCO_2e.

Table 17-8:GHG emissions arising from the Pre-Construction and Enabling and Construction Phase

Emissions source	Pre-construction and construction emissions (tCO_2e)	Proportion of total pre-construction and construction emissions
Land use change (Peat Excavations)	128,499	13%
Materials	322,012	32%
Enabling Work	170,767	17%

[36] Scottish Government (2018). Carbon calculator: technical guidance. Available at: https://www.gov.scot/publications/carbon-calculator-technical-guidance/ [Accessed 13th November 2024]

Emissions source	Pre-construction and construction emissions (tCO_2e)	Proportion of total pre-construction and construction emissions
Headpond peat carbon loss	174,040	17%
Fuel Use	131,431	13%
Transport of materials	79,902	8%
Commuting	1,056	<1%
Waste	1,649	<1%
Pre-construction & Enabling total (one year)	**126,208**	13%
Construction total (seven years)	**883,456**	88%
Total for Pre-construction and Enabling and Construction	**1,009,664**	100%

17.4.56 The annual emissions of the Pre-Construction and Enabling and Construction Phase have been compared to the relevant annual Scottish Net Zero Carbon Targets and are detailed in **Table 17-9: Scottish carbon budgets relevant to the construction period.**

Table 17-9: Scottish carbon budgets relevant to the construction period

Relevant Carbon Budget Period	Scottish Carbon Budget	Estimated total (tCO_2e) over carbon budget period	% of Scottish Carbon Budget
2030 Carbon Reduction Target (2021 – 2030)	285,641,192	631,040	0.22%
2040 Carbon Reduction Target (2031 – 2040)	142,607,749	378,624	0.27%
2045 Net Zero Target (2041 – 2045)	17,027,791	-	-

17.4.57 The overall significance of GHG emissions in the context of the Scottish carbon budgets and the national policy environment has been assessed in the Overall GHG Impact and Significance section below (from **paragraph 17.4.71**).

Operational Effects

17.4.58 The Operational Phase of the Proposed Development is assumed to be 125 years.

17.4.59 Energy imported, stored, and generated back to the grid from the Proposed Development during the first full year of operation (2034, noting that units are planned to be progressively brought online from 2030) is expected to be 4,209 GWh based on data provided by LCP-Delta.

17.4.60 In order to generate the 4,209 GWh operating at 81% efficiency, as determined by Glen Earrach Energy, 5,197 GWh of electricity would be required to pump water from the lower reservoir to the upper reservoir during periods of low electricity demand (e.g. at night) or when there is a surplus electricity generation from renewable sources like wind or solar. To determine the carbon intensity of the electricity required for pumping activities, the Greenbook Grid Decarbonisation[37] values were applied to give as a realistic picture as possible of the GHG impacts, also summarised in the Overall GHG Impact and Significance section below (from **paragraph 17.4.71**).

17.4.61 GHG emissions sources within the scope of the operational emissions include energy use (for pumping of water from the Tailpond to the Headpond and auxiliary services) and fuel use for the transportation of workers to the Proposed Development Site and maintenance activities.

17.4.62 As presented in **Table 17-10: Emissions resulting from the** , the operational emissions over the design life of the Proposed Development (assumed to be 125 years) are estimated at 4,087,800 tCO_2e. Almost 90% of this

[37] UK Government (2023). Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal [Accessed 25th October 2024]

figure results from the pumping activities to move water from the Tailpond to the Headpond between cycles. To calculate the greenhouse gas emissions for the Proposed Development's operation over its lifetime, expected generation figures were provided by LCP-Delta. The total electricity consumption value (GWh) per year (based on 81% efficiency) was multiplied by the Greenbook Grid Decarbonisation Values for each corresponding year, from 2034 to 2158. The result of this calculation was an emissions value for the operation of the Proposed Development each year, which were summed to get the total emissions for the Proposed Development's operation over its lifetime. The remaining 11% of GHG emissions result primarily from replacement materials – likely to be an overestimation due to uncertainties in emission factors out to 2158 - followed by maintenance activities and operational worker commuting.

Table 17-10: Emissions resulting from the Operational Phase

Emissions source	Operational emissions (tCO_2e)	Proportion of total operation emissions
Electricity Usage (Pumping)	3,199,280	88.90%
Maintenance, Repair, and Replacement	453,897	11.10%
Vehicle Journeys	34	<0.00%
Operation design life total	**4,087,800**	**100%**
Annual total	**32,702**	

17.4.63 The annual emissions of each phase have been compared to the relevant Scottish carbon budgets as detailed in **Table 17-11: Scottish carbon budgets relevant to the operational period**. To improve the robustness of the assessment and allow for temporal flexibility, the annual operational emissions have also been compared to the sector specific carbon budgets for electricity generation based on the CCC's Balanced Net Zero Pathway, these are detailed in **Table 17-12: Sector-specific (electricity generation) carbon budgets relevant to the operational period**. The figures compared against these budgets refer to the emissions from the consumption of grid electricity for pumping water to the Headpond and ultimately do not account for emissions reductions from the displacement of higher carbon grid balancing alternatives (as discussed in **paragraph 17.4.65** onwards).

Table 17-11: Scottish carbon budgets relevant to the operational period

Relevant Carbon Budget Period	Scottish Carbon Budget (tCO_2e)	Estimated total (tCO_2e) over carbon budget period	% of Scottish Carbon Budget
2030 Carbon Reduction Target (2021 – 2030)	285,641,192	-	-
2040 Carbon Reduction Target (2031 – 2040)	142,607,749	228,917	0.16%
2045 Net Zero Target (2041 – 2045)	17,027,791	130,810	0.77%

Table 17-12: Sector-specific (electricity generation) carbon budgets relevant to the operational period

Relevant UK Carbon Budget	Annualised UK Carbon Budget (tCO_2e)	Estimated total (tCO_2e) over the carbon budget period	% of Sectoral Budget for Electricity Generation.
2033-2037	35,740,000	89,932	0.25%
2038-2042	23,330,000	163,512	0.70%
2043-2047	12,360,000	163,512	1.32%
2048-2050	4,030,000	65,405	1.62%

17.4.64 The overall significance of GHG emissions in the context of the Scottish carbon budgets and national policy environment has been assessed in the Overall GHG Impact and Significance section below (from **paragraph 17.4.71**).

Carbon Intensity of the Proposed Development

17.4.65 The Scope 2 UK grid carbon intensity at the time of writing is 207 gCO_2e/kWh (excluding transmission and distribution losses). These figures cannot be directly compared to the Proposed Development as the published

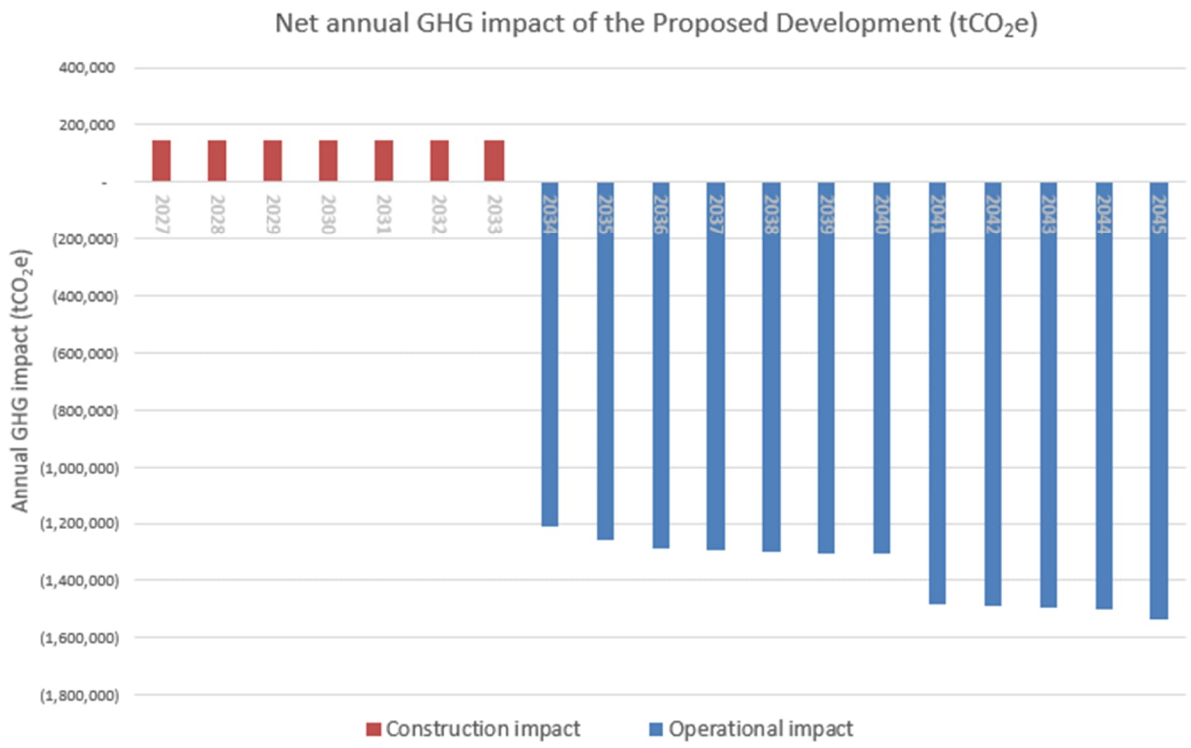
UK grid carbon intensity figure only takes into account operational GHG emissions from the generation of electricity, overwhelmingly from the fossil fuels used to power gas-fired power stations[38]. For a meaningful comparison to be made between the Proposed Development and the UK grid, the operational carbon intensity of the Proposed Development must only include emissions from the operations of the Proposed Development and exclude emissions from the Pre-Construction and Enabling and Construction Phases.

17.4.66 The carbon intensity of the Proposed Development varies over its anticipated operational lifespan due to the Proposed Development's reliance on electricity from the UK grid to pump water from the Tailpond to the Headpond and variance in expected generation. In 2030, the first year of operation, the carbon intensity of the Proposed Development was calculated to be 0.05 $kgCO_2e/kWh$. In 2045, the year Scotland is due to reach net zero, the carbon intensity is anticipated to be 0.01 $kgCO_2e/kWh$. To compare the Proposed Development against a counterfactual gas-fired CCGT generating facility, a representative figure for the carbon intensity of an CCGT is assumed to be 0.33 $kgCO_2e/kWh$[39].

17.4.67 **Insert 17-1: Estimated net annual GHG impact of the Proposed Development** has been prepared to demonstrate the annual carbon cost/benefit of the Proposed Development against the counterfactual CCGT up until the year 2045. Bars in red represent the Pre-Construction and Enabling and Construction Phase, a period in which there is a net carbon cost from activities like embodied emissions in materials purchased and fuel use at the Proposed Development Site. Meanwhile bars in blue represent the annual net carbon benefit from the Proposed Development, showing the difference in carbon intensity from the power consumed during the pumping phase (assumed to be at projected grid carbon average) relative to the power supplied to the grid during periods of high demand (assumed to displace the operation of an unabated CCGT). The carbon savings increase each year due to the projected ongoing decarbonisation of the grid.

17.4.68 It is reasonable to assume that the Proposed Development will displace existing unabated gas fired generation during the first decade of its operating life; beyond this date, there is less certainty around the type of dispatchable generation that the Proposed Development is likely to displace. It is very likely to remain the case that any dispatchable generation that the Proposed Development displaces in the future will be higher carbon than the power used during the pumping phase, i.e. there will be continued operational carbon savings over its design life although it is challenging to quantify these with any confidence.

[38] NESO (2024). Carbon Intensity Dashboard. Available at: https://www.neso.energy/about-neso/our-progress-towards-net-zero/carbon-intensity-dashboard [Accessed 13th December 2024]
[39] Subramanian, N. and Madejski, P. (2023). Analysis of CO_2 capture process from flue-gases in combined cycle gas turbine power plant using post combustion capture technology. *Energy,* Vol 282.



Insert 17-1: Estimated net annual GHG impact of the Proposed Development

17.4.69 **Insert 17-1: Estimated net annual GHG impact of the Proposed Development** above clearly shows the overall beneficial carbon impact of the Proposed Development. The carbon emissions from the Pre-Construction and Enabling and Construction Phase of 1,009,664 tCO_2e are quickly exceeded by the net carbon benefit from the operation of the Proposed Development, with carbon payback expected to be achieved during the second year of operation, with every subsequent year providing further carbon savings as discussed above.

17.4.70 It should be noted that the climate benefits of PSH developments go beyond direct carbon savings. Schemes like the Proposed Development should enable the integration of more renewable energy sources, such as wind and solar, into the electrical grid. This is due to its ability to act as an effective form of energy storage and grid stabilisation. PSH can store excess energy generated during periods of high renewable production, balancing the intermittency of renewable sources and smoothing the output of variability when renewable generation dips (e.g. at night or during calm weather). Without this storage, grid operators often rely on CCGT plant to fill gaps in renewable generation. The Proposed Development can reduce this reliance by providing an alternative for energy balancing, while enhancing the flexibility of the grid to make it easier to accommodate an increasing share of renewables. The role of pumped hydro storage in providing flexibility in the energy system to enable renewables is set out in chapter 5 of Scotland's draft energy strategy, highlighting the need for schemes like the Proposed Development.

Overall GHG Impact and Significance

17.4.71 Accounting for Scotland's climate objective to achieve net zero carbon by 2045, and in line with IEMA guidance for assessing GHGs and their significance, Scotland's carbon reduction targets and the UK sectoral carbon budgets have been used to contextualise emissions from the Proposed Development.

Pre-Construction and Enabling and Construction

17.4.72 Annual emissions from the Pre-Construction and Enabling and Construction of the Proposed Development (and their magnitude) are compared to the significance definitions outlined in **Table 17-7: Definition of levels of significance for the lifecycle GHG impact assessment**. In line with IEMA criteria for assessing the significance of GHG impacts, construction of the Proposed Development can be assumed to be consistent with applicable existing and emerging policy requirements. GHG emissions from pre-construction and construction are therefore determined to be **Minor Adverse** and **Not Significant**.

Operation

17.4.73 The Proposed Development results in some operational emissions associated with electricity storage, maintenance and worker travel. However, the benefits of generating renewable energy from the Proposed

Development outweigh the associated emissions as demonstrated in the Carbon Intensity of the Proposed Development section. Annual emissions from the operation of the Proposed Development (and their magnitude) are compared to the significance definitions outlined in **Table 17-7: Definition of levels of significance for the lifecycle GHG impact assessment.**

17.4.74 As stated in the IEMA guidance on assessing GHG emissions, *"…the crux of significance, therefore, is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050"*.

17.4.75 The Proposed Development's Operational Phase results in a reduction of GHG emissions compared to the without-project baseline. Operational emissions also align with Scotland's trajectory towards Net Zero. The GHG impact of the Operational Phase is therefore considered to be **Beneficial** and **Significant** when compared to the future baseline 'business-as-usual' scenario.

Summary

17.4.76 The Proposed Development directly supports the Scottish Government's ambition to decarbonise electricity generation in line with Scotland's 2045 Net Zero Target. Therefore, it is considered to be consistent with achieving Scotland's overall trajectory to net zero. Schemes like the Proposed Development are required by National Energy System Operator (NESO) as part of their strategy to decarbonise electricity generation and support the connection of more renewable energy sources to the electrical grid. This will be critical for enabling Scotland to reach its net zero targets. The Proposed Development is therefore considered to have an **overall beneficial, significant effect** on climate.

17.5 Climate Change Risk Assessment

Study Area

17.5.1 The Study Area for the Climate Change Risk Assessment covers the assets and infrastructure within the Proposed Development Site.

Methodology

17.5.2 The methodology described in the following section has been developed in line with the relevant planning policy and EIA Regulations (see **Section 17.2 Legislation and Policy**) and the guidance and standards listed below.

Guidance and Standards

17.5.3 The methodology in this chapter has been developed in line with appropriate industry guidance for assessing climate change resilience and adaptation such as IEMA Guide to: Climate Change Resilience and Adaptation[3].

17.5.4 The CCRA includes all infrastructure and assets associated with the Proposed Development during the pre-construction, construction, and Operational Phases as well as human receptors. As per the Taskforce on Climate-related Financial Disclosure (TCFD) guidelines[40], this assessment looks at the resilience against both gradual climate change i.e., chronic climate-related hazards and the risks associated with an increased frequency of severe weather events i.e., acute events.

Assessment Scope

17.5.5 The assessment considers the effects during the three phases of the Proposed Development lifespan as identified in **Section 2.16 – 2.20** of **Chapter 2: Project and Site Description (Volume 2: Main Report).** The phases include: Pre-construction and Enabling, Construction and Operation. A decommissioning phase has been scoped out of the CCRA on the basis that the infrastructure is likely to remain in-situ beyond the operational lifetime of the Proposed Development, and therefore climate risks would not be considered to have an impact on any workforce, materials, or financial elements.

17.5.6 The EIA Regulations require the inclusion of information on the vulnerability of the Proposed Development to climate change. Consequently, an assessment of climate change resilience for the Proposed Development has been undertaken, identifying potential climate change impacts per the IEMA Environmental Impact Assessment Guide to Climate Change Resilience & Adaptation[3].

[40] TCFD (2017). Recommendations of the Taskforce on Climate-related Financial Disclosures. Available at: https://assets.bbhub.io/company/sites/60/2021/10/FINAL-2017-TCFD-Report.pdf [Accessed 13th December 2024]

17.5.7 The assessment has included all infrastructure and assets associated with the Proposed Development. It covers resilience against both gradual climate change, and the risks associated with an increased frequency of extreme weather events as per the UKCP18 projections.

Baseline Data Collection

Desk Study

17.5.8 In preparation of the baseline data for the CCRA, the following sources of published information have been used:

- Historic climate data obtained from the Met Office website41 at the closest meteorological station to the Proposed Development (Fort Augustus, located approximately 14.5 km south of the Proposed Development);
- UKCP18[42] to determine the future baseline conditions;
- Think Hazard[43] was used for other projected trends/impacts of extreme weather events; and
- The UK Climate Change Risk Assessment[44] was analysed for the current state of nationwide climate change risks.

Assessment Methodology

Sensitivity

17.5.9 An assessment of the resilience of the Proposed Development to climate change has been undertaken to identify potential climate change impacts and to consider their potential consequence and likelihood of occurrence, taking account of the measures incorporated into the design of the Proposed Development.

17.5.10 The types of receptors considered vulnerable to climate change are described in **Section 2.2 to Section 2.13 of Chapter 2: Project and Site Description (Volume 2**: **Main Report)** and include:

- Construction Phase receptors e.g. workforce, plant and machinery, temporary compounds; and
- Development assets and their operation, maintenance and refurbishment e.g. electrical equipment, powerhouse pumps/turbines, generators, facility pavements and structures, earthworks, and drainage technology.

17.5.11 The CCRA will provide commentary on how the Proposed Development will be resilient to the predicted future climate baseline using UKCP18[37] data. UKCP18 projections for the 25 km^2 grid cell where the Proposed Development is located will be used to examine future climate parameters. This climate projection data provides a probabilistic indication of how global climate change is likely to affect the Development using defined climate variables and time periods.

Magnitude of Impact

17.5.12 The assessment has considered climate projections over a 100-year period from the Proposed Development's completion, assuming a pre-construction & construction start date of 2026 lasting for a period of 7 years, with full operation commencing in 2034.

17.5.13 Climate parameters considered in the CCRA during the construction and operation of the Proposed Development include the following:

- Storm events;
- Flooding;
- Wildfire event;
- Temperature change; and
- Precipitation change.

[41] UK Met Office (2019). UK Climate Averages (Fort Augustus). Available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gfhtjdb28 [Accessed 25th October 2024]
[42] Met Office (2018). UK Climate Projections (UKCP). Available at: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp [Accessed 25th October 2024]
[43] Global Facility for Disaster Reduction and Recovery (GFDDR) (n.d.). ThinkHazard – Scotland Highlands. Available at: https://thinkhazard.org/en/report/40172-united-kingdom-scotland-highland [Accessed 25th October 2024]
[44] UK Climate Risk (2022). Summary for Scotland (CCRA3-IA). Available at: https://www.ukclimaterisk.org/publications/summary-forscotland-ccra3-ia/ [Accessed 8th November 2024]

17.5.14 The CCRA has been undertaken for the Proposed Development to identify potential climate change impacts on the Proposed Development and associated receptors, and to consider their potential consequence and likelihood of occurrence, taking account of the adaption measures embedded into the design of the Proposed Development (**Section Embedded Mitigation**).

17.5.15 Climate projections for the Proposed Development during the enabling works and Construction Phase have been examined against receptors. Construction Phase receptors of the Proposed Development include the workforce, plant, machinery, and materials.

17.5.16 The following key terms and definitions relating to the CCRA have been used:

- Climate hazard – a weather or climate related event, which has potential to do harm to environmental or community receptors or assets, such as increased winter precipitation;
- Climate change risk – risks associated with climatic variables, such as increased winter precipitation leading to flooding;
- Climate change impact – an impact from a climate hazard which affects the ability of the receptor or asset to maintain its function or purpose; and
- Consequence – any effect on the receptor or asset resulting from the climate hazard having an impact.

17.5.17 A stepped approach is used to assess the impacts of climate change on the Proposed Development:

- Identify potential climate hazards and subsequent risks;
- Identify likelihood of climate impact occurring;
- Identify consequence of impact on the Proposed Development; and
- Identify significance of impact (likelihood of impact occurring x consequence of impact).

17.5.18 Once potential climate hazards have been identified (e.g., heatwaves from increased summer temperatures), the likelihood of their occurrence during each project phase (i.e. pre-construction, construction and operation) is categorised.

17.5.19 The criteria which have been used to determine the likelihood of a climate change risk occurring are detailed in **Table 17-13 Likelihood of a climate risk occurring**.

Table 17-13 Likelihood of a climate risk occurring

Likelihood of event	Qualitative description	Quantitative description (probability of occurrence)
Almost certain	Likely that the event will occur many times (reoccurs frequently).	90-100% probability that the hazard will occur.
Likely	Likely that the event will occur sometimes (reoccurs infrequently).	66-90% probability that the hazard will occur.
Moderate, about as likely as not	Possible that the event will occur (has occurred rarely).	33-66% probability that the hazard will occur.
Unlikely	Unlikely that the event will occur (not known to have occurred).	10-33% probability that the hazard will occur.
Rare	Almost inconceivable that the event will occur.	0-10% probability that the hazard will occur.

17.5.20 Following identification of climate hazards and risks, the consequences of climate impacts have been assessed according to Table **17-14 Level of consequence of a climate change risk occurring**. The categories and descriptions provided below are based on IEMA's 'Climate Change Resilience and Adaptation guidance'.

Table 17-14 Level of consequence of a climate change risk occurring

Consequence of Impact	Description
Catastrophic	• Permanent damage to structures/assets with cascading effects on the infrastructure system; • Complete, long-term loss of operation/service; • Significant reputational damage; • Complete renewal of infrastructure;

Consequence of Impact	Description
	• Exceptional environmental damage; and/or • Extreme financial impact.
Major	• Significant infrastructure damage and short-term loss of service; • Major infrastructure renewal; • Significant adverse impact on the environment; and/or • Major financial impact.
Moderate	• Partial infrastructure damage and some loss of service; • Some infrastructure renewal; • Adverse impact on the environment; and/or • Moderate financial impact.
Minor	• Localised infrastructure disruption and minor loss of service; • No permanent damage, minor restoration work required; • Slight adverse environmental effects; and/or • Small financial losses.
Insignificant	• No damage to infrastructure; • No impacts on the environment; and/or • No adverse financial impact.
	•

Significance of Effects

The significance of the CCRA is determined as a function of the likelihood of a climate change impact occurring and the consequence to the receptor if the impact occurs. The significance is detailed in

17.5.21 **Table 17-15: Significance of effect matrix for CCRA**. The assessment will take into account confirmed design and mitigation measures (referred to as embedded mitigation as set out within **Section Embedded Mitigation**).

Table 17-15: Significance of effect matrix for CCRA

		Level of consequence of a climate risk occurring				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood of climate-related impact occurring	Rare	Low (NS)	Low (NS)	Medium (NS)	Medium (NS)	Medium (NS)
	Unlikely	Low (NS)	Low (NS)	Medium (NS)	High (S)	High (S)
	Moderate	Low (NS)	Medium (NS)	High (S)	High (S)	Extreme (S)
	Likely	Medium (NS)	High (S)	High (S)	Extreme (S)	Extreme (S)
	Almost certain	Medium (NS)	High (S)	Extreme (S)	Extreme (S)	Extreme (S)

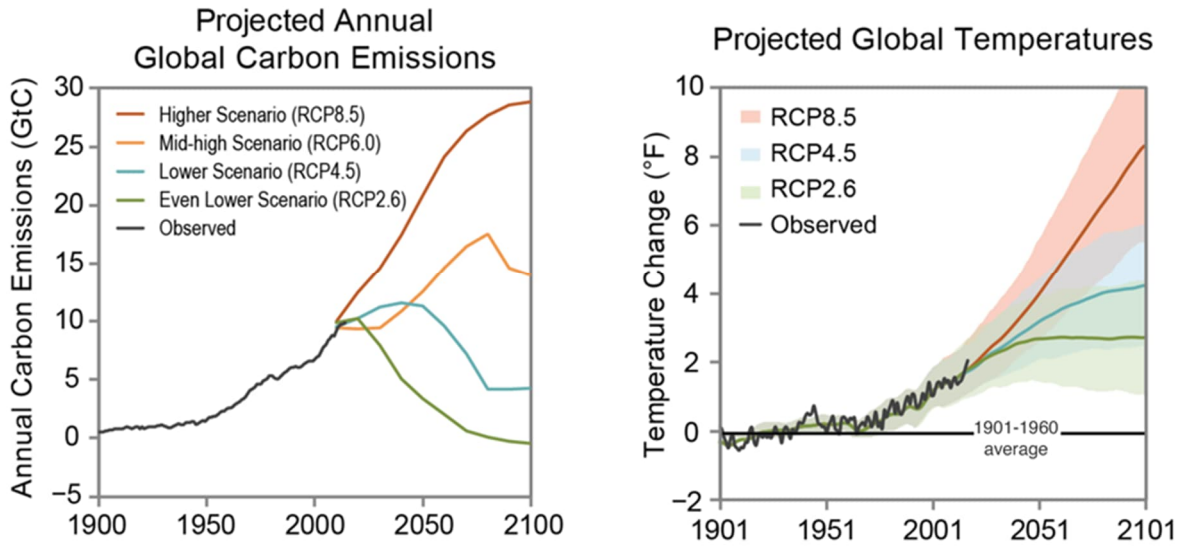
Note: S = significant; NS = not significant

Limitations and Assumptions

17.5.22 The climate assessment has been based on the parameters outlined in **Chapter 2: Project and Site Description (Volume 2: Main Report).**

17.5.23 As described in **Chapter 2: Project and Site Description**, Pre-Construction and Enabling and Construction is due to take place over an 8-year period, commencing in 2026, and is due to start full operation in 2034. The Proposed Development is anticipated to operate for a 125-year period. As such, climate projections for 2070 - 2099, the furthest projection period available in UKCP18[37], have been used for developing the future baseline. There are inherent uncertainties in using projections for over 125 years into the future, but an evaluation of global climate models used to project Earth's future global average surface temperature over the past half-century indicated that most models produced historically have been quite accurate[45], as illustrated in **Insert 17-2: Annual global historical temperature with projected annual global carbon emissions (left) and projected global temperatures (right)**. This improves confidence in the more advanced models being produced today.

17.5.24 It should be noted that uncertainty in climate models arises from two sources. The first is uncertainty regarding how quantities of global GHG emissions may change over time due to variable factors like changes in energy use, land use, and technology associated with economic developments, population growth, and lifestyle and behavioural changes, and the impacts associated with political drivers. The second source of uncertainty is variable confidence levels in how well the climate models can capture different climatic variables. For example, climate model performance tends to wane when simulating large-scale precipitation patterns in comparison to modelling surface temperature. Caution should ultimately be used when utilising climate projection data, hence why the worst-case scenario is selected under EIA Regulations.



Insert 17-2: Annual global historical temperature with projected annual global carbon emissions (left) and projected global temperatures (right)

17.5.25 The CCRA has been undertaken using IEMA guidance on climate change adaptation and is informed by the UK Climate Risk CCRA3 – Summary for Scotland[33]. Risks are categorised by receptor, nature of risk, and an urgency

[45] Hausfather, Z., Drake, H. F., Abbott, T., and Schmidt, G. A. (2020). Evaluating the Performance of Past Climate Model Projections. *Geophysical Research Letters,* Vol 47 (1).

score. Those with an urgency score of more action needed were reviewed, as well as any others deemed particularly relevant for the Proposed Development. This means new, stronger, or different government action, whether policies, implementation activities, or enabling environment for adaptation – over and above those already planned – would be beneficial in the next five years to reduce climate risks to the given receptors.

17.5.26 UKCP18[37] uses a wide range of possible scenarios, classified as Representative Concentration Pathways (RCP), to inform differing future emission trends. These RCPs *"… specify the concentrations of greenhouse gases that will result in total radiative forcing increasing by a target amount by 2100, relative to preindustrial levels"*. RCP8.5 has been used for the purposes of this assessment as a worst-case as this predicts a high-emissions or 'business-as-usual' scenario.

17.5.27 The components of the Proposed Development that have been considered in the CCRA have been discussed with the design team to ensure coverage of the most important aspects, and are described in **Section 2.2 to 2.15** of **Chapter 2: Project and Site Description (Volume 2: Main Report)**.

Baseline Environment

Existing Baseline

17.5.28 The existing baseline for the CCRA and ICCI assessments is based on historic, observational climate data recorded by the closest meteorological station to the Proposed Development (Fort Augustus, located approximately 14.5 km south of the Proposed Development) for the 30-year period of 1981-2010. This has been obtained from the Met Office website[30], and is summarised in **Table 17-16: Existing and future baseline climate data.**

Past Extreme Events

17.5.29 The following events are examples of past extreme climatic conditions experienced in Scotland:

- Highest recorded temperature recorded in Scotland was 34.8°C on the 19th July 2022[46].
- Lowest recorded temperature recorded in Scotland was -27.2°C on the 30th December 1995[46].
- Highest 24-hour rainfall totals for a rainfall day in Scotland was 238 mm and was recorded on 17th January 1974[46].
- The highest gust speed recorded in Scotland was 142 mph and was recorded on 13th February 1989[46].
- In October 2023, torrential rainfall from Storm Babet led to significant flooding and landslips across the west coast of Scotland as up to a month's rainfall accumulated within a 24-hour period, affecting the region's road network[47].
- Within the space of a week in February 2020, Scotland was hit by Storm Ciara and Storm Dennis. They brought heavy rain and very strong winds, causing widespread disruption to transportation and utility services with cancelled operations and power cuts affecting over 675,000 homes across the UK[48.] Estimated payouts from the impacts of both were £149 million[49.]
- In January 2023, Loch Ness and surrounding areas experienced much drier than usual conditions. The Loch dropped to its lowest level in decades[50] and businesses were urged to manage water carefully under the Alert level in the region[51].
- As recently as November 2024 and January 2025, the Scottish Highlands experienced heavy rainfall, the most powerful windstorm in over a decade, flooding, and snowfall from Storm Bert and Storm Éowyn. Observed rainfall totals were broadly in line with the forecast and the severe weather warnings issued in

[46] Met Office (2023). UK Climate Extremes. Available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-extremes [Accessed 19th November 2024].
[47] BBC News (2023) Landside-hit A83 remains closed after flooding. Available at: https://www.bbc.co.uk/news/uk-scotland-67012652 [Accessed 19th November 2024].
[48] Met Office (2020). Storm Ciara & Storm Dennis. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2020/2020_02_storm_ciara.pdf & https://www.metoffice.gov.uk/weather/warnings-and-advice/uk-storm-centre/storm-dennis [Accessed 11th November 2024]
[49] UK Climate Risk (2022). Summary for Scotland CCRA3. Available at: https://www.ukclimaterisk.org/publications/summary-forscotland-ccra3-ia/ [Accessed 11th November 2024]
[50] Phys.Org (2023).
[51] SEPA (2023). Majority of Scotland now at some level of water scarcity. Available at: https://beta.sepa.scot/news/2023/majority-of-scotland-now-at-some-level-of-water-scarcity/ [Accessed 17th March 2025]

advance, highlighting the potential for homes and business to flood with fast flowing or deep floodwater possible, causing a danger to life[52,53].

Future Baseline

17.5.30 The future baseline is expected to differ from the present-day baseline described above. UKCP18[37] provides probabilistic climate change projections for pre-defined 30-year periods for annual, seasonal, and monthly changes to mean and extreme climatic conditions over land areas. For the purpose of the assessments, UKCP18[37] probabilistic projections for the following average climate variables have been obtained:

- Mean annual temperature;
- Mean summer temperature;
- Mean winter temperature;
- Highest average temperature for baseline period;
- Lowest average temperature for baseline period;
- Mean annual rainfall;
- Mean summer rainfall;
- Mean winter rainfall; and
- Extreme weather events (e.g., heat waves & storm events).

17.5.31 Projected temperature and precipitation variables are presented in **Table 17-16: Existing and future baseline climate data.** UKCP18[37] probabilistic projections have been analysed for the 25 km^2 (square kilometres) grid square within which the Proposed Development is located. These figures are expressed as temperature/precipitation anomalies in relation to the 1981-2010 baseline.

17.5.32 As the design life of the Proposed Development is at least 125 years, the CCRA has considered a scenario that reflects a high level of GHG emissions at the 10%, 50% and 90% probability levels up to 2099 to assess the impact of climate change over the assessed lifetime of the Proposed Development.

17.5.33 Pre-construction and Enabling and Construction risks are assessed against the 2020-2049 projection data, while operation risks are assessed against 2020-2049, 2030-2059 and 2070-2099 projection data as a conservative worst-case scenario.

[52] Met Office (2024). New rainfall warning for Scotland as Storm Bert pulls aware. Available at: https://www.metoffice.gov.uk/about-us/news-and-media/media-centre/weather-and-climate-news/2024/new-rainfall-warning-for-scotland-as-storm-bert-pulls-away#:~:text=Storm%20Bert%20is%20still%20sitting,a%20risk%20of%20some%20flooding. [Accessed 16th December 2024]
[53] Met Office (2025). A look back on Storm Éowyn. Available at: https://www.metoffice.gov.uk/blog/2025/a-look-back-on-storm-eowyn [Accessed 18th March 2025]

Table 17-16: Existing and future baseline climate data

Climate Variable	Baseline (1981–2010) Fort Augustus	Climate change projection RCP 8.5			Projected Trend	Climate Projection Source
		Extreme Scenario RCP 8.5 (2020-2049)	Extreme scenario RCP8.5 (2030-2059)	Extreme scenario RCP8.5 (2070-99)		
Temperature						
Mean annual maximum daily temperature (°C)	11.9	+0.81 (+0.20 to +1.40)	+1.10 (+0.36 to +1.83)	+2.82 (+2.36 to +4.33)	↑	*UKCP18 RCP8.5*
Mean summer maximum daily temperature (°C)	17.9	+0.86 (+0.08 to +1.66)	+1.20 (+0.21 to +2.22)	+3.60 (+1.45 to +5.85)	↑	*UKCP18 RCP8.5*
Mean winter minimum daily temperature (°C)	0.6	+0.76 (-0.07 to +1.67)	+1.07 (-0.07 to +2.12)	+2.35 (+0.40 to +4.39)	↑	*UKCP18 RCP8.5*
Highest average temperature for baseline period (°C)	18.7	+0.79 (+0.16 to +1.42)	+1.10 (+0.31 to +1.87)	+2.87 (+1.29 to +4.51)	↑	*UKCP18 RCP8.5*
Lowest average temperature for baseline period (°C)	0.4	+0.87 (+0.24 to +1.51)	+0.17 (+0.39 to +1.97)	+2.88 (+1.31 to +4.52)	↑	*UKCP18 RCP8.5*
Rainfall						
Mean annual rainfall (%)	1336.4 (mm)	-0.01 (-6.13 to 3.78)	-0.02 (-7.11 to 3.45)	-3.28 (-10.22 to +3.62)	↕	UKCP18 RCP8.5
Mean summer rainfall (%)	70.7 (mm)	-0.03 (-17.30 to 11.24)	-0.06 (-23.19 to 12.62)	-23.85 (-47.22 to +5.11)	↕	*UKCP18 RCP8.5*
Mean winter rainfall (%)	158 (mm)	-0.02 (-10.32 to 6.65)	-0.02 (-10.05 to 7.77)	-1.20 (-14.38 to +14.61)	↕	*UKCP18 RCP8.5*
Wettest month on average (mm)	187.33 (January)					*UKCP18 RCP8.5*
Driest Month on average (mm)	62.57 (June)					*UKCP18 RCP8.5*
Other						
Droughts	The Met Office has projected a trend towards drier summers on average, with the trend being stronger under a high GHG emission scenario compared to a low one. However, it is the distribution of rainfall throughout the seasons that will determine UK drought risk. A recent NatureScot study suggests that drought risk in Scotland is likely, particularly in the east Highlands.				↑	Met Office, NatureScot[54]

[54] NatureScot (2020). Anticipating and mitigating projected climate-driven increases in extreme drought in Scotland, 2021 – 2040. Available at: https://www.nature.scot/doc/naturescot-research-report-1228-anticipating-and-mitigating-projected-climate-driven-increases [Accessed 18th March 2025]

Storms	Climate change is expected to lead to more frequent and intense winter storms across the UK, with higher wind speeds and wetter winters, while summers may become drier.	↑	Met Office
Wildfires	The wildfire hazard is classified as medium according to the information that is currently available to the Think Hazard tool. This means there is between a 10% and 50% chance of experiencing weather that could support a hazardous wildfire that may pose some risk of life and property loss in any given year.	↑	Think Hazard

Embedded Mitigation

17.5.34 Where practical, mitigation measures have been incorporated into the Proposed Development design and construction. Through iterative assessment, potential impacts have been predicted and opportunities to mitigate them identified with the aim of preventing or reducing impacts as much as possible. This approach provides the opportunity to prevent or reduce potential adverse impacts from the outset. This embedded mitigation approach has been taken into account when evaluating the significance of the potential impacts, and measures are listed in **Appendix 17-1: Climate Change Risk Assessment (Volume 5: Appendices**).

17.5.35 Once these measures are incorporated into the design, they are termed 'embedded measures'. Embedded measures relevant to the Construction Phase are described within each technical chapter of this EIAR For the Operational Phase, such embedded measures will be represented primarily in the design, e.g., the choice of infrastructure components. Embedded measures are therefore either incorporated into the design from the outset or identified through the assessment process.

17.5.36 Along with any measures required for legislative compliance, the Proposed Development will also incorporate industry standard control measures, which are common practice on construction sites, into the embedded measures. These are described in each technical chapter of this EIAR (**Chapters 6 – 16 and 18**). Embedded measures include (but are not limited to) the monitoring of weather forecasts and receipt of Scottish Environmental Protection Agency (SEPA) flood alerts by Contractors to allow works to be planned and carried out accordingly to manage extreme weather conditions, such as storms and flooding, infrastructure design, and flood resilience measures.

17.5.37 The following adaption measures are included within the oCEMP:

- Storing topsoil, construction plant and construction materials outside of high-risk flood risk areas;
- Named person(s) – likely the Safety, Health and Environment Manager/ Ecological Clerk of Works (ECoW) – to monitor weather forecasts and receive SEPA flood alerts to allow works to be planned and carried out accordingly to manage extreme weather conditions, such as storms and flooding; and
- Health and safety plans developed for construction activities will be required to account for potential climate change impacts on workers, such as flooding and heatwaves. Measures such as Toolbox Talks to educate workers on the dangers of extreme weather conditions should be included.

17.5.38 Embedded mitigation measures are also listed in **Appendix 17-1: Climate Change Risk Assessment (Volume 5: Appendices),** known as Planned Controls. These include, but are not limited to:

- Designing surface water drainage systems to accommodate 1-in-30-year plus 40% climate change rainfall events;
- Imposing constraints on the Proposed Development, secured through SEPA licensing, to restrict operation during periods of high flood levels (currently set at 17.6 AOD which equates to a 1-in-10-year event); and
- Operators monitoring weather forecasts, as with the oCEMP, and planning works accordingly to protect workers and resources from extreme weather events.

Assessment of Effects

17.5.39 The CCRA identified 22 risks, 11 related to Pre-Construction and Enabling and Construction, and 11 related to operation. The assessment and a complete list of climate change risks can be found in **Appendix 17-1: Climate Change Risk Assessment (Volume 5: Appendices).**

17.5.40 Future climate projections have been reviewed, and the sensitivity of assets has been examined before commenting on the adequacy of the embedded climate change adaption measures built into the Proposed Development.

Pre-Construction & Enabling and Construction Effects

17.5.41 The risks assessed in the CCRA at the Pre-construction and Enabling and Construction Phase of the Proposed Development predominantly cover workforce exposure to dangerous working conditions and damage to physical structures/asset damage.

17.5.42 Major climatic variables contributing to these risks include, but are not limited to, increased temperatures, flooding, and storms.

17.5.43 As a result of the embedded climate change mitigation measures (as presented in Embedded Mitigation Section), it is concluded that all climate change risks during the Construction Phase have been identified to be low or medium adverse, not significant.

Operational Effects

17.5.44 The risks assessed in the CCRA at the Operational Phase of the Proposed Development predominantly encapsulate asset damage from extreme weather conditions and changes in annual precipitation and temperatures, as well as workforce exposure to dangerous working conditions.

17.5.45 Major climatic variables contributing to these risks are temperatures, precipitation, and extreme weather events. The number of risks for each rating are summarised in **Table 17-17: Risk profile for proposed development** below. As a result of the embedded climate change mitigation measures, the most significant risks during operation are flooding and storm events rated high for the future scenarios. The significance rating takes into account the likelihood of a climate impact occurring, so while the consequences of these impacts are mitigated by protecting the operational workforce, adhering to engineering standards for design, and following SEPA advice on reservoir management in the short- and medium-term, the significant risks remain due to the long-term changes that are expected under future climate change projections.

Table 17-17: Risk profile for proposed development

Risk Rating	Residual risk rating RCP 8.5 (2020-2049)	Residual risk rating RCP 8.5 (2030-2059)	Residual risk rating RCP 8.5 (2070-2099)
Low	19	5	5
Medium	3	4	5
High	0	1	2
Extreme	0	0	0

17.6 In-combination Climate Change Impact Assessment

Study Area

17.6.1 The Study Area for the ICCI assessment is identified by each environmental discipline for their individual assessments.

17.6.2 The methodology used by the environmental disciplines to identify ICCIs is described below, and the ICCIs identified by other environmental disciplines is summarised in **Appendix 17-2: In-combination Climate Change Impact Assessment (Volume 5: Appendices).**

Methodology

17.6.3 The methodology described in the following section has been developed in line with the relevant planning policy (see **Section 17.2 Legislation and Policy**) and the guidance and standards listed below.

Guidance and Standards

17.6.4 The guidance and standards associated with the ICCI assessment can be found in **Section 17.5 Climate Change Risk Assessment, sub-section Methodology.**

Assessment Scope

17.6.5 The assessment considers the effects during the three phases of the Proposed Development lifespan as identified in **Section 2.16 – 2.20** of **Chapter 2: Project and Site Description (Volume 2: Main Report).** The phases include Pre-Construction and Enabling, Construction and Operations.

Baseline Data Collection

Desk Study

17.6.6 The published sources used for the ICCI assessment have been listed in **Section 17.5 Climate Change Risk Assessment, sub-section Methodology.**

17.6.7 In addition, the technical disciplines have been consulted and contributed in line with their discipline's associated guidance and standards.

Assessment Methodology

Sensitivity

17.6.8 The ICCI assessment considers the ways in which projected climate change will influence the significance of the impact of the Proposed Development on receptors in the surrounding environment by taking into account the existing and projected future climate conditions for the geographical location and assessment timeframe. It identifies the extent to which identified receptors in the surrounding environment are potentially vulnerable to and affected by these factors. The impacts have been assessed in liaison with the technical specialists responsible for preparing other technical chapters, listed below:

- Chapter 6: Landscape and Visual;
- Chapter 7: Terrestrial Ecology;
- Chapter 8: Ornithology;
- Chapter 9: Aquatic and Marine Ecology;
- Chapter 10: Water Environment;
- Chapter 11: Flood Risk and Water Resources;
- Chapter 12: Cultural Heritage;
- Chapter 13: Access, Traffic and Transport;
- Chapter 14: Noise and Vibration;
- Chapter 15: Geology and Ground Conditions;
- Chapter 16: Socioeconomics, Tourism and Recreation; and
- Chapter 18: Forestry.

17.6.9 Once the potential ICCIs have been identified in relation to the Proposed Development through liaison with technical disciplines, criteria used to determine the likelihood of an event occurring, based on its probability and frequency of occurrence, are detailed in **Table 17-13 Likelihood of a climate risk occurring**. This is the same process as is undertaken for the CCRA.

Magnitude of impact

17.6.10 In consideration of the likelihood of the climate risk occurring, and the sensitivity of the receptor, the likelihood of an impact occurring to the receptor is then defined. This includes consideration of any embedded mitigation measures and good practices. These classifications are defined in **Table 17-17: Risk profile for proposed development**.

17.6.11 The likelihood of a climate hazard occurring and this hazard impacting receptors is assessed in line with the methodology used for the CCRA.

17.6.12 The consequence of the impact on the receptor is then assessed, defined as the change to the significance of the impact already identified by the environmental discipline. To assess the consequence of an ICCI each discipline has assigned a level of consequence to an impact based on the criteria description in **Table 17-18: Consequence criteria for ICCI assessment** and their discipline assessment methodology.

Table 17-18: Consequence criteria for ICCI assessment

Consequence	Consequence Criteria
High	The climate change parameter in-combination with the effect of the Proposed Development causes the significance of the impact of the Proposed Development on the resource/receptor, as defined by the topic, to increase from negligible, low, or moderate to major.
Moderate	The climate change parameter in-combination with the effect of the Proposed Development causes the effect defined by the topic to increase from negligible or low, to moderate.
Low	The climate change parameter in-combination with the effect of the Proposed Development, causes the significance of effect defined by the topic, to increase from negligible to low.

Consequence	Consequence Criteria
Negligible	The climate change parameter in-combination with the effect of the Proposed Development does not alter the significance of the effect defined by the topic.

Significance of effects

17.6.13 The significance of the ICCI assessment is determined as a function of the likelihood of a climate impact occurring and the consequence to the receptor if the impact occurs. The significance of potential effects is determined using the matrix in **Table 17-19: ICCI significance criteria.** Where significant ICCI effects have been assessed, then appropriate additional mitigation measures (secondary mitigation) are identified.

Table 17-19: ICCI significance criteria

		Likelihood of climate-related impact occurring			
		Negligible	Low	Moderate	High
Level of consequence	Negligible	Negligible (NS)	Low (NS)	Low (NS)	Low (NS)
	Low	Low (NS)	Low (NS)	Low (NS)	Moderate (S)
	Moderate	Low (NS)	Low (NS)	Moderate (S)	High (S)
	High	Low (NS)	Moderate (S)	High (S)	High (S)

Note: S = significant; NS = not significant

Limitations and Assumptions

17.6.14 The climate assessment has been based on the parameters outlined in **Chapter 2: Project and Site Description (Volume 2: Main Report).**

17.6.15 Similarly to the CCRA, limitations and assumptions made in the ICCI assessment are based on a review of historic and future climate data. The ICCI assessment is undertaken in conjunction with the other technical disciplines (**Chapters 6 – 16 and 18**) and, as such, assumptions are applied based on the professional judgement of those authors.

Baseline Environment

17.6.16 The current and future baseline environments for the ICCI assessment are the same as those for the CCRA, in that they are the historical and projected climate conditions at the Proposed Development Site, as listed in **Table 17-16: Existing and future baseline climate data.**

Embedded Mitigation

17.6.17 Embedded mitigation for the ICCI assessment is dependent upon the measures that are secured through the various technical disciplines. The technical disciplines take into account the embedded mitigation associated with their chapters in the ICCI assessment.

Assessment of Effects

17.6.18 The significance of potential ICCIs are detailed in **Appendix 17-2: In-combination Climate Change Impact Assessment (Volume 5: Appendices).**

17.6.19 The ICCI assessment has been considered by all other technical disciplines within the EIAR. The following disciplines did not identify any significant ICCIs as part of their assessment:

- **C**hapter 6: Landscape and Visual;
- Chapter 7: Terrestrial Ecology;
- Chapter 8: Ornithology;
- Chapter 9: Aquatic and Marine Ecology;
- Chapter 10: Water Environment;
- Chapter 11: Flood Risk and Water Resources;

- Chapter 12: Cultural Heritage;
- Chapter 13: Access, Traffic and Transport;
- Chapter 14: Noise and Vibration;
- Chapter 15: Geology and Ground Conditions;
- Chapter 16: Socioeconomics, Tourism and Recreation; and
- Chapter 18: Forestry.

17.6.20 Future climate projections have been reviewed and the sensitivity of receptors to both climate change and the Proposed Development have been examined before commenting on the adequacy of the climate change resilience measures built into the Proposed Development.

17.6.21 As a result of the embedded mitigation and good practice measures (as presented in the Embedded Mitigation and the respective sections in the technical chapters) it is concluded that all ICCIs during the preconstruction, construction and operation Phase have been identified to be not significant.

Additional Mitigation and Monitoring

17.6.22 Additional mitigation measures are only required where significant effects are identified following the application of embedded mitigation measures. No significant adverse effects have been identified in the lifecycle GHG impact or ICCI assessments therefore no additional mitigation or enhancement measures are proposed. However, three significant effects were identified for the CCRA during operation.

17.6.23 For the CCRA, three significant effects related to storm events and flooding were identified during operation without additional mitigation. Extreme rainfall events could pose substantial operational risks to the Proposed Development, which are primarily managed through the Flood Risk Assessment and SEPA licensing. Furthermore, storms and severe weather can damage infrastructure, block access roads, and disrupt power supplies, leading to cascading effects across interconnected networks. These disruptions may interrupt critical services, including water supply, IT systems, and transportation, with rural areas being particularly vulnerable due to limited backup infrastructure and alternative resources. Additional mitigation and monitoring listed in **Appendix 17-1: Climate Change Risk Assessment (Volume 5: Appendices) results** in two significant residual effects.

Residual Effects

17.6.24 **Table 17-20: Summary of Effects: Pre-Construction and Enabling, Table 17-21: Summary of Effects: Construction,** and **Table 17-22: Summary of Effects:** Operation provide a summary of the residual effects for Pre-Construction and Enabling, Construction and Operation. There is one significant beneficial residual effect identified in the lifecycle GHG impact assessment during operation of the Proposed Development. There have been no significant residual effects identified in the CCRA for the construction period, and two significant effects identified for the operational period following additional mitigation and monitoring measures. There have been no significant residual effects identified in the ICCI assessment for the preconstruction, construction, and operation Phases.

Table 17-20: Summary of Effects: Pre-Construction and Enabling

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Global atmosphere	Impact of GHG emissions arising during construction of the Proposed Development on the climate.	Release of GHG emissions.	Not required	During the Pre-construction and Enabling Phase of the Proposed Development, there will be unavoidable GHG emissions due to the use of fuel and transportation. However, additional GHG savings are expected to be achieved by implementing the GHG mitigation measures listed in the Embedded Mitigation Section.	Minor adverse – Not Significant
The Proposed Development	Impact of projected future climate change on the Proposed Development.	Impact of future climate change.	Not required	During the Pre-Construction and Enabling of the Proposed Development, the impact of climate change will be unavoidable. The mitigation measures detailed in the embedded mitigation Section could reduce the impact of climate change on the Proposed Development.	Negligible to Low - Not Significant

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Various - identified by each discipline in their assessment	Combined impact of future climate conditions and the Proposed Development.	Impact of future climate change and the Proposed Development.	Not required	The impact of climate change during the Proposed Development's Pre-construction and Enabling will be unavoidable. The mitigation measures detailed within the technical chapters that identified ICCIs could reduce this impact.	Negligible to Low - Not Significant

Table 17-21: Summary of Effects: Construction

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Global atmosphere	Impact of GHG emissions arising during construction of the Proposed Development on the climate.	Release of GHG emissions.	Not required	During the construction of the Proposed Development, there will be unavoidable GHG emissions due to the use of materials, energy, fuel, and transportation. However, additional GHG savings are expected to be achieved by implementing the GHG mitigation measures listed in the Embedded Mitigation Section.	Minor adverse – Not Significant
The Proposed Development	Impact of projected future climate change on the Proposed Development.	Impact of future climate change.	Not required	During the construction of the Proposed Development, the impact of climate change will be unavoidable. The mitigation measures detailed in the embedded mitigation Section could reduce the impact of climate change on the Proposed Development.	Negligible to Low - Not Significant
Various - identified by each discipline in their assessment	Combined impact of future climate conditions and the Proposed Development.	Impact of future climate change and the Proposed Development.	Not required	The impact of climate change during the Proposed Development's construction will be unavoidable. The mitigation measures detailed within the technical chapters that identified ICCIs could reduce this impact.	Negligible to Low - Not Significant

Table 17-22: Summary of Effects: Operation

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Global atmosphere	Impact of GHG emissions arising during the operation of the Proposed Development on the climate	Release of GHG emissions	Not required	During the operation of the Proposed Development, there will be unavoidable GHG emissions due to operational maintenance activities. However, the Proposed Development is expected to achieve emissions reductions in comparison to the alternative future baseline scenario, in line with Scotland's commitment of net zero by 2045.	**Beneficial – Significant**
The Proposed Development	Impact of projected future climate change on the Proposed Development	Impact of future climate change.	Collaborating on collective impact with wider infrastructure providers e.g. Scottish Water and Scottish and Southern Electricity Networks could provide a strategic framework for adaptation and supporting partnerships for considering cross organisation risks and interdependencies.	During the operation of the Proposed Development, the impact of climate change will be unavoidable. The mitigation measures detailed in the embedded mitigation Section could reduce the impact of climate change on the Proposed Development. Significant risks relate to flooding, refer to the Flood Risk Assessment for further detail.	Low to High - Not Significant - **Significant**[55]

[55] Note this is not an overall rating, each risk is assigned its own level of significance

Receptor	Description of Effects	Effects	Additional Mitigation	Residual Effects	Significance
Various identified by each discipline in their assessment	Combined impact of future climate conditions and the Proposed Development	Impact of future climate change and the Proposed Development.	Not required	During the operation of the Proposed Development, the impact of climate change will be unavoidable. The mitigation measures detailed within the technical chapters that identified ICCIs could reduce the impact of climate change on the Proposed Development.	Negligible to Low - Not Significant[56]

17.7 Cumulative Effects

Inter-Cumulative Effects

17.7.1 According to IEMA Guidance on assessing GHG emissions in EIA, the concentration of GHGs in the atmosphere and their impact on climate change are influenced by all sources and sinks globally, whether they are human-caused or not. Unlike many topics in EIA that only focus on projects within a specific geographical area, GHG emissions and their effects are global in nature. For example, air pollutant emissions primarily affect nearby areas, but GHGs disperse around the world due to their persistence in the atmosphere. Therefore, when assessing the cumulative effects of GHGs, it's essential to consider all global sources rather than just focusing on individual projects. This is because a specific local impact of GHG emissions does not have a greater local climate change effect. When considering GHG emissions, it's crucial to account for the cumulative contributions of all GHG sources that contribute to the overall context. If the assessment is limited to a specific geographic or sectoral boundary, then the consideration of cumulative contributions will also be within that boundary.

17.7.2 The GHG assessment provided within this chapter is considered inherently cumulative as it presents the impact of the Proposed Development in the context of Scotland's GHG reduction targets, used to represent the key sensitive receptor, (i.e., the global atmosphere). This includes the provision of legally binding limits of GHG emissions that can be emitted by Scotland if it is to meet its net zero targets by 2045. This assessment is considered comprehensive and includes a worst case within the defined assessment parameters.

17.7.3 It is not feasible to assess cumulative effects with regards to climate change risk, as the effects of climate change are not contained within a project boundary. That being said, the cross-cutting impacts of climate change are identified and presented in the ICCI assessment for this Proposed Development. Refer to Appendix 17-2: In-combination Climate Change Impact Assessment for further detail.

Intra-Cumulative Effects

17.7.4 The ICCI assessment is, by nature, considered a cumulative assessment undertaken by each of the technical disciplines regarding sensitive receptors in the surrounding environment. The identified effects are detailed in **Appendix 17-2: In-combination Climate Change Impact Assessment (Volume 5: Appendices).**

17.8 Summary

Introduction

17.8.1 **Chapter 17: Climate** of the EIAR presents the findings of an assessment of the likely significant effects of the Proposed Development on the climate, the resilience of the Proposed Development and surrounding area to the impacts of climate change. The assessment looks at how the Proposed Development will affect the climate through greenhouse gas (GHG) emissions, how the changing climate will impact the Proposed Development, referred to as the climate change risk assessment (CCRA), and how the combined effects of climate change and the Proposed Development will impact the surrounding environment in the In-combination Climate Change Impact (ICCI) assessment.

[56] As above

Baseline Conditions

17.8.2 For the lifecycle GHG impact assessment, the existing baseline is the current conditions at the Proposed Development Site. The existing baseline comprises of the carbon stock and sources within the boundary of the existing activities on-site.

17.8.3 The future baseline provides an estimate of the emissions that would occur at the development site in the future if the Proposed Development does not proceed. It also accounts for other predicted grid energy generation sources that would be displaced by the Proposed Development.

17.8.4 The existing baseline for the CCRA and ICCI assessments is based on historic, observational climate data recorded by the closest Meteorological Office weather station to the Proposed Development (Fort Augustus, located approximately 14.5 km south of the Proposed Development) for the 30-year period of 1981-2010.

17.8.5 The future baseline for the CCRA and ICCI is informed by UK climate projections 2018 (UKCP18) for the 25 km^2 grid in which the Proposed Development is located. Details of the current and future climate can be found in **Table 17-16: Existing and future baseline climate data.**

Assessment of Effects: Preconstruction & Construction

17.8.6 The Pre-Construction and Enabling period is expected to take approximately one year, with the Construction Phase lasting approximately seven years. Emissions from each source have been assumed to arise equally over the one-year Pre-Construction and seven-year Construction Phase as an estimate. As a result, pre-construction emissions constitute 126,208 tCO2e while construction period emissions contribute 883,456 tCO2e.

17.8.7 The greatest GHG impacts during the Pre-Construction and Enabling and Construction Phase (2026 – 2033) occur as a result of embodied emissions in the materials required for the construction of the Proposed Development, contributing to 32% of emissions.

17.8.8 In line with IEMA criteria for assessing the significance of GHG impacts, preconstruction and construction of the Proposed Development can be assumed to be consistent with applicable existing and emerging policy requirements. GHG emissions from Pre-Construction and Enabling and Construction are therefore determined to be Minor Adverse and Not Significant.

17.8.9 As a result of the embedded climate change mitigation measures (as presented in Embedded Mitigation Section), it is concluded that all climate change risks during the preconstruction and Construction Phase have been identified to have insignificant to moderate levels of consequence, resulting in low to medium adverse, not significant effects. These effects are assessed individually without an overall significance rating given for the CCRA. The complete list of climate change risks can be found in the register presented in **Appendix 17-1: Climate Change Risk Assessment (Volume 5: Appendices)**.

17.8.10 As a result of the embedded mitigation and good practice measures (as presented in the Embedded Mitigation and the respective sections in the technical chapters), it is concluded that all ICCIs during the preconstruction, construction and operation Phase have been identified to be negligible or low adverse, not significant. The impacts have been assessed in liaison with the technical specialists responsible for preparing other technical chapters.

Assessment of Effects: Operation

17.8.11 The operational emissions over the design life of the Proposed Development are estimated at 4,087,800 tCO2e. A total of almost 90% of this figure results from the pumping activities to move water from the Tailpond to the Headpond between cycles.

17.8.12 The estimated operational GHG emissions from the Proposed Development, based on the DESNZ UK Grid Decarbonisation trajectory, indicate that the GHG impact from the Pre-Construction and Enabling and Construction phases are balanced by the net carbon benefit from the operation of the Proposed Development, with carbon payback expected to be achieved during the second year of operation, with every subsequent year providing further carbon savings. This is in comparison to the counterfactual CCGT with identical energy generation capacity to the Proposed Development, assuming the Proposed Development is recharged at the average UK grid carbon intensity. It is considered reasonable to assume that CCGT will still be in operation in 2036, but due to the uncertainty of the future grid electricity generation mix, further carbon benefits are qualitatively assessed below.

17.8.13 Looking at the Proposed Development's carbon benefits in the context of the national grid provides further parameters for the lifecycle GHG impact assessment of effects. Irrespective of which fast response dispatchable source is replaced by the Proposed Development, the cycle of pumping water to the Headpond when the actual energy grid intensity is close to zero and demand is low, then delivering back when demand peaks and carbon intensity is higher, provides carbon benefits from the first year of operation.

17.8.14 The Proposed Development's Operational Phase results in a reduction of GHG emissions compared to the without-project baseline. Operational emissions also align with Scotland's trajectory towards Net Zero. The GHG impact of the Operational Phase is therefore considered to be Beneficial and Significant when compared to the future baseline 'business-as-usual' scenario.

17.8.15 The Proposed Development directly supports the Scottish Government's ambition to decarbonise electricity generation in line with Scotland's 2045 Net Zero Target. Therefore, it is considered to be consistent with achieving Scotland's overall trajectory to net zero. Schemes like the Proposed Development are required by the National Energy System Operator (NESO) as part of their strategy to decarbonise electricity generation and support the connection of more renewable energy sources to the electrical grid. This will be critical for enabling Scotland to reach its net zero targets. The Proposed Development is therefore considered to have an overall beneficial, significant effect on climate.

17.8.16 Three high adverse, significant effects have been identified in the CCRA for the Operational Phase. These risks predominantly encapsulate asset damage from extreme weather conditions and changes in annual precipitation and temperatures, as well as workforce exposure to dangerous working conditions. During the operation of the Proposed Development, the impact of climate change will be unavoidable as the significant risk ratings are based on the likelihood of an event occurring. The consequence of these events may be mitigated by the mitigation measures detailed in the embedded mitigation Section. Regarding significant risks relating to flooding, refer to **Appendix 11.2: Flood Risk Assessment (Volume 5: Appendices)** for further detail.

17.8.17 As a result of the embedded mitigation and good practice measures (as presented in the Embedded Mitigation and the respective sections in the technical chapters), it is concluded that all ICCIs during the operation Phase have been identified to be negligible or low adverse, not significant.

Residual Effects

17.8.18 The lifecycle GHG impact assessment identified a Beneficial, Significant residual effect to the global climate as a result of the Proposed Development during the preconstruction and Construction Phase and the Operational Phase.

17.8.19 Following implementation of the additional mitigation and monitoring measures suggested in this chapter and the Flood Risk Assessment, two high adverse, significant effects were identified for the CCRA. These risks are related to storm events and changes in precipitation, both of which are deemed to have a moderate likelihood of the climate impact occurring. The impacts to workforce and infrastructure are mitigated by design standards and ceasing outdoor and non-essential work if conditions are dangerous, but the likelihood of the events occurring cannot be mitigated.

17.8.20 No residual significant effects were identified by the technical disciplines for the ICCI assessment.

Cumulative Effects

17.8.21 The GHG assessment provided within this chapter is considered inherently cumulative as it presents the impact of the Proposed Development in the context of Scotland's GHG reduction targets, used to represent the key sensitive receptor, (i.e., the global atmosphere). This includes the provision of legally binding limits of GHG emissions that can be emitted by Scotland if it is to meet its net zero targets by 2045. This assessment is considered comprehensive and includes a worst case within the defined assessment parameters.

17.8.22 It is not feasible to assess cumulative effects with regards to climate change risk, as the effects of climate change are not contained within a project boundary. That being said, the cross-cutting impacts of climate change are identified and presented in the ICCI assessment for this Proposed Development.

17.8.23 The ICCI assessment is, by nature, considered a cumulative assessment undertaken by each of the technical disciplines regarding sensitive receptors in the surrounding environment. The identified effects are detailed in **Appendix 17-2: In-combination Climate Change Impact Assessment (Volume 5: Appendices)**.

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