16 CLIMATE CHANGE AND CARBON BALANCE

16.1 Introduction

16.1.1 This Chapter of the Environmental Impact Assessment (EIA) Report evaluates the effects of the Torrance Wind Farm Extension II ('the Proposed Development') on climate change and carbon balance and presents a Climate Change Impact Assessment (CCIA). This assessment was undertaken by Arcus Consultancy Services Limited (Arcus).

16.1.2 This Chapter of the EIA Report is supported by the following Technical Appendix provided in Volume 4 Technical Appendices:

- A16.1: Carbon Balance Calculations;

16.1.3 This Chapter is structured as follows:

- Legislation, policy and guidance;
- Assessment methodology and significance criteria;
- Scoping Responses and Consultation;
- Baseline conditions;
- Assessment of potential effects;
- Assessment of cumulative effects;
- Mitigation measures;
- Residual effects and
- Summary.

16.2 Legislation, Policy and Guidance

16.2.1 The following legislation, policy and guidance have been considered in carrying out this assessment:

- Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation 2020[1];
- Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017[2] (the EIA Regulations);
- The 2020 Routemap for Renewable Energy in Scotland (2011)[3] and as updated in 2013[4] and 2015[5];
- The Electricity Generation Policy Statement (2013)[6];
- Letter from Chief Planner to all Heads of Planning in relation to energy targets and SPP (November 2015)[7];

[1] IEMA (2020) Environmental Impact Assessment Guide to Climate Change Resilience and Adaption 2020 [Online] Available at: https://www.iema.net/resources/reading-room/2020/06/26/iema-eia-guide-to-climate-change-resilience-and-adaptation-2020 (Accessed 09/01/2023)

[2] UK Government (2017) Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] Available at: https://www.legislation.gov.uk/ssi/2017/102/contents/made (Accessed 09/01/2023)

[3] Scottish Government (2011) 2020 Routemap for Renewable Energy in Scotland [Online] Available at: https://www.webarchive.org.uk/wayback/archive/20150218121205/http://www.gov.scot/Publications/2011/08/04110353/0 (Accessed 09/01/2023)

[4] Scottish Government (2013) 2020 Routemap for Renewable Energy in Scotland – Update 2013 [Online] Available at: https://www.webarchive.org.uk/wayback/archive/3000/https://www.gov.scot/Resource/0044/00441628.pdf (Accessed 09/01/2023)

[5] Scottish Government (2015) 2020 Routemap for Renewable Energy in Scotland – Update 2015 [Online] Available at https://www.webarchive.org.uk/wayback/archive/3000/https://www.gov.scot/Resource/0048/00485407.pdf (Accessed 09/01/2023)

[6] Scottish Government (2013) Electricity Generation Policy Statement 2013 [Online] Available at: https://www.gov.scot/publications/electricity-generation-policy-statement-2013/ (Accessed 09/01/2023)

[7] Scottish Government (2015) Letter from Chief Planner to all Heads of Planning in relation to energy targets and SPP [Online] Available at: https://www.gov.scot/publications/energy-targets-and-scottish-planning-policy-chief-planner-letter/ (Accessed 09/01/2023)

- Scottish Energy Strategy (December 2017)[8];
- Onshore Wind Policy Statement (December 2017)[9];
- European Commission Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (2013)[10];
- HM Government UK Climate Change Risk Assessment Government Report (2012);[11]
- Scottish Government's Scottish Climate Change Adaption Programme[12]
- The Scottish Climate Change Plan (2018)[13];
- The Scottish Government's declaration of a Climate Emergency (April 2019)[14];
- The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019[15] and the legally binding net zero target for 2045 and interim targets for 2020, 2030 and 2040;
- Achieving Net Zero (2020)[16];
- Energy White Paper: Powering our net zero future (2020)[17];
- Securing a green recovery on a path to net zero: climate change plan 2018–2032 – update (2020)[18]; and
- The Committee on Climate Change (CCC) Reducing UK emissions: 2020 Progress Report (2022)[19].

16.2.2 Notable information sources containing baseline and projected climate data include:

- Digest of United Kingdom Energy Statistics (DUKES) 2022[20];
- State of the UK Climate 2021[21];
- Met Office UK Climate Projections 2018 (UKCP18) (updated August 2022)[22]; and
- The Met Office UKCP18 Science Overview Report[23].

[8] Scottish Government (2017) The Future of Energy in Scotland: Scottish Energy Strategy [Online] Available at: https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/ (Accessed 09/01/2023)

[9] Scottish Government (2017) Onshore Wind: Policy Statement [Online] Available at: https://www.gov.scot/publications/onshore-wind-policy-statement-9781788515283/ (Accessed 09/01/2023)

[10] European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (2013) [Online] Available at: https://ec.europa.eu/environment/eia/pdf/EIA%20Guidance.pdf (Accessed 09/01/2023)

[11] HM Government (2012) UK Climate Change Risk Assessment: Government Report [Online] Available at: https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-government-report (Accessed 09/01/2023)

[12] Scottish Government (2014) Scottish Climate Change Adaption Programme (SCCAP) [Online] Available at: https://www.gov.scot/publications/climate-ready-scotland-scottish-climate-change-adaptation-programme/ (Accessed 09/01/2023)

[13] Scottish Government (2018) Climate Change Plan: Third Report on Proposals and Policies 2018 – 2031 (RPP3) [Online] Available at: https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018-9781788516488/ (Accessed 09/01/2023)

[14] Scottish Government (2019) Action to Address Climate Emergency [Online] Available at: https://www.gov.scot/news/action-to-address-climate-emergency/ (Accessed 09/01/2023)

[15] Scottish Government (2019) Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 [Online] Available at: http://www.legislation.gov.uk/asp/2019/15/enacted (Accessed 09/01/2023)

[16] National Audit Office (2020) Achieving Net Zero [Online] Available at: https://www.nao.org.uk/report/achieving-net-zero/ (Accessed 09/01/2023)

[17] UK Government (2020) Energy White paper: powering our net zero future [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/945899/201216_BEIS_EWP_Command_Paper_Accessible.pdf (Accessed 09/01/2023)

[18] Scottish Government (2020) Securing a green recovery on a path to net zero: climate change plan 2018–2032 – update [Online] Available at: https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/ (Accessed 09/01/2023)

[19] The CCC (2022) Reducing UK emissions: 2022 Progress Report to Parliament [Online] Available at: https://www.theccc.org.uk/publication/2022-progress-report-to-parliament/ (Accessed 19/01/2023)

[20] UK Government (2021) Digest of United Kingdom Energy Statistics 2022 [Online] Available at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2022 (Accessed 16/01/2023)

[21] Kendon, M., McCarthy, M., Jevrejeva, S., Matthews, A., Sparks, T., Garforth, J., & Kennedy, J. (2022). State of the UK Climate 2021. *International Journal of Climatology*, 42 (Suppl. 2), 1– 76.

[22] Met Office (2022) UK Climate Projections [Online] Available at: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/about/project-news (Accessed 19/01/2023)

[23] Lowe, J.A. *et al.* (2018) UKCP18 Science Overview Report [Online] Available at: https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf (Accessed 09/01/2023)

16.2.3 The COP26 Climate Change Conference which was held in Glasgow in November 2021 reaffirmed the aim of limiting the temperature rise to 1.5 °C. All countries agreed to revisit and strengthen their current emissions targets to 2030, known as Nationally Determined Contributions (NDCs). For the first time, heeding calls from the majority of world nations, the COP26 agreed action on phasing down fossil fuels.

16.2.4 Similarly, countries reaffirmed their commitment to limit global temperature rise to 1.5°C above pre-industrial levels at the COP27 Climate Change Conference, held in Sharm el-Sheikh in November 2022. Governments were also requested to revisit and strengthen their 2030 targets by the end of 2023, as well as increase efforts in phasing down coal generated power[24].

16.2.5 Other information sources are referenced throughout the Chapter.

16.3 Assessment Methodology and Significance Criteria

Scope of Assessment

16.3.1 The following assessments are considered in terms of the Proposed Development:

- The influence of the Proposed Development on climate change; and
- A summary of effects on environmental receptors sensitive to climate change.

16.3.2 The assessment of the influence of the Proposed Development on climate change focusses on the overall balance of greenhouse gas (GHG) emissions as climate change is directly linked to these emissions. No further analysis is undertaken of how climate parameters change in direct response to the emissions balance of the Proposed Development.

16.3.3 In relation to the effects on other environmental receptors, a qualitative review is undertaken in this Chapter of whether projected climate change will modify the future baseline without the Proposed Development sufficiently to change the results of the assessments undertaken in other chapters. The assessments are not repeated in this Chapter, as it should be read in conjunction with the other technical chapters.

16.3.4 Of the technical assessments included within this EIA Report, receptors within ecology, ornithology and hydrology have been identified as having a potential for the baseline to be modified as a result of climate change. Effects of climate change on ecology, ornithology and hydrology are included in this Chapter, with all other technical areas scoped out of further consideration as baseline receptors are unlikely to be affected by the climate changes forecast during the operational phase of the Proposed Development.

16.3.5 An assessment of the vulnerability of the Proposed Development to climate change has been scoped out, on the basis that none of the identified climate change trends could affect the Proposed Development, with the exception of increased windstorms. Any risk to the turbines from windstorms can be mitigated by installing braking mechanisms on the turbines, which would allow them to be operated only under specific wind speeds. Should severe windstorms be experienced, the turbines would be shut down. Additionally, flooding is not expected to pose a significant risk to the operation of the Proposed Development.

[24] UNFCCC (2022) Maintaining a clear intention to keep 1.5°C within reach - Key takeaways from COP27 [Online] Available at: https://unfccc.int/maintaining-a-clear-intention-to-keep-15degc-within-reach (Accessed 19/01/2023)

Study Area

16.3.6 The assessment of the influence of the Proposed Development on climate change considers GHG emissions (current levels and targets) within the Scottish and UK spatial scale. Reference is made to the global context as appropriate.

16.3.7 For the environmental receptors sensitive to the Proposed Development, the Study Area for the assessment on future baseline for these receptors is outlined in individual technical chapters, specifically ecology, ornithology and hydrology.

Survey Methodology

16.3.8 Climate trends and projections are published by the Met Office through the UK Climate Projections website. The UKCP18 became available in November 2018, and was most recently updated in August 2022[25]. The UKCP18 provide the most up to date assessment of how the climate of the UK may change over this century.

16.3.9 UKCP18 uses scenarios for future GHG emissions called Representative Concentration Pathways (RCPs). The four RCPs attempt to capture a range of potential alternative futures and outcomes linked to global temperature increases and include a wide variety of assumptions on socio-economic development and commitment to emissions reductions. The sensitivity of the scenario responses is much more pronounced in the second half of the 21st Century, where the responses diverge more rapidly than in the first half of the century. The four RCPs are as follows:

- RCP2.6: assumes an increase in global mean surface temperature of 1.6°C (-0.9-2.3) by 2081-2100 (no change scenario)[26];
- RCP4.5: assumes an increase in global mean surface temperature of 2.4°C (1.7-3.2) by 2081-2100 (low emissions scenario)[26];
- RCP6.0: assumes an increase in global mean surface temperature of 2.8°C (2.0-3.7) by 2081-2100 (medium emissions scenario)[26]; and
- RCP8.5: assumes an increase in global mean surface temperature of 4.3°C (3.2-5.4) by 2081-2100 (high emissions scenario)[26].

16.3.10 Over the 30-year anticipated operational phase of the Proposed Development, the choice of scenario is therefore not fundamental to the assessment but, where appropriate, the medium emissions scenario RCP6.0 is utilised as the future baseline. Reflecting the Paris Climate Agreement[27], in which most countries including the UK pledged to reduce emissions by 2030, this scenario assumes no further emissions reductions after 2030 and allows for some increase in emissions.

16.3.11 Projections are reported for 20-year time periods through to 2100. The 2021 – 2040 and 2041 - 2060 periods provide the closest projections to the operational phase of the Proposed Development. For the purpose of this CCIA, where appropriate the 2040 - 2059 time period is used as the impacts of climate change are anticipated to be more evident with time.

[25] Met Office (2020) UK Climate projections (UKCP) [Online] Available at: https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index (Accessed 10/11/2021)
[26] Met Office (2018) UCKP18 Guidance: Representative Concentration Pathways [Online] Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-guidance---representative-concentration-pathways.pdf (Accessed 10/11/2021)
[27] United Nations (2016) Framework Convention on Climate Change. Adoption of the Paris Agreement, 21st Conference of the Parties, Paris [Online] Available at: https://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf (Accessed 13/01/2023)

16.3.12 Projected climatic changes at the 50% probability level (central estimate) are utilised, unless otherwise indicated. This is the level where there is as much evidence pointing to a lower outcome as a higher one. There is substantial evidence that the actual climatic change outcome will be in the 10th to 90th percentile range and this is also utilised for limited assessment parameters[28].

Influence of the Proposed Development on Climate Change

16.3.13 This section of the CCIA seeks to quantify the effect of the Proposed Development on climate change.

16.3.14 Scottish Planning Policy (SPP)[29] states that energy infrastructure developments are required to identify their effects on carbon rich soils, using the Scottish Government's Carbon Calculator tool. This has been completed for the Proposed Development using the latest version of the calculator (C-CalcWebV1.7.0)[30]. The Proposed Development carbon calculator reference number is XUCJ-Y8EM-14NJ, as detailed within Technical Appendix A16.1.

16.3.15 The carbon assessment methodology used is consistent with that published by the Rural and Environment Research and Analysis Directorate of the Scottish Government entitled 'Calculating carbon savings from wind farms on Scottish peat lands – a new approach'[31]. This publication sets out the approach and assumptions that should be used to estimate potential carbon losses[32] and savings from wind farms on Scottish peatlands.

16.3.16 The calculation evaluates the balance of total carbon savings and carbon losses over the lifetime of the Proposed Development. The potential carbon savings and carbon costs associated with wind farms are as follows:

16.3.17 Carbon emission savings due to generation (based on displacing emissions from different power sources);

- Lifetime costs associated with manufacture of turbines and construction;
- Loss of carbon from backup power generation; Loss of carbon-fixing potential of peatland;
- Loss and/or saving of carbon stored in peatland (by peat removal or changes in drainage);
- Loss and/or saving of carbon-fixing potential as a result of forestry clearance; and
- Carbon gains due to proposed habitat improvements such as bog restoration.

[28] Lowe et al (2018) UKCP18 Science Overview Report (Page 13)

[29] Scottish Government (2014) Scottish Planning Policy [Online] Available at: https://www.gov.scot/publications/scottish-planning-policy/ (Accessed 13/01/2023)

[30] Scottish Government & SEPA. Carbon Calculator Tool v1.7.0 [Online]. Available at: https://informatics.sepa.org.uk/CarbonCalculator/index.jsp (Accessed 13/01/2023)

[31] Nayak et al (2008) Calculating carbon savings from wind farms on Scottish peat lands: a new approach (Scottish Government) [Online] Available at: https://www.gov.scot/publications/calculating-carbon-savings-wind-farms-scottish-peat-lands-new-approach/pages/13/ (Accessed 13/01/2023)

[32] Carbon losses are defined within the Scottish Governments Technical Note Version 2.10.0 on Calculating potential carbon losses and savings from wind farms on Scottish peatlands. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2018/12/carbon-calculator-technical-guidance/documents/calculating-potential-carbon-losses-and-savings-from-wind-farms-on-scottish-peatlands-technical-guidance/calculating-potential-carbon-losses-and-savings-from-wind-farms-on-scottish-peatlands-technical-guidance/govscot%3Adocument/Calculating%2Bpotential%2Bcarbon%2Blosses%2Band%2Bsavings%2Bfrom%2Bwind%2Bfarms%2Bon%2BScottish%2Bpeatlands%2B-%2Btechnical%2Bguidance.pdf (Accessed 13/01/2023)

16.3.18 The calculation of the carbon balance of a proposed wind farm provides a mechanism by which the carbon costs of a wind farm development can be weighed against the carbon savings attributable to the wind farm during its lifetime. This calculation is summarised as the length of time (in years) it will take the carbon savings to amount to the carbon costs and is referred to as the 'payback period'. This information can then inform decision makers of the viability of a wind farm development in terms of overall carbon savings.

16.3.19 Calculations are provided for expected, best case and worst-case scenarios for the Proposed Development. The expected scenario is based on the layout of four turbines and candidate turbine (SG170, 6.6 Megawatts (MW)) described in **Chapter 3 - Development Description**, and has an estimated installed capacity of approximately 26.4 MW. The other scenarios are based on varying assumptions regarding wind energy capacity factor, characteristics of peatland and development land-take.

16.3.20 The data sources and assumptions used in the carbon balance calculation are detailed in Technical Appendix 16.1. The assessment was informed by peat probing, as described in **Chapter 13 – Geology, Soils and Peat**.

Effects on Environmental Receptors Sensitive to Climate Change

16.3.21 This section of the CCIA identifies where climate change has the potential to significantly impact the findings of assessments undertaken and reported elsewhere in this EIA Report. Reference is made to the specific assessment chapters, where the baseline conditions and sensitivity of receptors are discussed, assessments are not repeated.

Assessment Methodology

16.3.22 To determine whether effects are significant under the EIA Regulations, it is appropriate to consider the sensitivity (vulnerability and susceptibility) of the receptor and the magnitude of the impact, taking into account uncertainty. This is based on the professional judgement of the assessor.

Sensitivity of Receptors

16.3.23 The sensitivity of the baseline conditions, including the importance of environmental features on or near to the Site or the sensitivity of potentially affected receptors, will be assessed in line with best practice guidance, legislation, statutory designations and / or professional judgement.

16.3.24 Table 16.1 details the criteria for determining the sensitivity of receptors.

Table 16.1: Criteria for Determining Sensitivity of Receptors

Sensitivity of Receptor	Definition
Very High	The receptor has little or no ability to absorb change without fundamentally altering its present character, is of very high environmental value, or of international importance.
High	The receptor has low ability to absorb change without fundamentally altering its present character, is of high environmental value, or of national importance.
Medium	The receptor has moderate capacity to absorb change without significantly altering its present character, has some environmental value, or is of regional importance.
Low	The receptor is tolerant of change without detriment or benefit to its character, is low environmental value, or is of local importance.

Sensitivity of Receptor	Definition
Very Low	The receptor is resistant to change and is of little environmental value.

Magnitude of Change

16.3.25 The magnitude of change will be identified through consideration of the Proposed Development, the degree of change to baseline conditions predicted as a result of the Proposed Development, the duration and reversibility of an effect and professional judgement, best practice guidance and legislation.

16.3.26 The criteria for assessing the magnitude of an effect are presented in Table 16.2.

Table 16.2: Criteria for Determining Magnitude of Change

Magnitude of Change	Definition
Very High	A national-level change to the baseline condition of a receptor, leading to the complete loss or alteration of character.
High	A fundamental change (positive or negative) to the baseline condition of the receptor, leading to a major loss or alteration of character.
Medium	A material change (positive or negative) leading to partial loss or alteration of character.
Low	A slight, detectable, change to the baseline condition which may be positive or negative, leading to a minor loss or alteration of character.
Negligible	A barely distinguishable change from baseline conditions, leading to no noticeable loss or alteration of character.

Significance of Effect

16.3.27 The sensitivity of the asset and the magnitude of the predicted change will be used as a guide, in addition to professional judgement, to predict the significance of the likely effects.

16.3.28 The IEMA guidelines for CCIA state the following with regards to the assessment of significance:

"This guidance is not proposing changes to the significance criteria used in the EIA process. However, the susceptibility or resilience of the receptor to climate change must be considered as well as the value of the receptor.

Therefore, a high-value receptor that has very little resilience to changes in climatic conditions should be considered more likely to be significantly affected than a high-value receptor that is very resilient to changes in climatic conditions.

The uncertainty of the combined effect needs to be taken into account. If uncertainty about how a receptor will adapt to a changing climate is high, then it is recommended that a conservative threshold of significance is adopted within the evaluation".

16.3.29 Table 16.3 outlines the framework for the assessment of significance of effects, which is supported heavily by professional judgement.

Table 16.3: Framework for Assessment of the Significance of Effects

Magnitude of Effect	Sensitivity of Resource or Receptor				
	Very High	**High**	**Medium**	**Low**	**Negligible**
Very High	Major	Major	Major	Moderate	Minor

High	Major	Major	Moderate	Moderate	Minor
Medium	Major	Moderate	Moderate	Minor	Negligible
Low	Moderate	Moderate	Minor	Negligible	Negligible
Negligible	Minor	Minor	Negligible	Negligible	Negligible

16.3.30 Those predicted to be of major or moderate significance are considered to be 'significant' in the context of the EIA Regulations, and are shaded in light grey in the above table.

16.3.31 The categories of significance are described in Table 16.4.

Table 16.4: Categories of Significance of Effect

Significance	Definition
Major	A fundamental change to location, environment, species or sensitive receptor.
Moderate	A material, but non-fundamental change to a location, environmental, species or sensitive receptor.
Minor	A detectable but non-material change to a location, environment, species or sensitive receptor
Negligible	No detectable or material change to a location, environment, species or sensitive receptor.

16.3.32 Effects assessed can be either positive, negative or neutral. Whilst receptors may be considered "high-value", a non-material magnitude of the impact would result in any effect being considered not significant.

Assessment Limitations

16.3.33 The climate change projections are based on global models for a range of GHG emissions scenarios and generally consider regional responses to climate change rather than local responses. This is based on best scientific knowledge at this time and judgements on datasets and future socioeconomic drivers.

16.3.34 Downscaling adds another level of uncertainty. There may be more detail, but the uncertainty of the science may be higher. As understanding of the climate system and the ability to model it improves, it is likely that future projections will be refined.

16.3.35 The probabilities presented and the estimated ranges are based on a set of modelling, statistical and dataset choices with expert judgement playing an important role. However, as some potential influences on future climate are not yet known some choices may change as the science develops[33].

16.3.36 Specifically, in relation to wind, the UKCP18 Wind Fact sheet[34] states that local variations due to the land surface are hard to model, particularly in very exposed or sheltered locations. This can be particularly relevant in high wind speed situations where local gusts can result from small scale weather events such as thunderstorms.

[33] Lowe *et al* (2018) UKCP18 Science Overview Report

[34] UKCP18 (2019) Factsheet: Wind [Online] Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-wind_march21.pdf (Accessed 13/01/2023)

16.4 Scoping Responses and Consultation

16.4.1 Throughout the scoping exercises, and subsequently during the ongoing EIA process, relevant organisations were contacted with regards to the Proposed Development. No consultation responses were received in relation to Climate Change and Carbon Balance.

16.5 Baseline Conditions

16.5.1 The State of the UK Climate 2021[35] provides the latest report on observed climate data for UK. Key findings are as follows:

- The decade 2012–2021 has been on average 0.2°C warmer than the 1991–2020 average and 1.0°C warmer than 1961–1990. The ten warmest years on record have occurred since 2002;
- Winter and spring were colder than the 1991–2020 average. However, 2021 included the UK's ninth warmest summer and equal-third warmest autumn on record in series from 1884.
- The most recent decade (2012–2021) has been on average 2% wetter than 1991–2020 and 10% wetter than 1961–1990 for the UK overall.
- For the most recent decade (2012–2021) UK summers have been on average 6% wetter than 1991–2020 and 15% wetter than 1961–1990. UK winters have been 10%/26% wetter.
- In the UK, there is no strong evidence for trends in storminess as determined by maximum gust speeds over the last five decades.

16.5.2 Climate Projections show that the trends over the 21st Century in the UK are towards warmer and wetter winters and hotter, drier summers, with an increase in frequency and intensity of extremes.

16.5.3 The climate parameters considered most relevant to the assessments referenced within this Chapter are wind speed, temperature and precipitation.

Wind Speed

16.5.4 The global projections over the UK show an increase in near surface (10 m height) wind speeds over the UK in the second half of the 21st Century, in the winter season when higher wind speeds are generally experienced. The increase is modest when compared to inter-annual variability. This would be accompanied by an increase in frequency of winter storms over the UK[36]. There are no significant changes forecast in the wind speeds over the first part of the century.

16.5.5 These projections are in line with earlier findings by Pryor and Barthelmie (2010)[37] who concluded that in the near-term (i.e., until the 2050s) there will be no detectable significant change in the wind resource of northern Europe.

[35] Kendon, M., McCarthy, M., Jevrejeva, S., Matthews, A., Sparks, T., & Garforth, J. (2021). State of the UK Climate 2020. *International Journal of Climatology*, 41 (Suppl. 2), 1– 76.

[36] UKCP18 (2018) Factsheet: Wind.

[37] Pryor, S.C. and Barthelmie, R. J. (2010) Climate Change Impact on Wind Energy: A Review. Renewable and Sustainable Energy Review, 14(1): 430-437

16.5.6 **Temperature**

16.5.7 At a UK level, for period 2041-2060 projected changes to annual mean temperature (compared to 1981-2000) is projected at +1.8ºC (50% probability) for RCP8.5 (unmitigated scenario). Results for the 10th to 90th percentile range are between +0.9ºC to +2.7ºC[38]. Key observations are that:

- Both winters and summers will be warmer, with more warming in the summer; and
- In summer there is a pronounced north/south divide with greater increases in maximum summer temperatures over the southern UK compared to Scotland.

16.5.8 **Precipitation**

16.5.9 Rainfall patterns over the UK are not uniform and vary on regional and seasonal scales, which will continue in the future. Future changes are uncertain but point to wetter winters and drier summers in general. Drying in summer will be strongest in the South of England, whilst Scotland is generally associated with increased precipitation in winter[39].

16.5.10 Over the UK, the changes to precipitation projected for 2041-2060 (compared to 1981-2000) for RCP8.5 (unmitigated scenario) are:

- Winter precipitation – increase of 7%. Results for the 10th to 90th percentile range are between -5% and +21%.
- Summer precipitation – decrease of 15%. Results for the 10th to 90th percentile range are between -31% and +0%.

16.5.11 **GHG Emissions and Renewable Energy**

16.5.12 The central aim of the Paris Agreement is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2ºC above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5ºC[40].

16.5.13 COP26 finalised the Paris Rulebook which sets out the guidelines for how the Paris Agreement is delivered. This will allow for the full delivery of the landmark accord, after agreement on a transparency process which will hold countries to account as they deliver on their targets. This includes Article 6, which establishes a robust framework for countries to exchange carbon credits through the UNFCCC[41].

16.5.14 COP26 also ended with the Glasgow Climate Pact, a historic agreement to incorporating the aim of limiting temperature rise to 1.5ºC. All countries agreed to revisit and strengthen their current emissions targets to 2030, known as NDCs, in 2022. This will be combined with a yearly political roundtable to consider a global progress report and a Leaders summit in 2023[42].

[38] Lowe *et al* (2018) UKCP18 Science Overview Report November 2018 (Updated March 2019) (Table 2.2, Page 16)

[39] Lowe *et al* (2018) UKCP18 Science Overview Report

[40] UN Climate Change (2015) The Paris Agreement [Online] Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement (Accessed 13/01/2023)

[41] Carbone Market Institute (2021) COP26 Glasgow Climate Pact ushers in the final Paris Rulebook [Online] Available at: https://carbonmarketinstitute.org/2021/11/14/cop26-glasgow-climate-pact-ushers-in-the-final-paris-rulebook/ (Accessed 13/01/2023)

[42] UNFCCC (2021) Glasgow Climate Pact [Online] Available at: https://unfccc.int/sites/default/files/resource/cop26_auv_2f_cover_decision.pdf (Accessed 13/01/2023)

16.5.15 Other outcomes from COP26 include:

- The Global Methane Pledge, which aims to cut methane emissions by at least 30% by 2030, and currently has 110 countries participating[43] ;
- The Glasgow Leaders Declaration on Forests and Land Use, which aims to reverse deforestation by 2030, and currently has 141 endorsers[44]; and
- Glasgow Financial Alliance for Net-Zero with USD $130 trillion in funds under management pledging to assist achievement of Paris temperature goals[45].

16.5.16 COP27 was held in Sharm el-Sheikh in November 2022. The highlight of COP27 was the agreement to establish the loss and damage fund. This fund establishes a dedicated fund to assist developing countries in responding to loss and damage caused as a result of climate disasters[46].

16.5.17 A substantial reduction in GHG emissions is imperative to avoid irreversible damage caused by the impacts of climate change. "When it comes to rises in global average temperature, every fraction of a degree matters" was stated in a publication providing analysis for the Global Carbon Budget 2018 . The latest Global Carbon Budget report was published in 2022 . The key findings from the 2022 report show that there appears to be no sign of a decrease in global CO2 emissions, and that there is a 50% chance that Global Warming of 1.5°C will be exceeded in 9 years if current emissions levels remain the same . These key findings also showed that global fossil CO2 emissions are expected to rise 1.0% in 2022 (range 0.1% to 1.9%).

16.5.18 The 2018 Intergovernmental Panel on Climate Change (IPCC) Special Report[47] highlighted that to limit global warming to below 1.5°C by the end of the century, emissions would need to decline by approximately 45% by 2030 and reach net zero around 2050. This is the temperature rise when a variety of increasingly severe effects are considered to occur and the IPCC identifies that rapid and far-reaching transitions are required in all sectors including energy. Action is required immediately to reduce emissions by 50% by 2030. Figures from the Global Carbon Project however report that global CO_2 emissions from fossil fuels and industry have increased every decade from an average of 11.4 gigatonnes of equivalent carbon dioxide ($GtCO_2$) in the 1960s to an average of 34.7$GtCO_2$ during 2009-2018. Emissions in 2018 reached a new record high of 36.6$GtCO_2$. This figure has remained consistent and remains at 36.6$GtCO_2$ in 2022. The key findings from the 2022 Global Carbon Budget report show that total CO2 emissions remain high at a projected 40.6GtCO2 in 2022.

16.5.19 Global emissions saw a record 5.4% drop in 2020 as a result of the Covid-19 pandemic however emissions rebounded by 5.1% in 2021, only 0.3% lower than the 2019 global emissions. On average, 1.4 billion tonnes of CO_2 need to be cut each year if the net zero by 2050 target is to be reached[48]

[43] Global Methane Pledge (2021) About the Global Methane Pledge [Online] Available at: https://www.globalmethanepledge.org/ (Accessed 13/01/2023)
[44] UKCOP206 (2021) Glasgow Leaders' Declaration on Forests and Land Use [Online] Available at: https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/ (Accessed 13/01/2023)
[45] GFANZ (2021) Our progress and plan towards a net-zero global economy [Online] Available at: https://assets.bbhub.io/company/sites/63/2021/11/GFANZ-Progress-Report.pdf (Accessed 13/01/2023)
[46] United Nations (2022) COP27 Reaches Breakthrough Agreement on New "Loss and Damage" Fund for Vulnerable Countries [Online] Available at: https://unfccc.int/news/cop27-reaches-breakthrough-agreement-on-new-loss-and-damage-fund-for-vulnerable-countries?gclid=EAIaIQobChMIr5fC1ezT_AIVT9PtCh2-jgsBEAAYAiAAEgIbPvD_BwE (Accessed 19/01/2023)
[47] IPCC (2018) Global Warming of 1.5°C: Summary for Policymakers [Online] Available at: https://www.ipcc.ch/sr15/ (Accessed 13/01/2023)
[48] Global Carbon Project (2021) Global Carbon Budget 2021 [Online] Available at: https://www.globalcarbonproject.org/global/images/carbonbudget/Infographic_Emissions2021.pdf (Accessed 13/01/2023)

16.5.20 The Scottish Government has introduced a number of policies aimed at reducing GHG emissions and meeting renewable energy targets set at Scotland, UK, European and International levels with ambitious targets for reductions in GHG emissions. The Climate Change Act (Emissions Reduction Targets) (Scotland) Act 2019 amends the Climate Change (Scotland) Act 2009 and was introduced to Parliament in May 2018. The Bill was passed in September 2019 and received Royal Assent in October 2019. Following the CCC recommendation, the Act was amended to set a new target to cut Scottish GHG emissions to net zero by 2045, five years ahead of the target date set for the whole of the UK, with interim targets now set to cut emissions by 75% and 90% by 2030 and 2040 respectively (in relation to 1990 levels).

16.5.21 The 2nd Scottish Climate Change Adaptation Programme 2019 – 2024 was published in September 2019. This document sets out the Scottish Government's policies and proposals for climate change adaptation, building on the 1st five-year programme.

16.5.22 In October 2020 the CCC published its report to the Scottish Parliament on progress in reducing carbon emissions[49]. The report notes the significant progress which the power sector has made towards reducing carbon emissions in Scotland and the UK as a whole. The switch to low carbon generation has contributed two thirds of the total fall in emissions in Scotland, driven by the increase in renewable generation from wind power, and the reduction in fossil fuel capacity – including the closure of all of Scotland's remaining coal fired plants. In June 2022 the CCC published its latest report on progress in reducing carbon emissions[50]. This showed that the provisional estimate of 2021 was 4% above 2020 levels, but still 10% below 2019 levels. 2020 saw a 13% decrease on 2019 emissions, compared to an average of 2% decreases per year over the previous decade. This was on account of the Covid-19 pandemic affecting travel and energy demand. It is unclear what the long-term impact of the pandemic will be.

16.5.23 Renewable generation capacity in Scotland has more than trebled since 2010 with 11.9 GW of installed generation capacity across the country as of December 2020[51]. The Energy Statistics for Scotland - Q3 2022 Report[52] shows that as of September 2022, this has increased to 13.6 GW. It is estimated that renewables generated the equivalent of 85.2% of Scotland's gross electricity demand in 2021, with renewable electricity generation up 34.7% in the first nine months of 2022 compared to the same period in 2021.

16.5.24 The CCC published the 2020 report to Parliament[53], assessing progress in reducing UK emissions over the past year. The report highlights that although a limited number of steps have been taken over the past year to support the transition to a net-zero economy and improve the UK's resilience to the impacts of climate change, much remains to be done. The report indicates that reaching net zero emissions in the UK will require all energy to be delivered to consumers in zero-carbon form, i.e., renewables and nuclear, bioenergy and fossil fuels combined with carbon capture and storage.

16.5.25 GHG emissions from the UK electricity sector have been decreasing over the last years, and this is primarily because of a reduction in GHG emissions from power stations. Despite consumption of electricity being provisionally estimated to be around 3.5% higher in 2021 than in 1990, CO_2 emissions from power stations were 73.4% lower in 2021 than in 1990[54]. There was however, a 3.3% increase in carbon dioxide emissions from power stations in 2021 compared to 2020. Overall this is a long-term decrease, which can mainly be attributed to changes in the mix of fuels being used for electricity generation. There has been an evident shift from coal to natural gas and growth in the use of renewable energy sources, combined with greater efficiency resulting from improvements in technology. In 2021 coal made up 2.9% of fuel used for electricity generation, compared to 65.3% in 1990.

16.5.26 With the continued development of onshore wind farms, in the planning and pre-construction phases (currently 10.2 GW of capacity in the pipeline[55]), it is anticipated that onshore wind farms will continue to make a sizeable contribution to the energy generated from renewable energy technologies within Scotland. The CCP sets out as one of the policy outcomes for this sector that from 2020 onwards, Scotland's electricity generation intensity will be less than 50 grams of CO_2 equivalent per kilowatt hour (CO_2eq/kWh), powered by a high penetration of renewables. The CCP figures for 2018 showed intensity had seen a slight increase to 44.6gCO_2e/kWh[56] compared to 2017 which was 24gCO_2e/kWh[57]. The most recent data, from 2019, shows that Grid emissions fell slightly on 2018 levels from 41.4gCO2e/kWh[58]

[49] Climate Change Committee (2020) Reducing emissions in Scotland Progress Report to Parliament [Online] Available at: https://www.theccc.org.uk/publication/reducing-emissions-in-scotland-2020-progress-report-to-parliament/ (Accessed 13/01/2023)

[50] Climate Change Committee (2022) Reducing emissions in Scotland Progress Report to Parliament [Online] Available at: https://www.theccc.org.uk/wp-content/uploads/2022/06/Progress-in-reducing-emissions-2022-Report-to-Parliament.pdf (Accessed 19/01/2023)

[51] Scottish Government (2020) Annual Compendium of Scottish Energy Statistics 2020 [Online] Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/statistics/2019/05/annual-compendium-of-scottish-energy-statistics/documents/annual-compendium-december-2020/annual-compendium-december-2020/govscot%3Adocument/ACSES%2B2020%2B-%2BDecember.pdf (Accessed 13/01/2023)

[52] Scottish Government (2022) Energy Statistics for Scotland - Q3 2022 [Online] Available at: https://www.gov.scot/publications/energy-statistics-for-scotland-q3-2022/ (Accessed 19/01/2023)

[53] The CCC (2020) Reducing UK emissions: 2020 Progress Report to Parliament [Online] Available at: https://www.theccc.org.uk/publication/reducing-uk-emissions-2020-progress-report-to-parliament/#key-findings (Accessed 16/01/2023)

[54] UK Government (2022) 2021 UK greenhouse gas emissions, provisional figures [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1064923/2021-provisional-emissions-statistics-report.pdf (Accessed 19/01/2023)

[55] Scottish Government (2022) Climate Change Plan Monitoring Reports 2022 Compendium [Online] Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/progress-report/2022/05/climate-change-plan-monitoring-reports-2022/documents/climate-change-plan-monitoring-reports-2022/climate-change-plan-monitoring-reports-2022/govscot%3Adocument/climate-change-plan-monitoring-reports-2022.pdf (Accessed 19/01/2023)

[56] Scottish Government (2020) Climate Change Plan 2018-2032 Update [Online] Available at: https://www.gov.scot/publications/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/ (Accessed 16/01/2023)

[57] Scottish Government (2019) Climate Change Plan: monitoring report 2019 [Online] Available at: https://www.gov.scot/publications/climate-change-plan-monitoring-report-2019/pages/3/#:~:text=Renewable%20electricity%20generation%20capacity%20in,2008%20to%2051.7%25%20in%202017 (Accessed 16/01/2023)

[58] Scottish Government (2022) Climate Change Plan Monitoring Reports 2022 Compendium [Online] Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/progress-report/2022/05/climate-change-plan-monitoring-reports-2022/documents/climate-change-plan-monitoring-reports-2022/climate-change-plan-monitoring-reports-2022/govscot%3Adocument/climate-change-plan-monitoring-reports-2022.pdf (Accessed 19/01/2023)

16.6 Assessment of Potential Effects

16.6.1 As a large energy generating asset with a capacity of up to 26.4 MW, the Proposed Development can be classed as an asset of 'regional' importance and therefore, as 'medium' sensitivity for the following assessments.

Influences of the Proposed Development on Climate Change - Carbon Savings

16.6.2 Every unit of electricity produced by a wind farm development displaces a unit of electricity which would otherwise have been produced by a conventional power station, and therefore presents carbon savings.

16.6.3 The electricity produced by a wind farm is assumed to substitute energy production by entirely coal-fired generation, or a mix of fossil fuels, or the national grid mix of energy generation. A renewable energy development would have a maximum potential to save carbon emissions when substituting coal fired generation, which is a possibility if coal is at the bottom of the cost merit order of generation.

16.6.4 However, it is not appropriate to define the electricity source for which this renewable electricity project would substitute, due to uncertainty in future grid mix. For this reason, carbon emission savings are calculated for each scenario in the carbon calculator (Technical Appendix 16.1)

16.6.5 The potential annual carbon emission savings for the Proposed Development are provided in Table 16.5. Based on the latest DUKES Statistics[59] and an average capacity factor of 26.54% (calculated as a rolling average of the past five years using data from the DUKES, using stats 2017-2021), it is expected the Proposed Development would result in the production of approximately 61,377 megawatt hours (MWh) annually, equating to approximately 2,455,099 MWh over the operational life of the Proposed Development (40 years). This equates to displacing approximately 1,060,600 tonnes of fossil fuel mix generation equivalent CO_2 emissions, over the operational life which is a positive environmental effect. The projected change in wind speeds as a result of climate change over the operational phase of the Proposed Development is considered to be non-material for the purposes of this assessment.

Table 16.5: Carbon Savings for the Proposed Development (Expected Scenario)

Type of Generation	Expected CO_2 Saving (t $C0_2yr^{-1}$)
Coal fired electricity generation	61,500
Gas fired electricity generation	22,832
Grid mix electricity generation	11,869
Fossil fuel mix electricity generation	26,515

16.6.6 It should be noted that the average capacity factor of 26.54% is likely to represent a considerable underestimation when compared to the actual capacity factor experienced at the Site. Consequently, carbon savings are also likely to be conservative.

[59] UK Government (2022) Load factors for renewable electricity generation (DUKES 6.3) [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1094495/DUKES_6.3.xlsx (Accessed 16/01/2023)

Influences of the Proposed Development on Climate Change - Carbon Losses

16.6.7 As detailed within the Scottish Government's Technical Note Version 2.10.0 on Calculating potential carbon losses and savings from wind farms on Scottish peatlands[60], the manufacturing, construction and installation of the wind turbines on Site has an associated carbon cost, and carbon losses are also generated by the requirement for extra capacity to back up wind power generation. Carbon losses associated with reduced carbon fixing potential and loss of soil organic matter occurs through drainage effects and excavation of peat for construction. Carbon losses at this site may also be associated with felling of existing forestry.

16.6.8 Organic soils (peatlands) in Scotland act as carbon sinks, whereby they absorb CO_2 during their formation. They may also release carbon due to land use change, such as drainage for agriculture or the establishment of forestry. The Proposed Development is located within a Site where very limited peat deposits are present, as per survey findings discussed in **Chapter 13 – Geology, Soils and Peat** of this EIA Report.

16.6.9 Carbon losses for the expected scenario are summarised in Table 16.6.

Table 16.6: Carbon Losses for the Proposed Development (Expected Scenario)

Losses	**t CO_2 Equivalent (total for wind farm lifetime)**
Losses due to turbine life (e.g., manufacture, construction, decommissioning)	23,903
Losses due to back-up	19,981
Losses due to reduced carbon fixing potential	614
Losses from soil organic matter	-5,066
Losses due to Dissolved Organic Carbon (DOC) and Particulate Organic Carbon (POC) leaching	50
Losses due to felling forestry	3,511
TOTAL LOSSES OF CO_2	42,994

Influences of the Proposed Development on Climate Change - Payback Period

16.6.10 The carbon payback period is a measurement/indicator to help assess a proposal. The shorter the payback the greater benefit the Proposed Development will have in displacing emissions associated with electricity generated by burning fossil fuels.

16.6.11 The payback period is calculated taking the total carbon cost (carbon losses) associated with the Proposed Development and dividing by the annual carbon gains from displaced fossil fuel power generation and any site improvements.

[60] Carbon losses are defined within the Scottish Governments Technical Note Version 2.10.0 on Calculating potential carbon losses and savings from wind farms on Scottish peatlands. Available at: https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2018/12/carbon-calculator-technical-guidance/documents/calculating-potential-carbon-losses-and-savings-from-wind-farms-on-scottish-peatlands-technical-guidance/calculating-potential-carbon-losses-and-savings-from-wind-farms-on-scottish-peatlands-technical-guidance/govscot%3Adocument/Calculating%2Bpotential%2Bcarbon%2Blosses%2Band%2Bsavings%2Bfrom%2Bwind%2Bfarms%2Bon%2BScottish%2Bpeatlands%2B-%2Btechnical%2Bguidance.pdf (Accessed 16/01/2023)

16.6.12 The estimated payback period for the Development is 3.8 years if it displaces energy generated from grid-mix electricity generation. In comparison to fossil fuel mix and coal-fired electricity generation, the payback period of the Development reduces to 1.7 years and 0.7 years respectively. Table 16.7 below goes into further detail regarding the carbon payback period for the Development.

Table 16.7: Payback in Years for each Scenario used in the Carbon Calculator

Compared to…	Expected Scenario	Best Case Scenario	Worst Case Scenario
Coal fired electricity generation	0.7	0.1	0.9
Grid-mix electricity generation	3.8	0.7	4.7
Fossil fuel-mix of electricity generation	1.7	0.3	2.1

16.6.13 On this basis, the CO_2 emission generated from the construction of the Proposed Development are forecast to be cancelled out within approximately 1.7 years. The CO_2 emission savings for the operational lifetime beyond that (currently predicted as 40 years), would be a net benefit of the Proposed Development to reducing climate change. This is considered a 'Low' magnitude of effect (i.e., a slight, detectable, alteration of the baseline condition).

Influences of the Proposed Development on Climate Change - Assessment

16.6.14 Given the challenge and international urgency of climate change, as identified in the recent IPCC special report, climate is considered to have 'Very High sensitivity' to changes in GHG emissions. The magnitude of change is considered 'Low' (i.e., a slight, detectable, change to the baseline condition, leading to an alteration of character).

16.6.15 The Proposed Development is therefore assessed to have 'Moderate', positive environmental effects, which is significant under the EIA Regulations.

Effects of Future Climate Change Scenario on Environmental Receptors Sensitive to Climate Change

16.6.16 The potential for environmental receptors to be impacted by the Proposed Development are assessed in Chapters 6 - 17 of this EIA Report. Of these ecological, ornithological and hydrological receptors are the most sensitive to climate change and are discussed further in Table 16.8 below.

Table 16.8: Climate Change Effects on Environmental Receptors

EIA Report Chapter	Receptor	Climate Change Effect	Effect on Receptor
10	Ecology	Temperature: up to Global mean of 2.8°C (2.0 °C - 3.7 °C) Shift to wetter winters and dryer summers Negligible change in wind speeds	While changes in temperature could affect the composition and growth rates of plant communities and invertebrates, and hence protected species and habitats, the uncertainties are high and it is not clear that the effect of the Proposed Development on those receptors would alter substantially as a result.

EIA Report Chapter	Receptor	Climate Change Effect	Effect on Receptor
11	Ornithology	Temperature: up to Global mean of 2.8ºC (2.0 ºC - 3.7 ºC) Shift to wetter winters and dryer summers Negligible change in wind speeds	A rise in temperature has the potential to impact on habitats which in turn may affect the behaviour of bird interests. As noted above uncertainties are high and the type and significance of effects identified from the Proposed Development are not anticipated to alter as a result.
13 and 14	Hydrology and Hydrogeology; and Geology, Soils and Peat	Shift to wetter winters and dryer summers	Limited change to future baseline and to the identified effects of the Proposed Development.

16.6.17 Given the relatively limited magnitude of change in climate parameters predicted over the operation of the Proposed Development, negligible changes to the baseline for environmental receptors are anticipated during this period. This is incorporated into the assessments undertaken in other chapters of this EIA Report.

16.6.18 No additional significant effects will occur as a result of climate change during the operational phase of the Proposed Development.

16.7 Assessment of Cumulative Effects

16.7.1 The Scottish and UK Governments have set ambitious targets for reducing GHG emissions by 2045 and 2050 respectively. The Proposed Development, in conjunction with other renewable energy developments, will contribute to Scotland and the UK's aims to reduce carbon emissions and achieve meet its ambitious GHG emissions targets.

16.7.2 DUKES 2022 details that renewable electricity represented 39.6% of total UK generation in 2021, with wind generations overall share of capacity increasing to 20.7% of all generators overall, down 3.5% on 2020. Of the total renewable energy generation in the UK, onshore wind accounts for 24%[61].

16.7.3 Scotland had 13.6 GW of installed renewable electricity generation capacity operational as of September 2022. The bulk of Scottish renewable generation capacity as of 2020 is still onshore wind, at 8.8 GW of operational capacity. Total renewable capacity in Scotland continues to grow steadily with an 11.7% increase between September 2021 and September 2022[62].

16.7.4 The Proposed Development will contribute approximately 26.4 MW of installed capacity which will contribute to increasing renewable energy generation capacity within Scotland and the UK.

[61] UK Government (2020) Digest of United Kingdom Energy Statistics 2020 [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1094629/DUKES_2022.pdf (Accessed 17/01/2023)

[62] Scottish Government (2021) Climate Change Plan Monitoring Reports 2021 Compendium [Online] Available at: https://www.gov.scot/publications/climate-change-plan-monitoring-reports-2021-compendium/documents/ (Accessed 17/01/2023)

16.7.5 The cumulative effect of the Proposed Development with other Scottish renewables generation is considered to be a fundamental change in the climate effects of Scottish / UK energy supply and contribute to the legally binding emission reduction targets.

16.7.6 As a 'Very High' sensitivity receptor (i.e., very high environmental value, and of international importance), with a 'Low' magnitude of effect (i.e., a slight change to the baseline condition, leading to a minor alteration of character), this represents a moderate, positive effect that is **significant** under the EIA Regulations.

16.8 Mitigation Measures and Residual Effects

16.8.1 As detailed in paragraph 16.6.13, the Proposed Development will have a positive effect due to the CO_2 emission savings for the operational lifetime and beyond resulting in a net benefit of the Proposed Development to reducing climate change.

16.8.2 Any adverse, negative effects as a result of the Proposed Development are of such limited, and negligible nature, that they are not significant in terms of the EIA Regulations. As such, no mitigation is required under the EIA Regulations other than that already embedded into the Proposed Development and recommended as best practice.

16.8.3 An iterative design approach was taken for the layout of the Proposed Development to carefully site turbines and hardstanding (e.g., maintain buffers to watercourses, use existing tracks where possible, minimise disturbance of peat soils and associated carbon losses). Further micro-siting will be informed by detailed pre-construction ground investigations.

16.8.4 Under the Scottish Government's Control of Woodland Removal policy, any tree crops permanently removed as a result of the Proposed Development would require to be replanted on a like-for-like area basis either within the Site or at a suitable substitute location. As stated in Section 8.6 in Chapter 8: Forestry, approximately 6.65 hectares (ha) of productive forestry would be removed for the duration of the operation of the Proposed Development, and would be replaced by a compensatory planting scheme on a substitute site. The mitigation work to re-establish the areas of crops removed by both restocking within the Site and supplemental compensatory planting out with the Site will ensure the overall area of forestry crops is maintained.

16.8.5 Other mitigation measures will include the management of wind turbines to maintain operational efficiency during their lifetime. Maintenance plans for wind turbines would be developed to maximise turbine output and efficiency.

16.9 Summary of Effects

16.9.1 Table 16.9 provides a summary of the effects detailed within this Chapter.

Table 16.9: Summary of Effects

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Influence of the Proposed Development on Climate Change				
Climate - average temperature predictions as linked to GHG emissions.	Reduction in GHG emissions through offsetting of existing conventional generation.	Moderate. Cumulatively – Moderate.	None. Embedded mitigation has reduced payback period and maximise beneficial impact.	Significant, positive contribution cumulatively to regional emissions and renewable energy generation targets.

Receptor	Potential Effect	Significance of Effect	Mitigation Proposed	Residual Effect
Effects on Environmental Receptors				
Environmental Receptors assessed in individual chapters of EIA Report.	Change to future baseline of receptors and assessment results.	Negligible. Little change over time period to baseline condition of receptors.	None. Mitigation as identified in individual assessment chapters.	None.

16.10 Statement of Significance

16.10.1 The Proposed Development will have a significant, positive effect on carbon savings and cumulatively with Scottish renewable energy deployment. This is significant in terms of the EIA Regulations.

16.10.2 No additional significant effects to those already identified within the EIA Report will occur as a result of climate change during the operational phase of the Proposed Development.