# 17 CLIMATE CHANGE & CARBON BALANCE

## 17.1 INTRODUCTION

1. This Chapter of the Environmental Impact Assessment Report (EIA Report) evaluates the effects of the Heathland Wind Farm (the Development) on climate change and carbon balance resource, and presents a Climate Change Impact Assessment (CCIA).

2. This Chapter of the EIA Report is supported by Technical Appendix A17.1 – Carbon Balance Calculations provided in Volume 3.

3. This Chapter includes the following elements:

- Legislation, Policy and Guidance;
- Assessment Methodology and Significance Criteria;
- Baseline Conditions;
- Assessment of Potential Effects;
- Mitigation and Residual Effects;
- Cumulative Effect Assessment;
- Summary of Effects; and
- Statement of Significance.

## 17.2 LEGISLATION, POLICY AND GUIDANCE

4. 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 Adaption 2020[1];
- Electricity Act 1989[2];
- Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, as amended[3] (the EIA Regulations);
- The 2020 Routemap for Renewable Energy in Scotland (2011)[4] and as updated in 2013[5] and 2015[6];
- The Electricity Generation Policy Statement (2013)[7];
- Letter from Chief Planner to all Heads of Planning in relation to energy targets and SPP (November 2015)[8];
- Scottish Energy Strategy (December 2017)[9];

[1] Institute of Environmental Management (2020). Environmental Impact Assessment Guide to: Climate Change Resilience and Adaption [Online].
[2] UK Government (1989) Electricity Act 1989 [Online] Available at: https://www.legislation.gov.uk/ukpga/1989/29/contents (Accessed 12/11/2020)
[3] UK Government (2017) Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 [Online] Available at: https://www.legislation.gov.uk/ssi/2017/101/contents/made(Accessed 08/09/2020)
[4] Scottish Government (2011). 2020 Routemap for Renewable Energy in Scotland [Online]. Available at: https://www2.gov.scot/Publications/2011/08/04110353/0 (Accessed 12/11/2020)
[5] Scottish Government (2013). 2020 Routemap for Renewable Energy in Scotland – Update 2013 [Online]. Available at: https://www2.gov.scot/Resource/0044/00441628.pdf (Accessed 12/11/2020)
[6] Scottish Government (2015). 2020 Routemap for Renewable Energy in Scotland – Update 2015 [Online]. Available at https://www2.gov.scot/Resource/0048/00485407.pdf (Accessed 12/11/2020)
[7] Scottish Government (2013) Electricity Generation Policy Statement 2013 [Online] Available at: https://www.gov.scot/publications/electricity-generation-policy-statement-2013/ (Accessed 12/11/2020)
[8] 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 12/11/2020)
[9] 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 12/11/2020)

- Onshore Wind Policy Statement (December 2017)[10];
- European Commission Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (2013)[11];
- HM Government UK Climate Change Risk Assessment Government Report (2012);[12]
- Scottish Government's Scottish Climate Change Adaption Programme[13]
- The Scottish Climate Change Plan (2018)[14];
- The Scottish Government's declaration of a Climate Emergency (April 2019)[15]; and
- The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019[16] and the legally binding net zero target for 2045 and interim targets for 2020, 2030 and 2040.

5. Notable information sources containing baseline and projected climate data include:

- Digest of United Kingdom Energy Statistics (DUKES) 2020[17];
- State of the UK Climate 2018[18];
- Met Office UK Climate Projections 2018 (UKCP18) (updated September 2019)[19]; and
- The Met Office UKCP18 Science Overview Report[20].

6. Other information sources are referenced throughout the Chapter.

## 17.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

### 17.3.1 Scoping Responses and Consultations

7. Consultation for this EIA Report topic was undertaken with various consultees however, not all responded. Responses relevant to climate change are detailed in Table 17.1.

[10] Scottish Government (2017) Onshore Wind: Policy Statement [Online] Available at: https://www.gov.scot/publications/onshore-wind-policy-statement-9781788515283/ (Accessed 12/11/2020)
[11] 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 12/11/2020)
[12] 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 12/11/2020)
[13] 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 12/11/2020)
[14] 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 12/11/2020)
[15] Scottish Government (2019) Action to Address Climate Emergency [Online] Available at: https://www.gov.scot/news/action-to-address-climate-emergency/ (Accessed 12/11/2020)
[16] Scottish Government (2019) Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 [Online] Available at: http://www.legislation.gov.uk/asp/2019/15/enacted (Accessed 12/11/2020)
[17] UK Government (2020) Digest of United Kingdom Energy Statistics 2020 [Online] Available at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2020 (Accessed 12/11/2020)
[18] International Journal of Climatology, volume 39, Issue S1 (July 2019) ed. Radan Huth. Wiley
[19] Met Office (2018). UK Climate Projections [Online]. Available at: https://www.metoffice.gov.uk/research/collaboration/ukcp (Accessed 12/11/2020)
[20] Lowe, J.A. *et al.* (2018). UKCP18 Science Overview Report. The Met Office. Available at: https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf (Accessed 12/11/2020)

***Table 17.1: Consultation Responses***

| Consultee | Type and Date | Summary of Consultation Response | Response to Consultee |
|---|---|---|---|
| Scottish Environment Protection Agency (SEPA) | Scoping Response 17/12/2019 | Scottish Planning Policy states (Paragraph 205) that "Where peat and other carbon rich soils are present, applicants must assess the likely effects of development on carbon dioxide ($CO_2$) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of $CO_2$ to the atmosphere. Developments must aim to minimise this release". | Noted. This chapter provides a CCIA which includes a Carbon Balance Assessment. |
| | | The submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of $CO_2$ and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat. Including a detailed map of peat depths and full Peat Management Plan | The Carbon Balance Assessment takes into account any peat disturbance and consequential release of $CO_2$. |

### 17.3.2 Scope of Assessment

8. The following assessments are considered in terms of the Development:
   - The influence of the Development on climate change; and
   - A summary of effects on environmental receptors sensitive to climate change.
9. These assessments consider effects on environmental receptors as a result of the Development.
10. The assessment of the influence of the 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 Development.

### 17.3.3 Elements Scoped Out of Assessment

#### *17.3.3.1 Vulnerability of the Development to Climate Change*

11. This topic has been scoped out of further assessment, on the basis that none of the identified climate change trends could affect the 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 wind farm.

12. Therefore, climate change is not expected to have a significant effect on the Development, and this topic is scoped out of further assessment.

#### *17.3.3.2 Effects of Future Climate Change Scenario on Environmental Receptors Sensitive to Climate Change*

13. 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 Development sufficiently to change the results of the assessments undertaken in other chapters. The assessments are not repeated in this Chapter, which should be read in conjunction with the technical chapters.

14. 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 Development.

### 17.3.4 Study Area / Survey Area

15. The study area for the assessment of the influence of the Development on climate change considers GHG emissions (current levels and targets) with renewable energy generation and grid mix within the Scottish and UK spatial scale. Reference is made to the global context as appropriate.

16. The study area for the assessment on future baseline for environmental receptors is outlined in individual technical chapters. Climate projections on a Scottish and Site scale (where available) are utilised for this Chapter.

### 17.3.5 Design Parameters

17. The design of the Development is a balance of technical, resource and environmental considerations. Those of relevance for the assessments in this Chapter include:

- Installed capacity and capacity factor - for calculation of carbon balance;
- Turbine spacing in relation to prevailing wind direction - for effects on generation, turbulence and direction;
- Amount and layout of new track and infrastructure in relation to deep peat – for calculation of carbon balance;
- Felling associated with the Development – for calculation of carbon balance; and
- Construction Management commitments particularly in relation to minimisation of disturbance and re-use of peat, as embedded in the Peat Management Plan (PMP), etc.) – for assessing potential emissions.

### 17.3.6 Baseline Survey Methodology

18. Climate trends and projections are published by the Met Office through the UK Climate Projections website. The UKCP18 became available in November 2018, and provides the most up to date assessment of how the climate of the UK may change over this century.

19. 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 socioeconomic 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:

20. RCP2.6: assumes an increase in global mean surface temperature of 1.6°C (-.9-2.3) by 2081-2100;

21. RCP4.5: assumes an increase in global mean surface temperature of 2.4°C (1.7-3.2) by 2081-2100 (low emissions scenario);

    - RCP6.0: assumes an increase in global mean surface temperature of 2.8°C (2.0-3.7) by 2081-2100 (medium emissions scenario); 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).

22. Over the 30-year anticipated lifetime of the 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[21], 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.

23. 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 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.

24. 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[22].

#### *17.3.6.1 Influence of the Development on Climate Change*

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

26. Scottish Planning Policy (SPP)[23] states that energy infrastructure developments are required to identify their effects on carbon rich soils, using the Scottish Government's Carbon Calculator. This has been completed for the Development using the latest version of the calculator (C-CalcWebV1.6.0)[24]. 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'[25]. This publication sets out the approach and assumptions that should be used to estimate potential carbon losses and savings from wind farms on Scottish peatlands. The carbon balance assessment is included as Appendix A17.1.

[21] 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 12/11/2020)
[22] Lowe et al (2018). UKCP18 Science Overview Report (Page 13).
[23] Scottish Government (2014). Scottish Planning Policy [Online]. Available at: https://www.gov.scot/publications/scottish-planning-policy/ (Accessed 12/11/2020)
[24] Scottish Government & SEPA. Carbon Calculator Tool v1.5.1 [Online]. Available at: https://informatics.sepa.org.uk/CarbonCalculator/index.jsp (Accessed 12/11/2020)
[25] 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/2008/06/25114657/0 (Accessed 12/11/2020)

27. The calculation evaluates the balance of total carbon savings and carbon losses over the life of a wind farm development. The potential carbon savings and carbon costs associated with wind farms are as follows:

    - 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. 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.

29. Calculations are provided for expected, best case and worst case scenarios of Development. The expected scenario is based on the layout of 14 turbines and candidate turbine described in Chapter 3 – The Development, and an anticipated installed capacity of up to 80 megawatts (MW). The other scenarios are based on varying assumptions regarding wind energy capacity factor, characteristics of peatland and Development land-take.

30. The data sources and assumptions used in the carbon balance assessment are detailed in Appendix A17.1. The assessment was informed by an iterative peat probing process, as described in Chapter 11 – Geology, Soils and Peat.

#### *17.3.6.2 Effects on Environmental Receptors Sensitive to Climate Change*

31. 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.

### 17.3.7 Methodology for the Assessment of Effects

32. The significance of the potential effects of the Development has been classified by professional consideration of the sensitivity (value and resilience) of the receptor and the magnitude of the potential effect, taking into account uncertainty, to determine whether effects are significant in terms of the EIA Regulations.

#### *17.3.7.1 Sensitivity of Receptors*

33. 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.

34. Table 17.2 details the criteria for determining the sensitivity of receptors.

***Table 17.2: 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. |
| Very Low | The receptor is resistant to change and is of little environmental value. |

#### *17.3.7.2 Magnitude of Change*

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

36. The criteria for assessing the magnitude of an effect are presented in Table 17.3.

***Table 17.3: Criteria for Determining Magnitude of Change***

| Magnitude of Change | Definition |
|---|---|
| Very High | A national-level change to the baseline condition of a receptor. |
| High | A fundamental change (positive or negative) to the baseline condition of the receptor, leading to total loss or major alteration of character. |
| Medium | A material change (positive or negative) leading to partial loss or alteration of character. |
| Low | A slight, detectable, alteration of the baseline condition which may be positive or negative. |
| Negligible | A barely distinguishable change from baseline conditions. |

#### *17.3.7.3 Significance of Effect*

37. 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.

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

> *"Once the sensitivity and magnitude have been determined, these should be combined to reach an overall judgement on the significance of the likely environmental effect. As there is no legislative definition of 'significance', the conclusion of whether an effect is significant/the level of significance is down to the CCAR [Climate Change Adaption and Resilience] Coordinator in conjunction with the EIA Coordinator. An explanation of the outcomes of the assessment should be clearly set out.*
>
> *Appropriate criteria for sensitivity, magnitude and significance for the climate resilience assessment should be developed on a project-by-project basis by the CCAR*

*Coordinator in conjunction with the EIA Coordinator, and should take into account the aims/purpose of the project."*

39. Table 17.4 outlines the framework for the assessment of significance of effects.

***Table 17.4: 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 |

40. 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.

41. The categories of significance are described in Table 17.5:

***Table 17.5: 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. |

42. 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.

### 17.3.8 Assessment Limitations

43. 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.

44. 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 ability to model it improves it is likely that future projections will be refined.

45. 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[26].

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

46. In relation to wind, the UKCP18 Wind Fact sheet[27] 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.

### 17.3.9 Embedded Mitigation

47. As detailed in Chapter 2 - Site Selection & Design and Chapter 3 – The Development, the Development has been driven by the key objective of capturing the maximum energy possible, while balancing environmental and technical constraints. The design choices made as a consequence of the key constraints are considered to be mitigation which is 'embedded' in the design; the following are most relevant for the CCIA:

- Development infrastructure is built to withstand strong windspeeds and to harness energy;
- Turbine spacing is sufficient to reduce turbulence effects on turbines downwind;
- The turbines are located to maximise energy generation while minimising environmental impacts;
- The Development design aims to reduce impacts on peat – e.g. through use of existing track layout and avoiding areas of deep peat where possible;
- The area of felling required was reduced as much as practicable, although any felled forestry will be replanted through compensatory planting on a substitute site;
- Implementation of a CEMP, PMP etc. during construction to minimise environmental impacts and peat disturbance; and
- Buffers from watercourses incorporated in layout design, protecting water quality and also protecting Development infrastructure from flooding.

## 17.4 BASELINE CONDITIONS

48. The State of the UK Climate 2019[28] provides the latest report on observed climate data for UK. Key findings are as follows:

- The decade 2010-2019 was on average 0.3°C warmer than the 1981-2010 average and 0.9°C warmer than 1961-1990. The ten warmest years on record have occurred since 2002;
- The decade 2010–2019 has been on average 1% wetter than 1981–2010 and 5% wetter than 1961–1990 for the UK overall. Six of the ten wettest years for the UK in a series from 1862 have occurred since 1998;
- In the context of seasonal changes, for the most recent decade (2010-2019):
  - UK summers have been on average 11% wetter than 1981–2010 and 13% wetter than 1961–1990;
  - UK winters have been on average 4% wetter than 1981–2010 and 12% wetter than 1961–1990; and
- In the UK, there is no strong evidence for trends in storminess as determined by maximum gust speeds over the last five decades.

49. 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.

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

[27] UKCP18 (2019) Factsheet: Wind [Online]. Available at: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-fact-sheet-wind.pdf (Accessed 12/11/2020)
[28] International Journal of Climatology, Volume 40, Issue S1 (July 2020). ed. Radan Huth. Wiley

### 17.4.1 Wind Speed

51. 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[29]. There are no significant changes forecast in the wind speeds over the first part of the Century.

52. These projections are in line with earlier findings by Pryor and Barthelmie (2010)[30] 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.

### 17.4.2 Temperature

53. At a UK level, for period 2041-2060 projected changes to annual mean temperature (compared to 1981-2000) is projected at +1.8°C (50% probability) for RCP8.5 (unmitigated scenario). Results for the 10th to 90th percentile range are between +0.9°C to +2.7°C[31]. 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.

### 17.4.3 Precipitation

54. Rainfall patterns over the UK are not uniform and vary on regional (e.g. Highland-wide, or from coast to coast) 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 winters[32].

55. 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%; and
- Summer precipitation – decrease of 15%. Results for the 10th to 90th percentile range are between -31% and +0%.

### 17.4.4 Greenhouse Gas Emissions and Renewable Energy

56. 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 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C[33].

57. A substantial reduction in greenhouse gas emissions is imperative to avoid irreversible damage caused by the impacts of climate change. *"When it comes to rises in global*

[29] UKCP18 (2018). Factsheet: Wind.
[30] 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.
[31] Lowe *et al* (2018). UKCP18 Science Overview Report November 2018 (Updated March 2019) (Table 2.2, Page 16).
[32] Lowe *et al* (2018). UKCP18 Science Overview Report.
[33] UN Climate Change (2015) the Paris Agreement [Online] Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement (Accessed 12/11/2020)

*average temperature, every fraction of a degree matters"* was stated in a recent publication providing analysis for the Global Carbon Budget 2018[34].

58. The 2018 IPCC Special Report[35] highlighted that to limit global warming to below 1.5ºC 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$GtCO_2$. Though global emissions in 2019 have been project to increase by an additional 6%, which is a slower growth than in the past two years[36].

59. The Scottish Government has introduced a number of policies aimed at reducing GHG emissions and meeting renewable energy targets set at a UK, European and International level with ambitious targets for reductions in greenhouse gas emissions. The Climate Change Act (Emissions Reduction Targets) (Scotland) Act 2019 amends the Climate Change (Scotland) Act 2009, was introduced to Parliament in May 2018. The Bill was passed in September 2019 and received Royal Assent in October 2019. Following the Committee on Climate Change recommendation, the Act was amended to set a new target to cut Scottish greenhouse gas 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).

60. 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.

61. Overall Scottish emissions are now 51% below 1990 levels and Scotland is on target to outperform the interim emissions reductions target for at least a 56% reduction in actual emissions by the end of 2020[37]. To date much of the emissions savings have come from action in the electricity sector, with closure of Scotland's last remaining coal-fired power station in 2016 and rapid growth in renewable generation to fill the energy gap.

62. On the 25 June 2020 the Committee on Climate Change (the CCC) published the 2020 report to Parliament, 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.

[34] Figueres, C., C. Le Quéré, G. P. Peters, G. Whiteman, A. Mahindra, D. Guan, et al. (2018) Carbon Budget 2018**:** Emissions are still rising: ramp up the cuts, Nature, vol 564, 27-30.
[35] Intergovernmental Panel on Climate Change (IPCC) (2018) Global Warming of 1.5ºC: Summary for Policymakers [Online] Available at: https://www.ipcc.ch/sr15/ (Accessed 12/11/2020)

[37] Climate Change Committee (December 2019) Reducing Emissions in Scotland: 2019 Progress Report to Parliament [Online]. Available at https://www.theccc.org.uk/publication/reducing-emissions-in-scotland-2019-progress-report-to-parliament/#:~:text=It%20assesses%20Scotland's%20progress%20in,a%2010%25%20fall%20in%202016 (Accessed 12/11/2020)

63. In October 2020 the CCC published its latest report to the Scottish Parliament on progress in reducing carbon emissions[38]. 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.

64. Renewable generation capacity in Scotland has more than trebled in the last 10 years with 11.9 GW of installed generation capacity across the country as of March 2020[39]. It is estimated that renewables generated the equivalent of 90.1% of Scotland's gross electricity demand in 2019.

65. However, Scotland has a target to reduce GHG emissions to net-zero by 2045, which includes electricity generation. As stated in the 2019 Progress Report to Parliament by the Climate Change Committee (CCC), Scotland must reduce its emissions by an average of 1.8 million metric tonnes ($MtCO_2e$). In 2017, emissions fell by 1.4 $MtCO_2e$ in Scotland, less than the Scottish Government's annual reduction targets. To be able to meet its 2045 target, Scotland must further reduce its GHG emissions.

66. GHG emissions from the electricity sector decreased by 83% between 1990 and 2016, with the Cities for Climate Protection (CCP) setting out policies and proposals to reduce emissions from this sector by a further 28% between 2018 and 2032, taking the overall reduction within the sector to 87% compared to 1990.

67. With the continued development of onshore wind farms, in the planning and pre-construction phases, 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 carbon dioxide equivalent per kilowatt hour ($CO_2eq/kWh$), powered by a high penetration of renewables. The CCP latest figures for 2017 show intensity was $24gCO_2e/kWh$ which displays a fall of 56% since 2016[40].With the continued development of onshore wind farms, in the planning and pre-construction phases, it is anticipated that onshore wind farms will continue to make a sizeable contribution to the energy generated from renewable energy technologies within Scotland.

## 17.5 ASSESSMENT OF POTENTIAL EFFECTS

68. As a large energy asset of generation in excess of 50MW, the Development can be classed as an asset of regional importance and classed as medium sensitivity for the following assessments.

[38] Climate Change Committee (October 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 23/11/2020)
[39] 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-august-2020/annual-compendium-august-2020/govscot%3Adocument/ACSES%2B2020%2B-%2BAugustFinal.pdf (Accessed 12/11/2020)
[40] 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 12/11/2020)

### 17.5.1 Influences of the Development on Climate Change

#### *17.5.1.1 Carbon Savings*

69. Every unit of electricity produced by a wind farm development displaces a unit of electricity which would otherwise have been produced by a conventional (coal or gas) power station, and therefore presents carbon savings.

70. The electricity produced from the 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.

71. 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 (Appendix A17.1).

72. The potential annual carbon emission savings for the Development are provided in Table 17.6. Based on an estimated capacity factor 27%[41], it is expected the Development would result in the production of approximately 5,016,589 MWh over the operational life of the Development. This equates to displacing approximately 2,257,470 tonnes of fossil fuel mix generation equivalent $CO_2$ emissions, based on DUKES emission factors[42], 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 Development is considered to be non-material for the purposes of this assessment.

***Table 17.6: Carbon Savings for the Development (Expected Scenario)***

| | **Expected $CO_2$ Saving (t $C0_2yr^{-1}$)** |
|---|---|
| Coal fired electricity generation | 153,842 |
| Grid mix electricity generation | 42,404 |
| Fossil fuel mix electricity generation | 75,249 |

#### *17.5.1.2 Carbon Losses*

73. 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 excavation of peat for construction and drainage effects. Carbon losses at this site may also be associated with felling of existing forestry.

74. Organic soils (peatlands) in Scotland act as carbon sinks, whereby they absorb carbon dioxide then they release it due to land use change, such as forestry. Wind farm developments on peatlands may result in a negative impact on these habitats if not appropriately considered during scheme design and development. Changes to the peatland habitat through development could result in a significant effect on its ability to store carbon, potentially resulting in reduced net carbon benefits of the Development.

75. A peat depth survey was undertaken across the Site where it was established that the 70% of the Site is underlain by shallow peat with a depth of <1 m, however pockets of deep peat do exist across the Site; noted in the north western area (2 m – 4 m depth), southern area (4 m – 6 m depth) and eastern area (>6 m depth). The design process sought where possible to avoid disturbance to deposits of deep peat, outlined in Chapter

[41] Based on DUKES 5 year average load factor for onshore wind between 2015 and 2019.
[42] DUKES (2020) Digest of United Kingdom Energy Statistics 2020 [Online] Available at: https://www.gov.uk/government/statistics/digest-of-uk-energy-statistics-dukes-2020 (Accessed 12/11/2020)

2 – Site Selection and Design. Existing forest tracks are used where possible to minimise the disturbance to peat and peaty soils and cable trenches will follow the on-site access tracks. Felling will be balanced by compensatory planting and there is no net loss of woodland associated with this proposal.

76. Carbon losses for the expected scenario are summarised in Table 17.7.

***Table 17.7: Carbon Losses for the Development (Expected Scenario)***

| Losses | t $CO_2$ Equivalent (total for wind farm lifetime) |
|---|---|
| Losses due to turbine life (e.g. manufacture, construction, decommissioning) | 62, 210 |
| Losses due to back-up | 41, 805 |
| Losses due to reduced carbon fixing potential | 1,904 |
| Losses from soil organic matter | 17,085 |
| Losses due to Dissolved Organic Carbon (DOC) and Particulate Organic Carbon (POC) leaching | 1,521 |
| Losses due to felling forestry | 19,761 |
| Total losses of carbon dioxide | 143,476 |

### *17.5.1.3 Payback Period*

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

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

79. The estimated payback period for the Development is 3.4 years compared to grid-mix electricity generation. In comparison to fossil fuel mix and coal-fired electricity generation the payback period of the Development reduces to 1.9 years and 0.9 years respectively. Table 17.8 below goes into further detail regarding the carbon payback period for the Development.

***Table 17.8: 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 | 0.9 | 0.7 | 2.7 |
| Grid-mix electricity generation | 3.4 | 2.4 | 9.7 |
| Fossil fuel-mix of electricity generation | 1.9 | 1.4 | 5.4 |

80. Beyond the payback period, the $CO_2$ emission savings for the operational lifetime (currently predicted as 30 years) would be a net benefit of the Development to reducing climate change. This is considered a Low magnitude of change i.e. a slight, detectable, alteration of the baseline condition.

81. 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 Development is therefore assessed to have Moderate, positive environmental effects, that is significant under the EIA Regulations.

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

82. The potential for environmental receptors to be impacted by the Development is assessed in Chapters 6-18 of this EIA Report. Of these ecological, ornithological and hydrological receptors are the most sensitive to climate change and are discussed further in Table 17.9 below.

***Table 17.9: Climate Change Effects on Environmental Receptors***

| EIA Report Chapter | Receptor | Climate Change Effect | Effect on Receptor |
|---|---|---|---|
| 8 | Ecology – Habitats, Protected Species | Temperature – up to + 2°C<br><br>Shift to wetter winters and dryer summers<br><br>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 Development on those receptors would alter substantially as a result. |
| 9 | Ornithology | Temperature – up to + 2°C<br><br>Shift to wetter winters and dryer summers<br><br>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 Development are not anticipated to alter as a result. |
| 10 & 11 | Geology, Hydrology and Hydrogeology | Shift to wetter winters and drier summers | Limited change to future baseline and to the identified effects of the Development. |

83. Given the relatively limited magnitude of change in climate parameters predicted over the operation of the 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.

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

## 17.6 MITIGATION AND RESIDUAL EFFECTS

85. As detailed in Section 17.5.1.3, the 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 Development to reducing climate change. Any adverse, negative effects as a result of the 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 Development and recommended as best practice.

86. An iterative design approach was taken for the layout of the Development to avoid siting turbines and hardstanding in proximity to watercourses as well as infrastructure in deep peat, where possible, to minimise disturbance of peat soils and associated carbon losses. Further micro-siting will be informed by detailed pre-construction ground investigations.

87. An Outline PMP has been produced and is provided as Technical Appendix A11.2. Proposed reuses of the excavated peat are in line with the Scottish Renewables and SEPA

Guidance[43] and the outline PMP demonstrates that all excavated peat can be suitably re-used on Site. Methods for handling and storing excavated peat have been described in the Outline PMP to ensure its reuse potential is maximised and any carbon losses are minimised. Monitoring of the reinstated areas will be carried out to ensure that the environmental objectives are realised.

88. The Outline PMP will be updated prior to construction once more detailed site investigation data and detailed engineering designs are available. The temporary peat storage locations will be identified in the updated PMP and will be guided by a geotechnical engineer. The updated PMP will also include detailed method statements and phasing of works, and will be agreed with SEPA and the planning authority prior to construction commencing.

    Under the Scottish Government's Control of Woodland Removal policy any tree crops permanently removed for the Development would require to be replanted on a like-for-like area basis either within the Site or at a suitable substitute location. 49.90 hectares (ha) of productive forestry would be removed for the duration of the operation of the Development, and would be replaced by a compensatory planting scheme on a substitute site. An additional 8.55 ha of forestry will be removed prior to the construction period and restocked on Site prior to operation. 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.

89. 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. Key performance indicators to monitor and track operational efficiency would be developed.

## 17.7 CUMULATIVE EFFECT ASSESSMENT

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

91. DUKES 2020 details that renewable electricity represented 37.1% of total UK generation in 2019, with onshore wind's overall share of capacity increasing to 13.3% of all generators overall, up two percentage points on 2018.

92. The Development will contribute up to 80 MW of installed capacity which will contribute to increasing renewable energy generation capacity within Scotland and the UK.

93. The cumulative effect of the Development with other UK renewable energy generation is considered to be a fundamental change in the climate effects of UK energy supply and contribute to the UK's legally binding emission reduction targets. This represents a major, positive effect that is significant in terms of the EIA Regulations.

## 17.8 SUMMARY OF EFFECTS

94. Table 17.10 provides a summary of the effects detailed within this Chapter.

***Table 17.10: Summary of Effects***

| Receptor | Potential Effect | Significance of Effect | Mitigation Proposed | Residual Effect |
|---|---|---|---|---|
| **Influence of the Development on Climate Change** | | | | |

[43] Scottish Renewables, SEPA (2012) Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste [Online] Available at: https://www.gov.scot/Topics/Business-Industry/Energy/Energy-sources/19185/17852-1/CSavings/guidancepeatwaste (Accessed 12/11/2020)

| Receptor | Potential Effect | Significance of Effect | Mitigation Proposed | Residual Effect |
|---|---|---|---|---|
| Climate - average temperature predictions as linked to GHG emissions. | Reduction in GHG emissions through offsetting of existing conventional generation. | Moderate<br>Major cumulatively | None<br>Embedded mitigation has reduced payback period and maximise beneficial impact. | Significant contribution cumulatively to regional emissions and renewable energy generation targets. |
| **Effects on Environmental Receptors** | | | | |
| Environmental Receptors assessed in individual chapters of EIA Report. | Change to future baseline of receptors and assessment results. | Negligible<br>Little change over time period to baseline condition of receptors. | None<br>Mitigation as identified in individual assessment chapters | None |

## 17.9 STATEMENT OF SIGNIFICANCE

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

96. 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 Development.