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## **21 Climate Change and Carbon Balance**

### **21.1 Introduction**

21.1.1 This Chapter does not repeat the information set out in Chapter 21: Climate Change and Carbon Balance of the Shepherds' Rig EIA Report (November 2018) where that information remains valid in the context of the reduced number of turbines now proposed as the Revised Development (AEI Figure 4.1). As such, the Additional Environmental Information (AEI) supplements Chapter 21 of the EIA Report (November 2018) and should be read in conjunction with it.

21.1.2 This Chapter of the AEI is supported by the following Appendix document provided in AEI Volume 3 Appendices:

- AEI Appendix 21.1: Updated Carbon Balance Calculations.

21.1.3 In response to the EIA Report (November 2018), there was no consultation response specific to climate change and carbon balance.

21.1.4 The principles of the EIA Report (November 2018) remain valid and appropriate and have not been reassessed for this AEI, unless otherwise stated.

### **21.2 Methodology**

21.2.1 Section 21.2 of the EIA Report (November 2018) outlines legislation, policy and guidance relevant to the assessment in relation to climate change. Key updates to this section are described below

21.2.2 In April 2019, the First Minister of Scotland declared a global climate emergency acknowledging the urgent challenge to reduce greenhouse gas emissions and adapt to the changing climate<sup>1</sup>. In May 2019, the Committee on Climate Change (CCC) recommended a net-zero emission date of 2045 for Scotland<sup>2</sup>.

21.2.3 The Climate Change Bill, which amends the Climate Change (Scotland) Act 2009<sup>3</sup>, was introduced to Parliament in May 2018 as reported in the EIA Report (November 2018). The Bill was passed in September 2019<sup>4</sup> and at the time of writing is awaiting Royal Assent. Following the CCC recommendation, the Bill 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).

21.2.4 The 2nd Scottish Climate Change Adaptation Programme 2019-2024<sup>5</sup> was

<sup>1</sup> SNP Conference, Edinburgh (April 2019)

<sup>2</sup> Committee on Climate Change (2019) Net Zero: The UK's contribution to stopping global warming. Available at <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>

<sup>3</sup> Scottish Government (2009) Climate Change (Scotland) Act 2009 [Online] Available at: <https://www.legislation.gov.uk/asp/2009/12/contents>

<sup>4</sup> Scottish Government (2019) Climate Change (Emissions Reduction Targets) (Scotland) Bill. Available at: [https://www.parliament.scot/S5\\_Bills/Climate%20Change%20\(Emissions%20Reduction%20Targets\)%20\(Scotland\)%20Bill/SPBill30BS052019.pdf](https://www.parliament.scot/S5_Bills/Climate%20Change%20(Emissions%20Reduction%20Targets)%20(Scotland)%20Bill/SPBill30BS052019.pdf)

<sup>5</sup> Scottish Government (2019) Climate Ready Scotland: Second Scottish Climate Change Adaptation Programme 2019-2024. Available at: <https://www.gov.scot/publications/climate-ready-scotland-second-scottish-climate-change-adaptation-programme-2019-2024/>

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. The Programme is a requirement of the Climate Change (Scotland) Act 2009.

- 21.2.5 The baseline information relied upon in order to make an assessment of the effects of the Revised Development is hereby updated to reflect the UK Climate Projections 2018 (UKCP18)<sup>6</sup>. These became available in November 2018 and provide the most up to date assessment of how the climate of the UK may change over this century. The assessment presented in the EIA Report (November 2018) used the Climate Change Projections Report 2009 (UKCP09), which was current at that time to provide baseline projections.
- 21.2.6 UKCP18 uses scenarios for future greenhouse gas emissions which attempt to capture a range of potential alternative futures and which diverge more rapidly in the second half of the 21st century. Over the 25 year anticipated lifetime of the Revised Development, the choice of scenario is not critical, but is specified as appropriate.
- 21.2.7 To ensure consistency of approach, the same significance criteria and assessment methodology as referred to in Section 21.3 of the EIA Report (November 2018) has been followed.
- 21.2.8 Taking into account the relevant policy and guidance, baseline information, and assessment criteria, an assessment is presented below which details the effect of the revised layout. The carbon balance assessment using the Scottish Government's carbon calculator tool has been completed for the revised Development using the latest version of the calculator (C-CalcWebV1.6.0). It should be noted that as battery storage technology is relatively new to the UK, the carbon balance assessment has not included the battery storage element of the Revised Development.

### **21.3 Baseline Conditions**

- 21.3.1 UKCP18 shows 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. The climate parameters considered most relevant to the assessments remain as outlined within the EIA Report (November 2019) and are wind speed, temperature and precipitation.

#### *Wind Speed*

- 21.3.2 There are no notable changes projected in the near-surface wind speeds over the first part of the 21st century, the timescale most relevant for the Revised Development<sup>7</sup>. This is consistent with UKCP09 projections used as the projected baseline in Section 21.5 of the EIA Report (November 2018).

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<sup>6</sup> Met Office (2018) UK Climate Projections. Available at <https://www.metoffice.gov.uk/research/collaboration/ukcp>

<sup>7</sup> UKCP18 (2018) Factsheet: Wind. Available at: <https://www.metoffice.gov.uk/binaries/content/assets/mohippo/pdf/ukcp18/ukcp18-factsheet-wind.pdf>

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*Temperature*

- 21.3.3 Projections from UKCP188 demonstrate a trend towards warmer winters and summers in the UK throughout the 21st century, with more warming in the summer. There is a pronounced north/south divide with greater increases in maximum summer temperatures over the southern UK compared to northern UK and Scotland. This is consistent with UKCP09 projections used as the projected baseline in Section 21.5 of the EIA Report (November 2018).

*Precipitation*

- 21.3.4 Rainfall patterns over the UK 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 Northern Scotland is associated with greatest wetting in winters<sup>9</sup>.
- 21.3.5 Although generally consistent with UKCP09 findings, UKCP18 provides more clarity on the seasonal variations. For the period 2041-60 (compared to 1981-2000) projections<sup>10</sup> show changes of between 0-10% in annual mean precipitation over most of southern and western Scotland (50% probability). This encompasses a projected drying in summer of up to 20%. In winter, the projection is for between 0-10% increase in precipitation over most of Scotland with up to 20% along the coastline and central belt.

*Greenhouse Gas Emissions and Renewable Energy*

- 21.3.6 The Digest of United Kingdom Energy Statistics (DUKES) is published annually and the most recent version<sup>11</sup> provides statistics for 2019. This shows the continuing upward trend in electricity generated by renewables, with generation up 11% in 2018 over 2017<sup>12</sup>. Chart 5.6 of DUKES shows that although fossil fuels still accounts for the largest share of UK electricity generation in 2018 at 44.9%, renewables reached a record share of 33% (up 3.8% on 2017)<sup>13</sup> primarily driven by wind and solar power.

## **21.4 Change in Effects**

*Climate Change*

- 21.4.1 The following assessments were considered in the EIA Report (November 2018):
- The vulnerability of the Proposed Development to climate change;
  - The influence of the Proposed Development on climate change; and

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<sup>8</sup> Lowe *et al* (2018) UKCP18 Science Overview Report. Available at: <https://www.metoffice.gov.uk/pub/data/weather/uk/ukcp18/science-reports/UKCP18-Overview-report.pdf>

<sup>9</sup> Lowe *et al* (2018) UKCP18 Science Overview Report

<sup>10</sup> Lowe *et al* (2018) UKCP18 Science Overview Report. Based on UKCP19 RCP8.5 unmitigated scenario

<sup>11</sup> Department for Business, Energy & Industrial Strategy (2019) Digest of United Kingdom Energy Statistics (DUKES) [Online] Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/822305/DUKES\\_2019\\_MASTER\\_COPY.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/822305/DUKES_2019_MASTER_COPY.pdf) (Accessed 10/09/19)

<sup>12</sup> DUKES paragraph 5.36

<sup>13</sup> DUKES Chart 5.6

- A summary of effects on environmental receptors sensitive to climate change.

21.4.2 Limited and not significant effects were identified in the EIA Report (November 2018) for each of the above assessments. The updated climate projections and other baseline data identified above do not give rise to any additional effects and therefore effects remain not significant.

21.4.3 The revisions to the turbine layout, as shown on **AEI Figure 4.1**, do not give rise to additional effects in relation to any of the assessments. The removal of two turbines and associated infrastructure, the associated reduction in installed capacity, and the re-siting of turbines into areas of shallower peat will all influence the detail, but not the overall validity and conclusion of the assessment of the influence of the Proposed Development on climate change, as presented in the EIA Report (November 2018).

21.4.4 The updated assessment is presented in the following sections alongside key findings reported in the EIA Report (November 2018) for comparison.

*Carbon Savings*

21.4.5 An updated carbon balance assessment has been undertaken as part of the AEI. The carbon balance assessment is included as **AEI Appendix 21.1**.

21.4.6 The potential annual carbon emission savings for the Revised Development (excluding the battery storage aspect of the Revised Development) are provided in Table 21.1. Based on the anticipated capacity factor of the onshore wind aspect of the Revised Development of 25.5%, it is expected that the Revised Development would result in the production of approximately 159,493 MWh annually, equating to 3,987,333 MWh over the operational life of the Revised Development (25 years). This equates to displacing approximately 1,871,701 tonnes of fossil fuel mix generation equivalent which is a positive environmental effect. A comparison to the overall carbon savings for the Proposed Development and the Revised Development are presented in AEI Table 21.1.

**AEI Table 21.1: Carbon Savings for the Development (Excluding Battery Storage) (Expected Scenario)**

Fuel Source	Proposed Findings Expected (t CO <sub>2</sub> yr <sup>-1</sup> )	Development within EIA Report CO <sub>2</sub> Saving	Revised Findings Expected (t CO <sub>2</sub> yr <sup>-1</sup> )	Development within this AEI CO <sub>2</sub> Saving
Coal fired electricity generation	163,640		146,734	
Grid mix electricity generation	50,069		40,444	
Fossil fuel mix electricity generation	81,998		71,772	

21.4.7 These are modest changes, which are largely due to the reduction in the number of turbines for the Revised Development. It should also be noted that

the carbon savings calculations will likely be an under-estimation due to battery storage being excluded from this assessment; however, the assessment has assessed worst-case scenario. The integration of the battery storage element of the Revised Development will enable further decarbonisation of the UK electrical grid and will therefore, be a positive environmental asset to the Revised Development and will likely increase overall carbon savings of the Revised Development.

*Carbon Losses*

21.4.8 An updated peat depth survey was undertaken for the Revised Development where it was confirmed that the majority of the Site was not underlain by deep peat; however, pockets of deep peat do exist particularly in the localised areas of flatter ground. The Revised Development layout has sought, where possible, to avoid disturbance to deposits of deep peat as detailed in Chapter 12 of this AEI.

21.4.9 A comparison to the overall losses for the Proposed Development and the Revised Development (excluding battery storage) are summarised in AEI Table 21.2.

**AEI Table 21.2: Carbon Losses for the Development (excluding battery storage) (Expected Scenario)**

Losses	Proposed Development Findings within EIA Report t CO <sub>2</sub> Equivalent (total for wind farm lifetime)	Revised Development Findings within this AEI t CO <sub>2</sub> Equivalent (total for wind farm lifetime)
Losses due to turbine life (e.g. manufacture, construction, decommissioning)	69,175	61,945
Losses due to back-up	32,156	27,653
Losses due to reduced carbon fixing potential	689	515
Losses from soil organic matter	9,565	9,369
Losses due to Dissolved Organic Carbon (DOC) and Particulate Organic Carbon (POC) leaching	0	0
Losses due to felling forestry	25,146	0
<b>TOTAL LOSSES</b>	<b>111,585</b>	<b>99,483</b>

21.4.10 Overall, the carbon losses for the Revised Development have reduced. This is largely due to the reduction in the number of turbines and track infrastructure for the Revised Development.

Payback Period

- 21.4.11 The carbon payback period is a measurement to help assess a proposal. The shorter the payback, the greater the benefit the Revised Development will have in displacing emissions associated with electricity generated by burning fossil fuels.
- 21.4.12 The estimated payback period for the Revised Development (excluding battery storage) has increased from 2.2 years for the Proposed Development, to 2.4 years for the Revised Development when compared to grid-mix electricity generation. This increase is due to the reduction in carbon intensity of the grid-mix emission factor in the updated version of the carbon calculator, which will be due to the increased penetration of low carbon generation into the grid. AEI Table 21.3 below goes into further detail regarding the carbon payback period.

**AEI Table 15.3: Payback in years for each scenario used in the Carbon Calculator**

Compared to...	Expected Scenario		Best Scenario		Worst Scenario	
	Proposed Dev.	Revised Dev.	Proposed Dev.	Revised Dev.	Proposed Dev.	Revised Dev.
Coal fired electricity generation	0.7	0.7	0.4	0.4	2.2	2.5
Grid-mix electricity generation	2.2	2.4	1.4	1.3	7.1	9.1
Fossil fuel-mix of electricity generation	1.4	1.4	0.9	0.7	4.4	5.1

- 21.4.13 On this basis, CO<sub>2</sub> emissions for the Revised Development are forecast to be cancelled out within approximately 2.4 years. The CO<sub>2</sub> emission savings for the operational lifetime beyond that (currently predicted as 25 years) would result in a net benefit of the Revised Development to reducing climate change. This is considered a low magnitude of effect; i.e. a slight, detectable alteration of the baseline condition which is not significant.

**21.5 Mitigation Measures and Residual Effects**

- 21.5.1 This Chapter of the AEI identifies no significant negative effects are predicted as a result of the Revised Development and therefore, no formal mitigation is required under the EIA Regulations other than that already incorporated into the Revised Development and recommended as best practice. An iterative design approach has been undertaken for the Revised Development to avoid siting infrastructure in deep peat where possible to minimise disturbance of peat soils and associated carbon losses.

21.5.2 An outline PMP has been produced and is provided as AEI Appendix 12.1. Proposed reuses of the excavated peat are in line with the Scottish Renewables and SEPA Guidance<sup>14</sup>, and the updated outline PMP demonstrates that all the excavated peat will be reused on-site. The outline PMP will be updated prior to construction once more detailed site investigation data and detailed engineering designs are available.

21.5.3 Other best practice 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.

## 21.6 Cumulative Effects

21.6.1 The Revised Development will contribute up to 76.2 MW of further installed capacity to the baseline of previously installed renewable energy development. The reduction of 8.4 MW from the layout assessed in the EIA Report (November 2018) is not a significant change in the cumulative context and the conclusions remain valid.

21.6.2 The cumulative effect of the Revised Development with other UK renewables generation is considered to be a fundamental change in the climate effects of UK energy supply, which is a major, positive, environmental effect that is significant under the EIA Regulations and will contribute to the UK's legally binding emission reduction targets.

## 21.7 Summary

21.7.1 In summary, the findings predicted in the EIA Report (November 2018) as a result of climate change remain valid:

- The predicted future climatic baseline conditions are highly unlikely to affect the operation of the Revised Development;
- The Revised Development will have a positive effect on carbon savings and a significant positive effect when considered cumulatively with the UK-wide renewable energy deployment. There will be a slight reduction in positive effect associated with the reduction in number of turbines from 19 to 17 and an extended payback period to the reduction in carbon intensity of the grid-mix emission factor in the updated version of the carbon calculator; and
- 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.

## 21.8 Statement of Significance

21.8.1 The Revised Development is predicted to have a significant positive effect on carbon balance when considered cumulatively with other UK wide renewable energy development. Other effects relating to climate change associated with

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<sup>14</sup> 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 27/09/2019)



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the Revised Development are considered to be not significant. This represents no change to the conclusions outlined in the EIA Report (November 2018).