# Technical Appendix 9.4: Carbon Balance Assessment

## Ben Sca Redesign Wind Farm

### Ben Sca Wind Farm Limited

Prepared by:

**SLR Consulting Limited**

4/5 Lochside View, Edinburgh Park, Edinburgh, EH12 9DH

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Making Sustainability Happen

# Basis of Report

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# 1.0 Introduction

SLR has been commissioned by Ben Sca Wind Farm Limited (The Applicant) to calculate the carbon pay-back period for the proposed Ben Sca Redesign Wind Farm (the 'Proposed Development') using the Scottish Government Carbon Calculator Tool[1] in accordance with the associated guidance[2].

The Proposed Development is located approximately 2.5km southwest of Edinbane and 7km to the east of Dunvegan on the Isle of Skye. The Proposed Development would comprise of nine wind turbines with associated infrastructure including access tracks, crane hardstandings, borrow pits, substation and temporary construction compounds. Full details of the Proposed Development are provided in EIA Report **Chapter 1: Introduction and Project Description**.

The Carbon Calculator Tool has been developed by the Scottish Government to support the process of determining the carbon pay-back period for wind farm developments in Scotland. The carbon payback period is derived by comparing the carbon costs of wind farm developments (particularly during construction) with the carbon savings likely to be achieved through their operation.

The Carbon Calculator Tool v1.7.0 uses methods given in Nayak et al, 2008 (http://www.scotland.gov.uk/Publications/2008/06/25114657/0) and revised equations for GHG emissions (Nayak, D.R., Miller, D., Nolan, A., Smith, P. and Smith, J.U., 2010 & 2011, and Wind Farm and Carbon Savings – Technical Note v.2 2.10.0. Input Parameters).

To calculate the pay-back period, the Scottish Government's Carbon Calculator Tool considers the following carbon saving and carbon loss parameters, as shown in Annex 9.4A:

- Carbon emissions savings, based on emissions from different power sources;
- Loss of carbon due to production, transportation, erection, operation and decommissioning of the wind farm;
- 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);
- Carbon saving due to improvement of habitat.; and
- Loss and/or saving of carbon-fixing potential as a result of forestry clearance.

[1] Scottish Government Wind Farm Developments on Peat Land: Carbon Calculator Tool v1.7.0 https://informatics.sepa.org.uk/CarbonCalculator/

[2] Calculating Carbon Savings from Wind Farms on Scottish Peatlands – A New Approach (Nayak et al., 2008; Nayak et al., 2010 and Smith et al,. 2011)

# 2.0 Context

By 2030, the Scottish Government aims to have reduced greenhouse gas emissions by at least 75% compared to 1990 levels and generate 50% of Scotland's overall energy consumption from renewable sources, with aims to have decarbonised Scotland's energy system and economy completely by 2050.

Large scale wind farm development in Scotland has raised concerns about the reliability of methods used to calculate the time taken for these proposals to reduce greenhouse gas emissions, largely due to the potential siting of wind farms on peatland which represent large stores of carbon. The implication for carbon emissions is therefore a factor that should be included in the consideration of proposed wind farm development.

# 3.0 Input Data

The data inputs for the online calculator tool have been extracted from the sources listed below:

- Ben Sca Redesign Wind Farm EIAR Chapter 1: Introduction and Project Description.
- Ben Sca Redesign Wind Farm EIAR Chapter 6: Hydrology, Hydrogeology and Soils.
- Ben Sca Redesign Wind Farm EIAR Technical Appendix 6.1: Peat Management Plan.
- Ben Sca Redesign Wind Farm EIAR Technical Appendix 6.2: Peat Landslide Hazard Risk Assessment.

The calculation spreadsheet within the Carbon Calculator Tool (online version reference number MN3C-23RM-QLN1 v18) allows a range of data to be input in order to utilise expected, minimum and maximum values, where relevant and applicable. The input data is presented within Annex 9.4A of this report. However, if several parameters are varied together, this can have the effect of 'cancelling out' a single parameter change. For this reason, the approach for this assessment, has been to include 'maximum values' as those values which would result in the longest (maximum) payback period; and 'minimum values' as those values which would result in the shortest (minimum) payback period. The expected value is based on the most realistic option for the Proposed Development.

# 4.0 Results

The model calculates carbon emissions savings and losses from the various aspects of the model; and also calculates a payback period based on the three counterfactual emission factors, coal-fired plant, normal grid mix and fossil fuel mix. The counterfactual emission factors are fixed within the calculator tool, the coal-fired and fossil fuel mix emission values are based on DUKES[3] data for which the UK is annually updated. The grid mix emission factor is the list of emission factors used to report on 2022 greenhouse gas emissions as published by DECC[4].

**Table 4-1** presents the estimates of carbon dioxide ($CO_2$) emissions savings for the Proposed Development when compared against coal-fired, grid-mix and fossil fuel electricity generation.

**Table 4-1 Estimate of $CO_2$ Emission Savings**

| Wind Farm $CO_2$ emission saving over… | Exp. | Min. | Max. |
|---|---|---|---|
| …coal-fired electricity generation (t $CO_2$/yr) | 137,026 | 134,326 | 139,726 |
| …grid-mix of electricity generation (t $CO_2$/yr)) | 30,015 | 29,424 | 30,607 |
| …fossil fuel – mix of electricity generation (t $CO_2$/yr) | 61,480 | 60,269 | 62,692 |
| **Energy output from Wind Farm over lifetime (MWh)** | 5,800,038 | 5,685,752 | 5,914,325 |

**Table 4-2** and **Table 4-3** present the estimated losses and gains from the various aspects of the wind farm construction and operation. This shows that the improvement of degraded bogs will have a positive impact on carbon capture.

**Table 4-2 Estimated $CO_2$ Losses**

| Total CO2 losses due to wind farm (tCO2 eq.) | Exp. | Min. | Max. |
|---|---|---|---|
| Losses due to turbine life (eg. manufacture, construction, decommissioning) | 34,881 | 34,881 | 34,881 |
| Losses due to backup | 30,286 | 30,286 | 30,286 |
| Losses due to reduced carbon fixing potential | 636 | 248 | 953 |
| Losses from soil organic matter | 15,155 | 10,217 | 20,036 |
| Losses due to Dissolved Organic Carbon (DOC) & Particulate Organic Carbon (POC) leaching | 128 | 30 | 247 |
| Losses due to felling forestry | 34,178 | 31,915 | 36,227 |
| **Total losses of $CO_2$** | 115,263 | 107,577 | 122,629 |

[3] Department for Business, Energy & Industrial Strategy, Digest of UK Energy Statistics (DUKES)

[4] https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022

**Table 4-3 Estimated $CO_2$ Gains**

| Total $CO_2$ gains due to improvement of site (t $CO_2$ eq.) | Exp. | Min. | Max. |
|---|---|---|---|
| Change in emissions due to improvement of degraded bogs[5] | 0 | 0 | 0 |
| Change in emissions due to improvement of felled forestry | -6,206 | -4,793 | -7,659 |
| Change in emissions due to restoration of peat from borrow pits | 113 | 0 | 178 |
| Change in emissions due to removal of drainage from foundations & hardstanding areas | -328 | -234 | -437 |
| **Total change in emissions due to improvements** | -6,421 | -5,027 | -7,918 |

**Table 4-4** demonstrates that the net emissions of $CO_2$ are estimated at 108,842 tonnes of $CO_2$, with an estimated payback period of 1.8 years. Therefore, the Proposed Development will produce a reduction in emissions from the electricity grid of around 61,480 tonnes of $CO_2$ per year (this assumes that the wind farm replaces grid electricity generated from a fossil fuel mix).

A summary of the anticipated carbon emissions and carbon payback of the Proposed Development are provided below:

**Table 4-4 $CO_2$ Emissions and Payback Time**

| Results | Exp. | Min. | Max. |
|---|---|---|---|
| **Net emissions of $CO_2$ (t $CO_{2\ eq}$) (carbon losses minus carbon gains)** | 108,842 | 99,658 | 117,602 |
| **Carbon Payback Time** | | | |
| …coal-fired electricity generation (years) | 0.8 | 0.7 | 0.9 |
| …grid-mix of electricity generation (years) | 3.6 | 3.3 | 4 |
| **…fossil fuel – mix of electricity generation (years)** | 1.8 | 1.6 | 2 |
| **Ratio of $CO_2$ eq. emissions to power generation (g/kWh)** | 18.77 | 16.85 | 20.68 |

[5] Included in the 'Change in emissions due to improvement of felled forestry' calculations.

# 5.0 Conclusions

The calculations of total $CO_2$ emission savings and payback time for the Proposed Development indicates that the overall payback period will be around 1.8 years when compared to the grid fuel mix of electricity generation. This means that the Proposed Development is anticipated to take around 1.8 years to repay the carbon exchange to the atmosphere (the $CO_2$ debt) through construction; the site would in effect be in a net gain situation following this time period and can then claim to contribute to national emissions reduction objectives thereafter for its remaining operational life.

# 6.0 References

Carbon Calculator Tool v1.7.0. Available at https://informatics.sepa.org.uk/CarbonCalculator/

Carbon Calculator Tool User Guidance. Available at https://informatics.sepa.org.uk/CarbonCalculator/assets/Carbon_calculator_User_Guidance.pdf

Calculating Carbon Savings from Wind Farms on Scottish Peatlands - A New Approach, Nayak et al; 2008 and 2010 and Smith et al; 2011. (http://www.gov.scot/Publications/2008/06/25114657/0)

Nayak, D.R., Miller, D., Nolan, A., Smith, P. and Smith, J.U., 2010, Calculating carbon budgets of wind farms on Scottish peatland. Mires and Peat 4: Art. 9. Online. (http://mires-and-peat.net/pages/volumes/map04/map0409.php)

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Peatbogs and Carbon: A Critical Synthesis Lindsey, R. (2010) for RSPB Scotland.

Scottish Natural Heritage (SNH), SEPA, Scottish Government & The James Hutton Institute. (2014). Peat Survey Guidance; Developments on Peatland: Site Surveys.

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Scottish Government. 2020. Update to the Climate Change Plan 2018 – 2032 Securing a Green Recovery on a Path to Net Zero. Available at https://www.gov.scot/binaries/content/documents/govscot/publications/strategy-plan/2020/12/securing-green-recovery-path-net-zero-update-climate-change-plan-20182032/documents/update-climate-change-plan-2018-2032-securing-green-recovery-path-net-zero/update-climate-change-plan-2018-2032-securing-green-recovery-path-net-zero/govscot%3Adocument/update-climate-change-plan-2018-2032-securing-green-recovery-path-net-zero.pdf

# Annex 9.4A

## Technical Appendix 9.4: Carbon Balance Assessment

### Ben Sca Redesign Wind Farm

**Ben Sca Wind Farm Limited**

SLR Project No.: 405.064982.00001

14 March 2024

Carbon Calculator v1.8.1
Ben Sca Redesign Wind Farm Location: 57.450016 -6.455144
Ben Sca Wind Farm Ltd.

## Core input data

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Windfarm characteristics | | | | |
| Dimensions | | | | |
| No. of turbines | 9 | 9 | 9 | EIAR Chapter 1: Introduction and Project Description |
| Duration of consent (years) | 40 | 40 | 40 | EIAR Chapter 1: Introduction and Project Description |
| Performance | | | | |
| Power rating of 1 turbine (MW) | 4.53 | 4.53 | 4.53 | EIAR Chapter 1: Introduction and Project Description |
| Capacity factor | 40.6 | 39.8 | 41.4 | EIAR Chapter 1: Introduction and Project Description |
| Backup | | | | |
| Fraction of output to backup (%) | 5 | 5 | 5 | Dale et al 2004 |
| Additional emissions due to reduced thermal efficiency of the reserve generation (%) | 10 | 10 | 10 | Fixed |
| Total CO2 emission from turbine life ($tCO2\ MW^{-1}$) (eg. manufacture, construction, decommissioning) | Calculate wrt installed capacity | Calculate wrt installed capacity | Calculate wrt installed capacity | |
| Characteristics of peatland before windfarm development | | | | |
| Type of peatland | Acid bog | Acid bog | Acid bog | ES Chapter 8 |
| Average annual air temperature at site (°C) | 5 | 4 | 6 | Met Office data |
| Average depth of peat at site (m) | 0.68 | 0.6799 | 0.68001 | EIAR Chapter 6: Hydrology, Hydrogeology and Soils |
| C Content of dry peat (% by weight) | 55 | 49 | 62 | Birnie et al. 1991 |
| Average extent of drainage around drainage features at site (m) | 5 | 4 | 6 | Conservative values estimated by Hydrologist |
| Average water table depth at site (m) | 0.2 | 0.1 | 0.3 | Conservative values estimated by Hydrologist |
| Dry soil bulk density ($g\ cm^{-3}$) | 0.2 | 0.18 | 0.22 | Default value taken from Lilly et al., 2010 |
| Characteristics of bog plants | | | | |
| Time required for regeneration of bog plants after restoration (years) | 10 | 5 | 15 | Suggested acceptable literature values from carbon calculator protocol. |
| Carbon accumulation due to C fixation by bog plants in undrained peats ($tC\ ha^{-1}\ yr^{-1}$) | 0.25 | 0.12 | 0.31 | Default values provided by Nayak et al. |
| Forestry Plantation Characteristics | | | | |
| Area of forestry plantation to be felled (ha) | 64.73 | 64 | 65 | EIAR Chapter 1: Introduction and Project Description |
| Average rate of carbon sequestration in timber ($tC\ ha^{-1}\ yr^{-1}$) | 3.6 | 3.4 | 3.8 | Figures from Cannell, 1999. min and max entered as a range. |
| Counterfactual emission factors | | | | |

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Coal-fired plant emission factor (t CO2 $MWh^{-1}$) | 0.945 | 0.945 | 0.945 | |
| Grid-mix emission factor (t CO2 $MWh^{-1}$) | 0.207 | 0.207 | 0.207 | |
| Fossil fuel-mix emission factor (t CO2 $MWh^{-1}$) | 0.424 | 0.424 | 0.424 | |
| Borrow pits | | | | |
| Number of borrow pits | 3 | 3 | 3 | EIAR Chapter 1: Introduction and Project Description |
| Average length of pits (m) | 83.33 | 83.33 | 83.33 | EIAR Chapter 1: Introduction and Project Description |
| Average width of pits (m) | 63.33 | 63.33 | 63.33 | EIAR Chapter 1: Introduction and Project Description |
| Average depth of peat removed from pit (m) | 0.5 | 0.5 | 0.5 | EIAR Chapter 6: Hydrology, Hydrogeology and Soils |
| Access tracks | | | | |
| Total length of access track (m) | 6293 | 6270 | 6310 | EIAR Chapter 1: Introduction and Project Description |
| Existing track length (m) | 1784 | 1780 | 1790 | EIAR Chapter 1: Introduction and Project Description |
| Length of access track that is floating road (m) | 167 | 160 | 170 | EIAR Chapter 1: Introduction and Project Description |
| Floating road width (m) | 7 | 7 | 7 | EIAR Chapter 1: Introduction and Project Description |
| Floating road depth (m) | 0 | 0 | 0 | EIAR Chapter 1: Introduction and Project Description |
| Length of floating road that is drained (m) | 167 | 160 | 170 | EIAR Chapter 1: Introduction and Project Description |
| Average depth of drains associated with floating roads (m) | 0.3 | 0.3 | 0.3 | EIAR Chapter 1: Introduction and Project Description |
| Length of access track that is excavated road (m) | 4342 | 4330 | 4350 | EIAR Chapter 1: Introduction and Project Description |
| Excavated road width (m) | 5 | 5 | 5 | EIAR Chapter 1: Introduction and Project Description |
| Average depth of peat excavated for road (m) | 0.6 | 0.6 | 0.6 | EIAR Chapter 6: Hydrology, Hydrogeology and Soils |
| Length of access track that is rock filled road (m) | 0 | 0 | 0 | N/A |
| Rock filled road width (m) | 5 | 5 | 5 | N/A |
| Rock filled road depth (m) | 0 | 0 | 0 | N/A |
| Length of rock filled road that is drained (m) | 0 | 0 | 0 | N/A |
| Average depth of drains associated with rock filled roads (m) | 1 | 1 | 1 | N/A |
| Cable trenches | | | | |
| Length of any cable trench on peat that does not follow access tracks and is lined with a permeable medium (eg. sand) (m) | 0 | 0 | 0 | N/A |
| Average depth of peat cut for cable trenches (m) | 0 | 0 | 0 | N/A |
| Additional peat excavated (not already accounted for above) | | | | |
| Volume of additional peat excavated ($m^3$) | 7596 | 7500 | 7600 | EIAR Chapter 6: Hydrology, Hydrogeology and Soils |

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Area of additional peat excavated ($m^2$) | 11408 | 11400 | 11500 | EIAR Chapter 6: Hydrology, Hydrogeology and Soils |
| Peat Landslide Hazard | | | | |
| Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments | negligible | negligible | negligible | Fixed |
| Improvement of C sequestration at site by blocking drains, restoration of habitat etc | | | | |
| Improvement of degraded bog | | | | |
| Area of degraded bog to be improved (ha) | 0 | 0 | 0 | N/A |
| Water table depth in degraded bog before improvement (m) | 0 | 0 | 0 | N/A |
| Water table depth in degraded bog after improvement (m) | 0 | 0 | 0 | N/A |
| Time required for hydrology and habitat of bog to return to its previous state on improvement (years) | 2 | 2 | 2 | N/A |
| Period of time when effectiveness of the improvement in degraded bog can be guaranteed (years) | 2 | 2 | 2 | N/A |
| Improvement of felled plantation land | | | | |
| Area of felled plantation to be improved (ha) | 64.73 | 64 | 65 | Chapter 1: Introduction and Project descriptions |
| Water table depth in felled area before improvement (m) | 0.2 | 0.19 | 0.21 | Conservative estimate |
| Water table depth in felled area after improvement (m) | 0.1 | 0.09 | 0.11 | Conservative estimate |
| Time required for hydrology and habitat of felled plantation to return to its previous state on improvement (years) | 7.5 | 5 | 10 | Conservative estimate |
| Period of time when effectiveness of the improvement in felled plantation can be guaranteed (years) | 40 | 40 | 40 | Conservative estimate |
| Restoration of peat removed from borrow pits | | | | |
| Area of borrow pits to be restored (ha) | 1.56 | 1.55 | 1.57 | Chapter 1: Introduction and Project descriptions |
| Depth of water table in borrow pit before restoration with respect to the restored surface (m) | 0.1 | 0.05 | 0.15 | Assumed to be equal to the average water table depth across the site. |
| Depth of water table in borrow pit after restoration with respect to the restored surface (m) | 0.05 | 0 | 0.1 | After, restoration of the peat into the borrow-pits, the aim would be to restore the water table to an optimum 0.1m. |

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Time required for hydrology and habitat of borrow pit to return to its previous state on restoration (years) | 7.5 | 5 | 10 | For successful restoration of blanket bog, the supporting hydrology must return reasonably quickly and it would be expected that if the hydrological restoration is successful the hydrology and habitat would be restored c. 5-7 years post development. |
| Period of time when effectiveness of the restoration of peat removed from borrow pits can be guaranteed (years) | 40 | 40 | 40 | The guidance within the carbon calculator states that unless there strong supporting evidence that restoration of the borrow-pits can be guaranteed beyond the lifetime of the wind farm, this parameter should be set as the lifetime of the wind farm. |
| Early removal of drainage from foundations and hardstanding | | | | |
| Water table depth around foundations and hardstanding before restoration (m) | 0.3 | 0.29 | 0.31 | Conservative estimate |
| Water table depth around foundations and hardstanding after restoration (m) | 0.2 | 0.19 | 0.21 | Conservative estimate |
| Time to completion of backfilling, removal of any surface drains, and full restoration of the hydrology (years) | 5 | 5 | 5 | For successful restoration of blanket bog, the supporting hydrology must return reasonably quickly and it would be expected that if the hydrological restoration is successful the hydrology and habitat would be restored c. 5-7 years post development. |
| Restoration of site after decomissioning | | | | |
| Will the hydrology of the site be restored on decommissioning? | Yes | Yes | Yes | |
| Will you attempt to block any gullies that have formed due to the windfarm? | Yes | Yes | Yes | Chapter 1: Introduction and Project descriptions |
| Will you attempt to block all artificial ditches and facilitate rewetting? | Yes | Yes | Yes | Chapter 1: Introduction and Project descriptions |
| Will the habitat of the site be restored on decommissioning? | No | No | No | |
| Will you control grazing on degraded areas? | No | No | No | Chapter 1: Introduction and Project descriptions |
| Will you manage areas to favour reintroduction of species | Yes | Yes | Yes | Chapter 1: Introduction and Project descriptions |
| Methodology | | | | |
| Choice of methodology for calculating emission factors | Site specific (required for planning applications) | | | |

## Forestry input data

N/A

## Construction input data

| Input data | Expected value | Minimum value | Maximum value | Source of data |
|---|---|---|---|---|
| Area 1.1 | | | | |
| Number of turbines in this area | 9 | 9 | 9 | EIAR Chapter 1: Introduction and Project Description |
| Turbine foundations | | | | |
| Depth of hole dug when constructing foundations (m) | 0.58 | 0.58 | 0.58 | EIAR Chapter 6: Hydrology, Hydrogeology and Soils |
| Aproximate geometric shape of whole dug when constructing foundations | Circular | Circular | Circular | EIAR Chapter 1: Introduction and Project Description |
| Diameter at bottom | 23 | 23 | 23 | |
| Diameter at surface | 23 | 23 | 23 | |
| Hardstanding | | | | |
| Depth of hole dug when constructing hardstanding (m) | 0.58 | 0.58 | 0.58 | EIAR Chapter 6: Hydrology, Hydrogeology and Soils |
| Aproximate geometric shape of whole dug when constructing hardstanding | Rectangular | Rectangular | Rectangular | EIAR Chapter 1: Introduction and Project Description |
| Length at surface | 72 | 72 | 72 | |
| Width at surface | 30 | 30 | 30 | |
| Length at bottom | 70 | 70 | 70 | |
| Width at bottom | 28 | 28 | 28 | |
| Piling | | | | |
| Is piling used? | No | No | No | EIAR Chapter 1: Introduction and Project Description |
| Volume of Concrete | | | | |
| Volume of concrete used ($m^3$) in the entire area | 3150 | 3150 | 3150 | EIAR Chapter 1: Introduction and Project Description |

## Payback Time and $CO_2$ emissions • MN3C-23RM-QLN1 v18

| 1. Windfarm CO2 emission saving over... | Exp. | Min. | Max. |
|---|---|---|---|
| ...coal-fired electricity generation (t CO2 / yr) | 137,026 | 134,326 | 139,726 |
| ...grid-mix of electricity generation (t CO2 / yr) | 30,015 | 29,424 | 30,607 |
| ...fossil fuel-mix of electricity generation (t CO2 / yr) | 61,480 | 60,269 | 62,692 |
| Energy output from windfarm over lifetime (MWh) | 5,800,038 | 5,685,752 | 5,914,325 |

| Total CO2 losses due to wind farm (tCO2 eq.) | Exp. | Min. | Max. |
|---|---|---|---|
| 2. Losses due to turbine life (eg. manufacture, construction, decomissioning) | 34,881 | 34,881 | 34,881 |
| 3. Losses due to backup | 30,286 | 30,286 | 30,286 |
| 4. Lossess due to reduced carbon fixing potential | 636 | 248 | 953 |
| 5. Losses from soil organic matter | 15,155 | 10,217 | 20,036 |
| 6. Losses due to DOC & POC leaching | 128 | 30 | 247 |
| 7. Losses due to felling forestry | 34,178 | 31,915 | 36,227 |
| Total losses of carbon dioxide | 115,263 | 107,577 | 122,629 |

| 8. Total CO2 gains due to improvement of site (t CO2 eq.) | Exp. | Min. | Max. |
|---|---|---|---|
| 8a. Change in emissions due to improvement of degraded bogs | 0 | 0 | 0 |
| 8b. Change in emissions due to improvement of felled forestry | -6,206 | -4,793 | -7,659 |
| 8c. Change in emissions due to restoration of peat from borrow pits | 113 | 0 | 178 |
| 8d. Change in emissions due to removal of drainage from foundations & hardstanding | -328 | -234 | -437 |
| Total change in emissions due to improvements | -6,421 | -5,027 | -7,918 |

| RESULTS | Exp. | Min. | Max. |
|---|---|---|---|
| Net emissions of carbon dioxide (t CO2 eq.) | 108,842 | 99,658 | 117,602 |
| | | | |
| Carbon Payback Time | | | |
| ...coal-fired electricity generation (years) | 0.8 | 0.7 | 0.9 |
| ...grid-mix of electricity generation (years) | 3.6 | 3.3 | 4.0 |
| ...fossil fuel-mix of electricity generation (years) | 1.8 | 1.6 | 2.0 |
| | | | |
| Ratio of soil carbon loss to gain by restoration (not used in Scottish applications) | 2.38 | 1.29 | 4.03 |
| Ratio of CO2 eq. emissions to power generation (g/kWh) (for info. only) | 18.77 | 16.85 | 20.68 |

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