



Sporad na Mara Offshore Wind Farm

Offshore Project

Environmental Impact Assessment Report

Chapter 8: Greenhouse Gases, Volume 2a

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8 GREENHOUSE GASES

8.1 INTRODUCTION

8.1.1 OVERVIEW

- 8.1.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) presents the results of the assessment of the likely significant effects of the proposed Spiorad na Mara Offshore Wind Farm (hereafter referred to as the 'Offshore Project') with respect to Greenhouse Gas (GHG) emissions that may arise during, construction, operation and maintenance (O&M), and decommissioning.
- 8.1.1.2 This chapter should be read in conjunction with the project description provided in **Chapter 3: Project Description, Volume 1a**. In addition, the effects of climate change on the Offshore Project has been assessed in **Chapter 7: Climate Resilience, Volume 2a**, informed by **Appendix 7.1: Climate Vulnerability Assessment, Volume 2c**.
- 8.1.1.3 This technical chapter describes the following:
- Legislation, planning policy and other documentation that has informed the assessment (Section 8.2: Summary of policy and legislative context and **Chapter 2: Policy and Legislative Context, Volume 1a**);
 - Outcome of consultation and engagement that has been undertaken to date, including how matters relating to GHG emissions have been addressed (Section 8.3: Scoping and consultation);
 - Scope of the assessment for GHG emissions (Section 0: Scope of the assessment);
 - The methods of assessment used for baseline data gathering and impact assessment (Section 8.5: Methodology for baseline data gathering and impact assessment);
 - Overall baseline (Section 8.6: Baseline conditions);
 - Embedded environmental measures relevant to GHG emissions and the relevant maximum design scenario (Section 8.7: Basis for Environmental Impact Assessment);
 - Assessment of likely significant effects and further mitigation of GHG emissions (Section 8.8-8.10: Assessment of effects);
 - Carbon payback period and GHG intensity of the Offshore Project (Section 8.11: Carbon payback period and GHG intensity of the Offshore Project);
 - Benefits and loads beyond the system boundary (Section 8.12: Benefits and Loads Beyond the System Boundary);
 - Assessment of GHG combined effects (Section 8.13: Assessment of Combined Effects);
 - Assessment of GHG whole project effects (Section 8.14: Consideration of the OTW Project);
 - Assessment of GHG emissions cumulative effects (Section 8.15: Assessment of Cumulative Effects);

- Assessment of transboundary effects (Section 8.16: Transboundary Effects);
- A summary of residual effects for GHG emissions (Section 8.17: Summary of Residual Effects);
- Glossary and abbreviations used in the Climate Resilience assessment (Section 8.18: Glossary of Terms and Abbreviations);
- Information sources and documentation referred to in this chapter (Section 8.19: References).

8.2 SUMMARY OF RELEVANT POLICY AND LEGISLATION

8.2.1.1 This section outlines the legislation, policy and guidance relevant to the assessment of likely significant effects on GHG emissions associated with the construction, O&M and decommissioning of the Offshore Project. In addition, other national, regional, and local policies are considered within this assessment where they are judged to be relevant. Further information on policies relevant to the Environmental Impact Assessment (EIA) is provided in **Chapter 2, Volume 1a**.

8.2.1.2 A summary of the legislation, policy and guidance relevant to GHG emissions is provided in **Table 8-1**.

Table 8-1 Legislation and policy in relation to Greenhouse Gases

| Title | Relevance to the Assessment |
|---|--|
| International Legislation | |
| United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol (UNFCCC, Kyoto Protocol to the United Nations Framework Convention on Climate Change, 1998) | The Kyoto Protocol was adopted in December 1997. It commits industrialised countries and economies to transitioning towards limiting and reducing GHG emissions in accordance with agreed individual targets. These have been strengthened in more recent international agreements culminating in the Paris Agreement, as described below. The Kyoto Protocol covers seven categories of GHG: carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), F-gases (comprised of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs)), sulphur hexafluoride (SF ₆), and nitrogen trifluoride (NF ₃). In this GHG assessment, these GHGs are collectively considered "GHG emissions" and reported as carbon dioxide equivalent (CO ₂ e) GHG emissions. |
| UNFCCC Paris Agreement (UNFCCC, Paris Agreement, 2015) | The UNFCCC is the major international body responsible for managing climate change and carbon emissions. In 2015, it adopted the Paris Agreement, the aims of which are stated as: <i>"to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by: (a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change; (b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emission development, in a manner that does not threaten food production; and (c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilience"</i> |

| Title | Relevance to the Assessment |
|--|--|
| | <i>development.</i> ". The agreement sets targets for countries' GHG emissions, but these are not legally binding or enforceable. |
| UNFCCC Glasgow Climate Pact (UNFCCC, Glasgow Climate Pact, 2021) | The Conference of the Parties (COP 26) held in Glasgow in November 2021, resulted in almost 200 countries agreeing on: the acceleration of action on climate change this decade to reduce emissions (mitigation); helping those already impacted by climate change (adaption); enabling countries to deliver on their climate goals (finance); and working together to deliver even greater action (collaboration). This agreement is in the form of the Glasgow Climate Pact which reaffirms the long-term goal of limiting global warming to 1.5°C above pre-industrial levels and resolves to pursue efforts to achieve this, recognising that limiting global warming to 1.5°C <i>"requires rapid, deep and sustained reductions in global greenhouse gas emissions, including reducing global CO2 emissions by 45% by 2030 relative to the 2010 level and to net zero around mid-century, as well as deep reductions in other greenhouse gases"</i> . |
| National Legislation / Policy | |
| Climate Change Act 2008 (HM-Government, Climate Change Act 2008, 2008) Climate Change Act 2008 (2050 Target Amendment) Order 2019 (HM-Government, Climate Change Act 2008 (2050 Target Amendment) Order 2019, 2019) | This legislation established a legal requirement for an 80% reduction in the GHG emissions of the UK economy by 2050 (against a 1990 baseline) and sets interim targets to ensure progress towards this target. In June 2019 the UK Government updated this commitment to net zero emissions by 2050 (the 'UK carbon target', often referred to as 'net zero'). This legislation also established an independent expert body, the Climate Change Committee (CCC), with responsibility for setting 5-year carbon budgets covering successive periods of Emissions reduction to 2050. |
| The Carbon Budgets Order 2009 (HM-Government, The Carbon Budgets Order 2009, 2009) | This legislation implements the carbon budgets set out in the Climate Change Act 2008. The budgets place restrictions on the amount of GHG the UK can emit over a 5 year period The carbon budgets are: <ul style="list-style-type: none"> - First carbon budget, 2008-2012: 3,018 mega tonnes carbon dioxide equivalent (MtCO₂e) representing a 25% reduction below 1990 levels; - Second carbon budget, 2013-2017: 2,782 MtCO₂e representing a 31% reduction below 1990 levels; - Third carbon budget, 2018-2022: 2,544 MtCO₂e representing a 37% reduction below 1990 levels by 2020; - Fourth carbon budget, 2023-2027: 1,950 MtCO₂e representing a 52% reduction below 1990 levels by 2025; - Fifth carbon budget, 2028-2032: 1,725 MtCO₂e representing a 57% reduction below 1990 levels by 2030; |

| Title | Relevance to the Assessment |
|---|--|
| | <ul style="list-style-type: none"> - Sixth carbon budget, 2033-2037: 965 MtCO₂e representing a 78% reduction below 1990 levels by 2035. <p>The seventh carbon budget has been recommended by The CCC in February 2025, which will need to be agreed upon in Parliament by the latest June 2026. The recommended seventh carbon budget (2038-2042) is 535 MtCO₂e representing a 87% reduction below 1990 levels by 2040.</p> |
| The Climate Change (Emissions Reduction Targets) (Scotland) Act, 2019 (UK Government, 2019) | The legislation outlines emissions reduction targets designed to achieve net-zero by 2045. It includes interim goals requiring a 75% cut in greenhouse gas emissions by 2030 and a 90% cut by 2040, measured against 1990 levels. The Act also sets legally binding annual emissions limits for every year up to 2045, aligned with the 2030 and 2040 milestones. Between 2031 and 2040, these annual targets amount to a combined 142.6 MtCO ₂ e, with a further total of 17.0 MtCO ₂ e allocated for the years 2041 to 2045. |
| The Scottish Energy Strategy: The Future of Energy in Scotland (Energy and Climate Change Directorate, 2017) | This strategy outlines Scotland/ <i>Alba</i> 's long term vision for a secure, affordable, low-carbon energy system. It emphasises expanding renewable electricity, improving energy efficiency, decarbonising heat and transport, and supporting innovation across the energy sector. The strategy sets a pathway toward a fully integrated, sustainable energy system that enables Scotland/ <i>Alba</i> to meet its climate goals while strengthening economic resilience. |
| National Planning Framework 4 (Scottish Government, 2023) | NPF4 embeds climate action into all planning decisions by requiring the planning system to help meet Scotland/ <i>Alba</i> 's statutory greenhouse-gas reduction targets. It prioritises cutting emissions through its core climate policy (Policy 1), supports low-carbon development, and integrates lifecycle GHG assessments for national developments. Overall, it aligns land-use planning with Scotland/ <i>Alba</i> 's goal of reducing emissions and achieving net zero by 2045. |
| The Offshore Wind Policy Statement (Scottish Government, 2020b) (Energy and Climate Change Directorate, 2020) | The Scottish Offshore Wind Policy Statement set out Scotland/ <i>Alba</i> 's ambitions for offshore wind as a key pillar of its net-zero transition. It emphasised accelerating deployment, strengthening supply-chain capacity, and integrating offshore wind with the wider Energy Strategy to accelerate decarbonisation. |
| National Policy Statement for Energy EN-1 (DESNZ, 2023) | EN-1 paragraph 2.3.6 acknowledges that to achieve net zero by 2050, transformation of the energy system is needed and identifies the role of low carbon hydrogen (para. 3.3.49). Section 5.3 acknowledges that although this type of development is essential for the decarbonisation of the UK economy, and whilst mitigation of climate change impacts are incorporated, the development itself can lead to residual GHG emissions. Section 5.3 states: " <i>All proposals for energy infrastructure projects should include a GHG assessment as part of their ES</i> " and sets out inclusions for the assessment and the approach to mitigation. |
| National Policy Statement for Renewable Energy | The National Policy Statement for Renewable Energy Infrastructure (EN-3) treats GHG emissions as a core driver for rapid deployment of renewable energy. It states that renewables are essential for meeting the UK's statutory |

| Title | Relevance to the Assessment |
|---|---|
| Infrastructure EN-3 (DESNZ, 2023) | carbon-budget obligations, the Clean Power 2030 Mission, and the pathway to net zero. EN-3 therefore establishes an urgent need for low-carbon generation and supports consenting decisions that prioritise emissions reduction across all renewable technologies. |
| Technical Guidance | |
| Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance (Institute of Environmental Management and Assessment (IEMA), 2022) | This guidance assists practitioners in addressing GHG emissions assessment and mitigation in both statutory and non-statutory EIA, following the 2014 amendment to the EIA Directive and provides a framework for assessing and mitigating GHG emissions in environmental impact assessments, ensuring compliance with updated EIA regulations. |
| Planning Practice Guidance 2024 (UK Government, 2024) | Highlights the importance of identifying suitable climate change mitigation and adaptation measures in the planning process, advising local planning authorities on implementation and guides local planning authorities in integrating climate change mitigation and adaptation measures into planning processes, promoting sustainable development. |
| The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (Greenhouse Gas Protocol, 2004) | Establishes comprehensive global standardised frameworks to measure and manage GHG emissions from private and public sector operations, value chains, and mitigation actions and provides standardised methods for measuring and managing GHG emissions, facilitating consistent and transparent reporting and mitigation efforts. |
| Carbon Management in Infrastructure and Built Environment – Publicly Available Standard (PAS) 2080: 2023 (British Standards Institution (BSI), 2023) | A standard for managing carbon in building and infrastructure, focusing on reducing carbon and cost through intelligent design, construction, and use across the whole value chain. It also encourages the reduction of carbon emissions and costs in building and infrastructure projects through best practices in design, construction, and operation. |
| Royal Institution of Chartered Surveyors (RICS) Whole Life Carbon Assessment (WLCA) for the Built Environment 2017 (Royal Institution of Chartered Surveyors (RICS), 2023) | Provides technical details for whole life carbon calculations for built projects, aiming to standardise these assessments and standardises whole life carbon assessments for built projects, ensuring comprehensive and consistent evaluation of carbon impacts throughout a project’s lifecycle. |

8.3 SCOPING AND CONSULTATION

8.3.1.1 This section describes the stakeholder engagement undertaken for the Offshore Project. This consists of the outcome of, and response to, the Scoping Opinion in relation to the GHG assessment. No informal consultation on the GHG topic has been required or undertaken. An overview of engagement undertaken for the Offshore Project can be found in **Chapter 5: Approach to EIA, Volume 1a** and associated **Appendix 5.2: Response to EIA Scoping Opinion, Volume 1c** and **Appendix 5.4: Stakeholder Consultation and Engagement, Volume 1c**.

8.3.2 SCOPING OPINION

- 8.3.2.1 Spiorad na Mara Limited (hereafter referred to as 'the Applicant') submitted a Scoping Report (Spiorad na Mara Limited, 2023) and request for a Scoping Opinion to the Marine Directorate Licensing Operations Team (MD-LOT) in September 2023. A Scoping Opinion was received in May 2024 (MD-LOT, 2024). The Scoping Report presented a 'Climate' topic which considered both GHG and Climate Resilience. For the EIAR, the assessments for Climate Resilience and GHG have been separated into 2 separate chapters. This is due to the inherent differences in approach of each assessment in that the Climate Resilience topic considers the impact of climate change on the Offshore Project, whereas the GHG topic considers the impact of emissions on the environment. Given that each approach would need to present a different methodology, baseline and assessment, if presented as a combined chapter, it is considered that this would culminate in a chapter which is hard to follow and comprehend.
- 8.3.2.2 This GHG chapter of the EIAR differs from the Scoping Report which noted that the assessment Study Area would comprise both the Offshore Project and the Onshore works. However, as described in **Chapter 1: Introduction, Volume 1a**, this EIAR considers only the Offshore Project.
- 8.3.2.3 The comments received in the Scoping Opinion and how these have been addressed in this EIAR is provided in **Appendix 5.2, Volume 1c**. Comments relevant to the GHG assessment were noted in the Scoping Opinion and are summarised in **Table 8-2**.

Table 8-2 Summary of consultation – Greenhouse Gases

| Consultee | Date/Document | Comment | Response/where this is addressed in the EIAR |
|------------|--|---|---|
| MD-LOT | Licensing Operations Team Scoping Opinion, May 2024 | The Scottish Ministers agree with the climate change assessment approach in the Scoping Report, which aligns with the IEMA GHG Guidance and considers GHG emissions as significant. The assessment must comply with the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 and EIA Regulations. (Paragraph 5.4.1.1 and page 50 of 57) | Reference to the Institute of Environmental Management & Assessment (IEMA) Technical Guidance and EIA regulations have been followed throughout the assessment. |
| MD-LOT | Licensing Operations Team Scoping Opinion, May 2024 | The GHG Assessment to be based on a Life Cycle Assessment (LCA) approach, covering all project phases including pre-construction and supply chain considerations, and should also account for benefits beyond the project's life cycle. (Paragraph 5.4.1.1 and page 50 of 57) | The assessment has estimated whole life emissions wherever possible (depending on scope and data availability). |
| NatureScot | Licensing Operations Team Scoping Opinion, May 2024 - Appendix I | The Impact of climate change effects should be considered, both in futureproofing the project design and how certain climate stressors may work in combination with potential effects from the proposed wind farm. The EIA Report should also consider the carbon cost of the wind farm (including supply chain) and to what extent this is offset through the production of green energy. We recognise that some aspects of this are | Carbon balance calculations and whole life project impacts are presented in the analysis. |

| Consultee | Date/Document | Comment | Response/where this is addressed in the EIAR |
|----------------------------|--|---|---|
| | | addressed in section 9.8 (Climate Change). (Representations – NatureScot submission p111 Climate Change and Carbon Costs paragraph) | |
| Barvas Estate Trust | Licensing Operations Team Scoping Opinion, May 2024 - Appendix I | Evaluation of the overall carbon footprint of N4 should be provided in the EIA. This estimate should provide a detailed breakdown of different contributors to the carbon footprint of N4, taking into consideration all phases of the project life cycle as well as any additional infrastructure—including proposed SSEN Converter Station. (Representations – Barvas Estate representation – p9 Climate section) | A whole life carbon assessment for the Offshore Project is presented in this chapter. Section 8.14 considers the Onshore Transmission Works (OTW) Project. |
| Carloway Estate Trust | Licensing Operations Team Scoping Opinion, May 2024 - Appendix I | Projected carbon auditing should be produced demonstrating carbon outlay and payback periods. (Representations – Carloway Estate Trust representation – p22 Additional Comments section) | A whole life carbon assessment is presented. |
| Sandwick Community Council | Licensing Operations Team Scoping Opinion, May 2024 - Appendix I | Carbon footprint should be provided including a breakdown of different contributors to the carbon footprint of N4 taking into account all phases of the project lifecycle as well as any additional infrastructure that is necessary for N4 to be fully operational including the carbon footprint of the SSEN Converter station to give a combined total given that N4 is dependent on the new converter | A whole life carbon assessment for the Offshore Project is presented in this chapter. Section 8.14 considers the OTW Project. |

| Consultee | Date/Document | Comment | Response/where this is addressed in the EIAR |
|----------------------------|--|---|--|
| | | station being built. (Representations – Sandwick Community Trust representation – p174) | |
| Sandwick Community Council | Licensing Operations Team Scoping Opinion, May 2024 - Appendix I | The carbon footprint should include: production and transportation of materials for offshore and onshore infrastructure, construction of required offshore and onshore infrastructure, maintenance over the lifecycle Including frequency and fuel used for maintenance process, possibility of increased embodied energy scenarios where by concrete mattressing array cables and steel skirts, helipad and electrical and ancillary infrastructure associated with the onshore substation is included. (Representations – Sandwick Community Trust representation – p174) | A whole life carbon assessment for the Offshore Project is presented in this chapter. Section 8.14 considers the OTW Project. |
| Shawbost Community Council | Licensing Operations Team Scoping Opinion, May 2024 - Appendix I | In order to provide a comprehensive assessment of environmental impact, an evaluation of the overall carbon footprint of N4 should be provided in the EIA. This estimate should provide a detailed breakdown of different contributors to the carbon footprint of N4, taking into consideration all phases of the project life cycle as well as any additional infrastructure that is necessary for N4 to be fully operational. Essential additional infrastructure requires the inclusion of the carbon footprint of the proposed SSEN Converter Station. It is necessary that the carbon footprints of N4 | A whole life carbon assessment for the Offshore Project is presented in this chapter. Section 8.14 considers the OTW Project. |

| Consultee | Date/Document | Comment | Response/where this is addressed in the EIAR |
|-----------|---------------|--|--|
| | | <p>and the SSEN Converter Station (as described on p.39) are evaluated as a combined total given that N4 is dependent on this new Converter Station being built. (Representations – Shawbost Community Council representation – p199 Overall Impact section)</p> | |

8.3.3 POST-SCOPING CONSULTATION

8.3.3.1 No consultation has been required for the GHG assessment. The approach follows industry standard guidance and data to inform the baseline is from publicly available sources.

8.4 SCOPE OF THE ASSESSMENT

8.4.1 OVERVIEW

8.4.1.1 This section sets out the scope of the GHG assessment. This scope has been developed as the Offshore Project design has evolved and responds to feedback received to date as set out in Section 8.3.

8.4.2 SPATIAL SCOPE AND STUDY AREA

8.4.2.1 The Study Area for the assessment is defined by the Offshore Project Boundary, as illustrated in **Figure 1.1: Location Plan, Volume 1b** of the EIA, encompassing the Offshore Project (see also **Figure 1.2: Offshore Project Location, Volume 1b**).

8.4.2.2 The Offshore Project will connect to the Scottish and Southern Electricity Networks (SSEN) Lewis Hub (referred to as SSEN Lewis Hub), which is to be built as part of the upgraded Western Isles High-Voltage Direct Current Link between Stornoway/*Steòrnabhagh* and mainland Scotland/*Alba*. The embodied and operational emissions associated with SSEN Lewis Hub is not in the scope of assessment of the Offshore Project. Design details of the Lewis Hub are presented by SSEN in their separate planning application.

8.4.2.3 To inform this assessment, an estimated value of the potential generation capacity of the Project of 900 MW has been assumed. Note, this is not part of the parameters or description of the Offshore Project nor a fixed minimum or maximum, but rather an indicative assumption.

8.4.2.4 The spatial extent of the GHG assessment reflects the Project Design Envelope (PDE). The PDE follows the principles of the Rochdale Envelope approach, which allows for the definition of appropriate design parameters to inform assessment where details of a proposal have not yet been confirmed, such as the tip height or rotor diameter of a WTG. The Rochdale Envelope approach is discussed further in **Chapter 5, Volume 1a**. The assessments therefore includes the following components as described in **Chapter 3, Volume 1a**:

WTGs

8.4.2.5 Two bounding WTG scenarios that provide maximum parameters are considered:

- Up to 44 of the larger offshore WTG type, with a maximum blade tip height of 338.4 m above mean sea level (MSL);

- Up to 60 of the smaller WTG type, with a maximum blade tip height of 293.8 m above MSL.

8.4.2.6 The following foundation WTG foundation types are considered:

- Multi leg jacket with pin piles;
- Hybrid multi leg jacket with gravity base.

Electrical transmission infrastructure

8.4.2.7 Two scenarios are for the transmission infrastructure that provide maximum parameters are considered:

Scenario 1: WTGs connected to an OSP and then to Landfall

8.4.2.8 In Scenario 1, the substation (referred to as the Offshore Substation Platform (OSP)) on the west coast of Lewis/*Eilean Leòdhais* will be located offshore within the Turbine Area. The key components of this scenario are:

- Array Cables will be installed in a string circuit configuration, connecting multiple WTGs together. These cables (referred to as 'Array Cables') will transmit the generated power from each WTG to the OSP located within the Turbine Area;
- From the OSP, Export Cables, that are designed to transmit higher voltages over longer distances, will transmit the collected power to the Landfall;
- At the Landfall, the Export Cables will connect to the Onshore Cables at the TJBs, which are underground concrete chambers, used to house the interface joint between the Export Cables and the Onshore Cables. The Export Cables will be connected to the TJB at Landfall using a trenchless solution (HDD) from the HDD Exit Pit;
- From the TJBs, the buried Onshore Cables will connect to the Grid Substation on the east of the Isle of Lewis/*Eilean Leòdhais*. The Grid Substation will then connect to the National Grid connection point at the Lewis Hub Converter Substation.

Scenario 2: WTGs connected directly to an Onshore Landfall Substation

8.4.2.9 In Scenario 2, the substation on the west coast of Lewis/*Eilean Leòdhais* will be located onshore northeast of Barvas/*Barabhas*, referred to as the Onshore Landfall Substation. The key components of this scenario are:

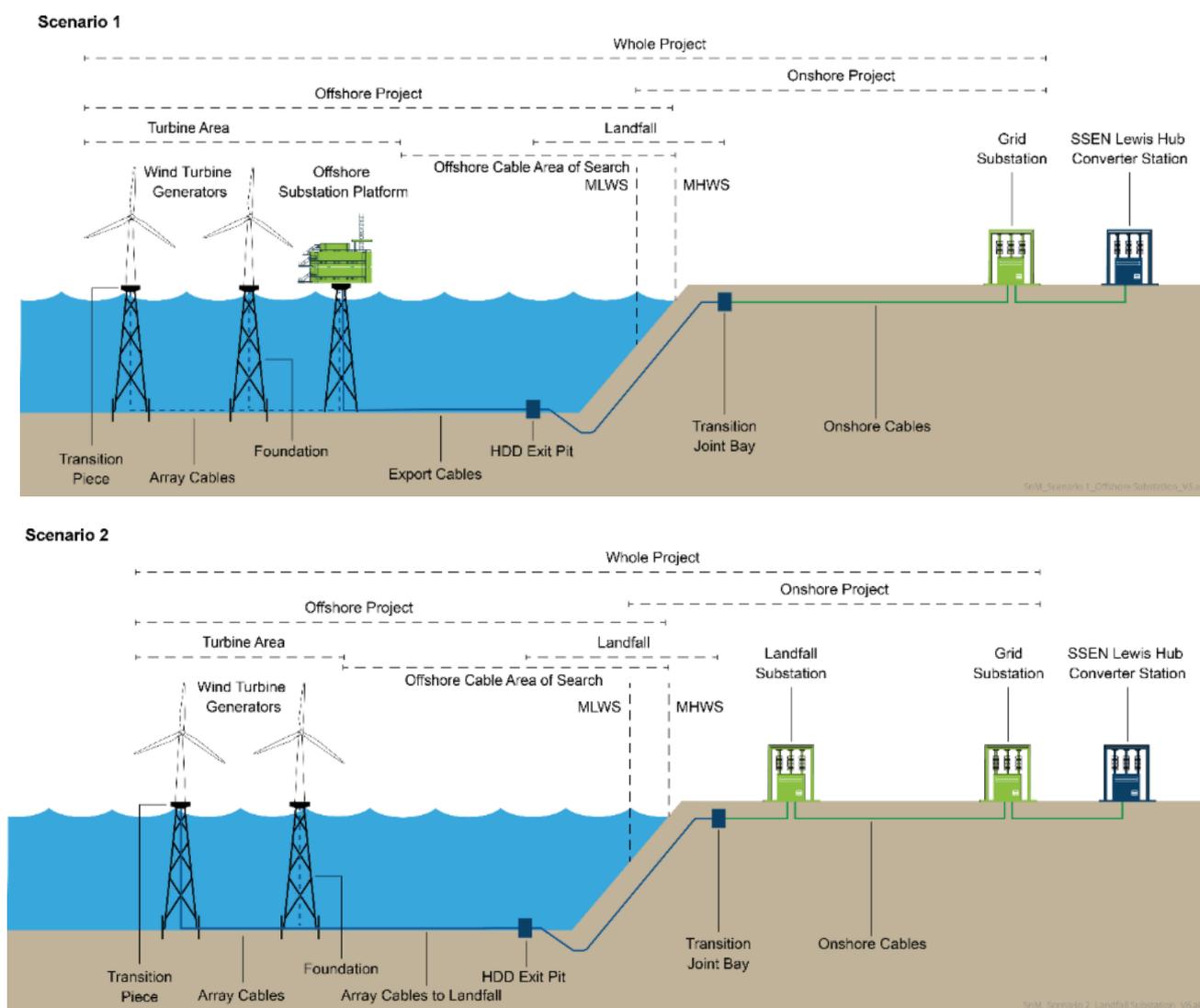
- Array Cables will be installed in several string circuit configurations, connecting multiple WTGs together (referred to as 'Array Cables'). The final WTG in each chain will transmit the generated power from the WTG directly to the Landfall (referred to as 'Array Cables to Landfall');
- The Array Cables to Landfall will connect to the Onshore Cables at the TJBs;
- From the TJBs, the Onshore Cables will connect to the Landfall Substation on the west of the Isle of Lewis/*Eilean Leòdhais*;
- The collected power will be transmitted from the Landfall Substation to the Grid Substation via buried Onshore Cables;

- The Grid Substation will then connect to the National Grid connection point at the Lewis Hub Converter Substation.

8.4.2.10 The GHG assessment has considered multiple layout and infrastructure scenarios as noted in paragraphs 8.4.2.4 to 8.4.2.9. Using a Rochdale Envelope approach, design parameters have been collated to produce a Maximum Design Scenario (MDS) (see **Table 8-13**). This reports the worst case scenario, based on design parameters that are forecast to produce the highest carbon impacts (e.g. use of 60 Smaller WTGs, maximum number of Array Cables, and most material-intensive infrastructure).

8.4.2.11 For reference a schematic to illustrate the components described above is shown as **Plate 8-1**.

Plate 8-1 Project schematic



8.4.2.12 The assessment of GHG emissions is not restricted by geographical area, instead focussing on any increase or decrease in emissions as a result of the Offshore Project, wherever that may be. This includes:

- Construction emissions from the Offshore Project footprint but also relating to the transport of materials to and from the site and their manufacture. This may be distant from the Offshore Project location (for example, GHG emissions associated with the manufacture of concrete in terms of embodied carbon and energy in the production process);
- Operation emissions (increase or reduction) which result from the operation of the Offshore Project and any shifts in energy usage that may occur. In this case, GHG emissions include those for embodied emissions arising from materials and waste for the operation and maintenance (O&M) of the Offshore Project as well as energy and water use;
- Decommissioning emissions from the safe dismantling and removal of turbines, foundations, and associated infrastructure. In this case, emissions from decommissioning activities, both on-site and off-site, are assumed to be similar to those during construction and installation. This includes energy consumption for plant use and transport emissions for materials and labour. The removal process is expected to follow the reverse sequence of construction.

8.4.3 TEMPORAL SCOPE

8.4.3.1 The temporal scope of the assessment of GHG emissions is the entire lifetime of the Offshore Project, which therefore covers the construction, O&M, and decommissioning phases.

8.4.4 POTENTIAL RECEPTORS

8.4.4.1 The global atmosphere is the receptor for the effects on the climate of GHG emissions arising from the Offshore Project. The impacts of GHG emissions relate to their contribution to global warming and climate change. These impacts are global and cumulative in nature, with every tonne of GHG emissions contributing to impacts on natural and human systems. GHG emissions result in the same global effects wherever and whenever they occur and, therefore, the sensitivity of different human and natural receptors is not considered.

8.4.5 POTENTIAL EFFECTS

8.4.5.1 Potential impacts on Greenhouse Gas receptors that have been scoped in for assessment are summarised in **Table 8-3**. This is based on lifecycle stages as defined within PAS 2080: Carbon Management in Infrastructure (British Standards Institution (BSI), 2023).

Table 8-3 Activities or impacts scoped into the assessment for Greenhouse Gases

| Receptor | Lifecycle Stage Impacts (with codes as per PAS 2080:2023) | Design Element/Activity | Sub-component (if any) | Potential Effect | |
|---------------------|--|---|--|--|--|
| Construction | | | | | |
| Global atmosphere | Product stage (manufacture and transport of raw materials to suppliers) (A1-3) | WTG | - | Embodied GHG emissions linked to the extraction and manufacturing of raw materials needed for Offshore Project construction. | |
| | | WTG foundations | Hybrid Gravity Base (HGB) Foundation -Concrete and Ballast | | |
| | | | Bedding – Gravel | | |
| | | | Scour Protection – Rock and Concrete | | |
| | | | Multi-Leg Jacket with Piles – Concrete | | |
| | | | Jackets– Steel | | |
| | | Offshore Cables (Array and Export Cable) (including cable protection – Horizontal Direct Drilling (HDD) ducts, pre-lay and post-lay rock) | Cable materials | | |
| | | | HDD Duct | | |
| | | | Rock Protection | | |
| | OSP | Steel Topside Structure and Jacket Foundation | | | |
| | Foundation (HGB or Multi-Leg Jacket) | | | | |
| | Bedding and scour protection | | | | |
| | Transport of materials to site (A4) | Offshore (materials) | Transport of WTG from Northern Europe pre-assembly/marshalling harbour to site | GHG emissions from fuel and electricity used in material transport, vessels, and | |

| Receptor | Lifecycle Stage Impacts (with codes as per PAS 2080:2023) | Design Element/Activity | Sub-component (if any) | Potential Effect |
|----------------------------------|---|--|---|--|
| | | | | equipment during the construction period. |
| | Plant and equipment used during construction (A5) | Installation offshore vessel movements and associated energy use for construction activities (i.e. seabed preparation, installation of WTG, foundations, cables and sub-station) | Offshore vessel movements (includes helicopters) | GHG emissions tied to installation operations, including emissions from ships used in offshore works installation and helicopters associated with offshore worker movements. |
| Operation and maintenance | | | | |
| Global atmosphere | Operational use (B1) | WTG – Consumables | Grease, oils, lubricants, water/glycerol, nitrogen, SF ₆ | GHG emissions associated with materials use. |
| | | OSP - Consumables | Transformer oil, SF ₆ , UPS batteries, grey water, black water, fire suppressant system and HVAC coolant | GHG emissions associated with materials use. |
| | Maintenance, repair, repair, replacement (B2-B5) | Offshore O&M Activities | Offshore vessel movements (includes helicopters) | Emissions associated with the maintenance and repair, replacement and refurbishment of the Offshore Project. |
| | | Offshore O&M Materials | Offshore Cable (Array/Export Cable) repair | |

| Receptor | Lifecycle Stage Impacts (with codes as per PAS 2080:2023) | Design Element/Activity | Sub-component (if any) | Potential Effect |
|------------------------|---|-------------------------|---|--|
| | | | Offshore Cable (Array/Export Cable) - rock replacement during operation J-tubes replacement (WTG) WTGs – Anode replacement WTGs – Ladder Replacement WTGs – Exchange events WTGs – Exchange events | |
| Decommissioning | | | | |
| Global atmosphere | Decommissioning process and End-of-life transport and disposal of materials (C1-C4) | Offshore works | | Assumed to be the reverse of the construction phase plus the disposal of materials (therefore equated to the sum of the construction process emissions). Assumes no infrastructure left in-situ. |



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8.4.6 ACTIVITIES OR IMPACTS SCOPED OUT OF ASSESSMENT

8.4.6.1 A number of potential impacts have been scoped out from further assessment, resulting from a conclusion of no likely significant effect. These conclusions have been made based on the knowledge of the baseline environment, the nature of planned works and the wealth of evidence on the potential for impact from such projects more widely. The conclusions follow (in a site-based context) existing best practice. Each scoped out activity or impact is considered in turn in **Table 8-4**.

Table 8-4 Activities or impacts scoped out of assessment for Greenhouse Gases

| Activity or impact | Rationale for scoping out |
|----------------------------|--|
| Preconstruction stage (A0) | Pre-construction activities, such as preliminary studies, design, EIA, and cost planning, are expected to generate minimal GHG emissions. These office-based tasks and surveys are not considered significant enough to include in the emissions assessment. |
| Operational Energy (B6) | Emissions associated with the daily activities for running the Offshore Project is negligible. |
| Operational water use (B7) | Operational water use, which involves GHG emissions from water consumption during the Offshore Project's operation, is excluded from consideration. The emissions are expected to be minimal, hence scoped out of this assessment. |

8.5 METHODOLOGY FOR BASELINE DATA GATHERING AND IMPACT ASSESSMENT

8.5.1 METHODOLOGY FOR BASELINE DATA GATHERING

Overview

8.5.1.1 Baseline data collection has been undertaken to obtain information over the Study Area described in Section 8.4.2. For the purposes of the GHG emissions impact assessment, the baseline conditions are defined as a 'do nothing' scenario where the Offshore Project does not go ahead.

Desk study

8.5.1.2 The baseline comprises of existing carbon stocks and sources of GHG emissions which occur widely in the Study Area because of human and natural activity. This includes emissions related to energy consumption (fuel and power), industrial processes, land use and land use change. **Table 8-12** shows the contextual baseline for local authority, Scotland/*Alba* and UK emissions. The GHG assessment has only considered instances in which the Offshore Project results in additional or avoided emissions in comparison to the baseline scenario and its assumed evolution. The baseline

therefore focuses on those emissions sources subject to change between the baseline and the Offshore Project. There is no development/activity on site at present. On this basis, the existing baseline emissions are considered zero.

8.5.2 METHODOLOGY FOR ENVIRONMENTAL IMPACT ASSESSMENT

Introduction

- 8.5.2.1 The GHG assessment methodology follows the PAS 2080 guidance covering the 'before use,' 'use,' and 'end of life' stages of the infrastructure lifecycle to estimate the GHG emissions throughout the Offshore Project's lifecycle. This approach aligns with the latest IEMA guidance, ensuring a comprehensive evaluation with a focus on a reasonable worst-case scenario. The evaluation considers a development's net lifetime impact, acknowledging emissions may be positive, negative, or negligible. Significance assessment extends beyond emission magnitude to evaluate whether the Offshore Project contributes to GHG reduction compared to a baseline aligned with a trajectory toward net zero by 2050.
- 8.5.2.2 The significance of the impacts associated with the proposed operations will be determined based on its whole life GHG emissions (aligned with IEMA best practice) as listed in **Table 8-5**.

Table 8-5 IEMA's GHG impact levels of significance

| Impact Level of Significance | Description |
|---------------------------------|---|
| Major adverse (Significant) | The Project's GHG impacts are unmitigated and do not significantly contribute to UK's emissions reduction goals. |
| Moderate adverse (Significant) | The Project's GHG impacts are partially mitigated, and it only partially contributes to UK's emissions reduction goals. |
| Minor adverse (Not Significant) | The Project's GHG impacts align fully with policy requirements and design standards, consistent with UK's emissions reduction goals. |
| Negligible (Not Significant) | The Project, with negligible effects, surpasses UK's emissions reduction goals, showcasing ahead-of-the-curve performance. |
| Beneficial (Significant) | The Project has net negative GHG impacts, reducing overall concentrations compared to the baseline, making a substantial positive contribution to UK's emissions reduction goals. |

8.5.2.3 GHG emissions for design parameters described in **Table 8-3** have been calculated using the following equation:

$$(Activity\ data) \times (GHG\ emissions\ factor) = GHG\ emissions\ value$$

8.5.2.4 Activity data (material type, quantities, fuel usage etc) have been based on the details available at this stage of design. Relevant assumptions (based on similar offshore wind farms projects and suitable literature studies) have been made to characterise the likely activities associated with the Offshore Project and quantify the GHG emissions (where applicable).

8.5.2.5 All assumptions and limitations relevant to this assessment are stated in Section 8.5.3. GHG Emission factors have been sourced from public data and reputable sources as listed in **Table 8-6**.

Table 8-6 Emission factors used in the GHG assessment

| Material/Activity in the design | Emission Factor Name | Value | Source |
|---|----------------------|------------------------------|---|
| WTG Consumables – Grease, Hydraulic Oil, Gear Oil, Lubricants | Lubricants | 2.74 kgCO ₂ e/L | Department for the Environment, Food and Rural Affairs (DEFRA) – UK Government GHG conversion Factors |
| WTG Consumables – Transformer Silicon/Ester oil | Fuel oil | 3.17 kgCO ₂ e/L | DEFRA – UK Government GHG conversion Factors |
| WTG Consumables | Nitrogen | 0.43 kgCO ₂ e/L | DEFRA – UK Government GHG conversion Factors |
| WTG and OSP Consumables | Glycol/Coolants | 4.14 kgCO ₂ e/L | DEFRA – UK Government GHG conversion Factors |
| WTG and OSP Consumables | SF ₆ | 11.11 kgCO ₂ e/kg | (Harrison, 2010) |

| Material/Activity in the design | Emission Factor Name | Value | Source |
|--|---------------------------------------|---|---|
| WTG Base Foundation, Bedding, Scour Protection and Offshore Cable Protection and Rock Replacement during Operation | Stone | 209.35 kgCO ₂ e/m ³ | Inventory of Carbon and Energy (ICE) DB Educational V4.0 – Dec 2024 – emission factor for rock (stone, general) Density of rock assumed to be 2650 kg/m ³ |
| WTG Base Foundation, Scour Protection and Piles | Concrete | 246 kgCO ₂ e/m ³ | ICE DB Educational V4.0 – Dec 2024 – emission factor for concrete (In-Situ Concrete – General) |
| WTG Foundation Jacket; WTG J-tubes and Ladder Replacement; OSP | Steel | 1.90 kgCO ₂ e/kg | ICE DB Educational V4.0 – Dec 2024 – emission factor for Steel (global seamless tube) |
| WTG – Anode replacement | Aluminium | 13.10 kgCO ₂ e/kg | ICE DB Educational V4.0 – Dec 2024 – emission factor for general aluminium (worldwide) |
| Offshore Cables (Array and Export Cable) (Installation and Repair) | 400 kV cable 2500 mm ² | 133.56 kgCO ₂ e/m | National Grid – Capital Delivery Carbon Tool – 3.4.4 Carbon Interface Tool |
| | 132 kV cable 1000mm ² | 55.52 kgCO ₂ e/m | National Grid – Capital Delivery Carbon Tool – 3.4.4 Carbon Interface Tool |
| | 275 kV cable 2500 mm ² | 133.56 kgCO ₂ e/m | National Grid – Capital Delivery Carbon Tool – 3.4.4 Carbon Interface Tool |
| Offshore HDD Cable Ducts | High Density Polyethylene (HDPE) Pipe | 2,394 kgCO ₂ e/m ³ | ICE DB Educational V4.0 – Dec 2024 – emission factor for HDPE Pipe (plastics) – 55.1 MJ/kg Feedstock Energy (Included) Conversion of EF from per kg to per m ³ using HDPE average density of 950 kg/m ³ for SDR11 HDPE pipe (HDPE Datasheet) |
| | Optical Fibre 14 mm diameter | 406 kgCO ₂ e/km | Optical fibre cables (EPD) |
| 60 No. smaller WTGs | Wind Turbine Generator | 6,825 tCO ₂ e /turbine | Vestas LCA report for an offshore wind farm (Vestas, 2024) |

| Material/Activity in the design | Emission Factor Name | Value | Source |
|--|------------------------------|------------------------------------|---|
| 44 No. larger WTGs | Wind Turbine Generator | 10,909 tCO ₂ e /turbine | Environmental Product Declaration (EPD) for a SG14-222 Wind Turbine (Siemens Gamesa Renewable Energy, 2023) |
| Offshore marine vessels for construction and maintenance | Marine Fuel Oil | 3.10 kgCO ₂ e/L | DEFRA – UK Government GHG conversion Factors |
| Offshore marine vessels for construction and maintenance | Marine Gas Oil | 2.77 kgCO ₂ e/L | DEFRA – UK Government GHG conversion Factors |
| Helicopter use | Aviation Turbine Fuel | 3.178 tCO ₂ e/t | DEFRA – UK Government GHG conversion Factors |
| OSP – Consumables | UPS batteries | 0.02 kg CO ₂ e/kg | (Product Environmental Profile, 2024) |
| | Grey water | 0.00017 kgCO ₂ e/L | DEFRA – UK Government GHG conversion Factors |
| | Black water | 0.00017 kgCO ₂ e/L | DEFRA – UK Government GHG conversion Factors |
| | Fire suppressant (foam) | 3 kgCO ₂ e/L | Estimated emission factor range of 1.5–3.5 kgCO ₂ e/L for fluorine - free firefighting foam is based on comparable chemical products and lifecycle benchmarks. (Wood, Ramboll, Cowi, 2020) |
| | Fire suppressant (argon gas) | 0 kgCO ₂ e/L | Argonite – inert gas suppression systems (Autronica, 2024) |

Construction Phase

8.5.2.6 The construction carbon footprint is divided into 3 main categories:

- Embodied carbon;
- Transport of materials;
- Plant equipment.

8.5.2.7 The following subsections discuss the approach used in estimating the GHG emissions within each lifecycle stage:

- A1-A3 – Product Stage (manufacture and transport of raw materials to suppliers);
- A4 – Transport of Materials to Site;
- A5 – Plant and Equipment Use.

A1-A3 – Product Stage (manufacture and transport of raw materials to suppliers)

8.5.2.8 Emissions 'embodied' within the construction materials are calculated as follows:

$$\text{Quantity of material (t)} \times \text{emissions factor (tCO}_2\text{e/t)} = \text{Emissions (tCO}_2\text{e)}$$

8.5.2.9 In the Turbine Area, 2 bounding WTG scenarios have been considered in determining the MDS:

- Up to 60 No. Smaller WTGs;
- Up to 44 No. Larger WTGs.

8.5.2.10 The embodied emission factors for WTGs were sourced from respective available EPDs matching WTG specifications and adjusted to match the specifications of WTGs considered here. This provides an indicative range within which a finalised design will fit.

8.5.2.11 Details of the key elements associated with embodied carbon calculations relating to the WTG foundations, laying of Offshore Cables and construction works associated with the OSP are provided in **Table 8-7** to **Table 8-9**, inclusive.

Table 8-7 Component-wise quantity of materials used in the assessment in for WTGs and foundations

| Activity | | Description | Quantity | | Unit | Assumptions |
|-----------------|-----------------------------|-------------------------------|-------------|---|----------------|---|
| | | | Smaller WTG | Larger WTG | | |
| WTG | Embodied | Turbines | 60 | 44 | No. | As per design scenarios. |
| | Consumables (per WTG) | Grease | 80 | 255 | litres | Assumed to be lubricants in litres. |
| | | Hydraulic Oil | 1,100 | 850 | litres | |
| | | Gear Oil | 2,700 | 384 | litres | |
| | | Lubricants | 0 | 1,000 | litres | |
| | | Nitrogen | 50,000 | 63,000 | litres | Assume Liquid Nitrogen with a density of 0.8 kg/litre. |
| | | Water/Glycerol | 1,400 | 1,300 | litres | Assume Propylene glycol, C ₃ H ₈ O ₂ . |
| | | Transformer Silicon/Ester oil | 6,500 | 12,000 | litres | Assumed to be fuel oil in litres. |
| SF ₆ | 24 | 24 | kg | All consumables quantities assumed to be per turbine across operational lifetime. | | |
| WTG Foundations | Gravity Foundation | Foundation | 2,700,000 | 2,000,000 | m ³ | Assuming 60 % ballast and 40 % concrete |
| | | Bedding | 900,000 | 660,000 | m ³ | Assuming 0 % gravel used from disturbed seabed material. |
| | | Scour Protection | 1,440,000 | 1,056,000 | m ³ | Calculated the percentage of rock and concrete as 66 % rock and 34 % concrete |
| | Multi-Leg Jacket (4-legged) | Piles | 376,991 | 289,026 | m ³ | Sum of concrete used in all piles (driven and drilled). Both have different depths of between 70 m to 120 m. |
| | | Jacket Steel | 750 | 550 | tonnes | Scaled up steel weight to a jacket with seabed dimension 55 x 55 m, top dimension 35 x 35 m from a study (University of Strathclyde). |

Table 8-8 Component-wise quantity of materials used in the assessment in for OSP

| Activity | | Description | Quantity | Unit | Assumptions | |
|----------|-----------------------------|-------------------------|-----------|---------|--|---|
| OSP | Topside Structure | Steel | 8,000,000 | kg | As per design weight of topside. Assuming all material is steel. | |
| | Multi-Leg Jacket Foundation | Steel | 1,500,000 | kg | Assumed as in similar studies (WSP, 2024). | |
| | Consumables | Transformer oil | | 900,000 | kg | Assumed to be fuel oil in litres |
| | | SF ₆ | | 6,000 | kg | As per OSP design parameters. |
| | | UPS batteries | | 24,000 | kg | As per OSP design parameters. |
| | | Grey water | | 5,000 | L | As per OSP design parameters. |
| | | Black water | | 3,000 | L | As per OSP design parameters. |
| | | Fire suppressant system | Foam | 10,000 | L | As per OSP design parameters. |
| | | | Argonite | 10,000 | L | As per OSP design parameters. |
| | | HVAC cooling | | 5,000 | L | As per OSP design parameters. Assumed Propylene glycol, C ₃ H ₈ O ₂ . All consumables quantities assumed to be across operational lifetime. |

Table 8-9 Component-wise quantities used in the assessment for Offshore Cables

| Offshore Cables | | | | | |
|---|----------------------------|------------------|----------------------------------|----------------|---|
| Parameter | Description | Quantity | | Unit | Assumptions |
| | | Scenario 1 (OSP) | Scenario 2 (Landfall Substation) | | |
| Array Cables / Array Cables to Landfall | Length of cable | 160 | 350 | km | - |
| | Voltage of cable | 132 | 132 | kV | EF of 132 kV cable scaled down to 66 kV cable. EF of 275 kV cable scaled down to 220 kV cable. EF of 132 kV cable and 275 kV cable used directly. |
| Export Cables | Length of cable | 30 | N/A | km | - |
| | Voltage of cable | 275 | N/A | kV | - |
| HDD Duct – SDR11 | HDD Duct Diameter | 1 | 1 | m | Dimensions used to calculate volume of HDD Pipe material – HDPE. |
| | HDD Duct Length | 1.5 | 1.5 | km | - |
| | Wall Thickness | 0.09 | 0.09 | m | A pipe with SDR11 has an outer diameter that is 11 times its wall thickness. |
| Cable Protection - Surface Lay Option | Pre-lay rock carpet volume | 611,500 | 1,130,000 | m ³ | Scoped in as it is the worst-case scenario compared to burial option. |
| | Post-Lay Rock Berm | 1,408,500 | 2,600,000 | m ³ | - |



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A4-- Transport of Materials to Site

8.5.2.12 Transport of materials during the construction phase was estimated for transport of WTG from Northern Europe pre-assembly/marshalling harbour to site.

A5-- Construction and installation process

8.5.2.13 Emissions from construction and installation process include offshore vessel movements and associated energy use for construction activities (i.e. sea bed preparation, installation of WTG, foundations, Offshore Cables and OSP).

8.5.2.14 Offshore Project construction traffic has been calculated using the data relating to installation vessels used and respective return trips across the construction period for the installation of offshore infrastructure.

8.5.2.15 GHG emissions associated with the marine vessels are estimated using the following equation:

$$GHG\ emissions\ (kgCO_2e) = [C\ (kgCO_2e/l)] \times [SFC\ (l/kWh)] \times [P\ (kW)] \times [t(hr)];\ where$$

- C – Carbon emissions factor;
- SFC - Specific fuel consumption;
- P – Total installed power of vessel;
- t – Time spent by the vessel for travel (includes transit and construction activity on site).

8.5.2.16 The emissions from helicopter usage during the construction phase have been calculated based on hourly fuel consumption, whereas for the O&M phase a worst case of daily usage across the year has been assumed as per the information available at the time of assessment.

8.5.2.17 A list of assumptions associated with vessels and helicopter movements have been summarised in subsequent text.

8.5.2.18 The current programme of works translates as a construction phase for a majority of the works over a 36 month period in total which is based on works happening during April – October (excluding HDD installation works) over a 5 year period between 2028/2029 – 3032/2033.

8.5.2.19 Stornoway/*Steòrnabhagh* Port has been assumed as the Marshalling yard during the construction phase and as the base for operation and maintenance works. Each vessel is assumed to transit 53 nm between Stornoway/*Steòrnabhagh* Port and the Array Area.

8.5.2.20 A worst case scenario of vessel movements with minimal overlap in trips has been assumed. In the event of any overlaps in construction works and associated vessel movements, the emissions are expected to reduce in proportion.

8.5.2.21 Indicative durations of construction activities have been assumed based on similar offshore wind farm development projects:

- A cable laying speed of 5 km/day has been assumed and an average of 245 km length of all cables (average length of all the four cable scenarios) has been used in calculations;
- Installation of each wind turbine would take 24 hours;
- Support vessels are assumed to work for 12 hours daily (including time on array site) as they cannot anchor.

8.5.2.22 A list of vessels chosen for each activity is provided in **Table 8-10**:

- Vessel transit is assumed to use 100 % of engine power, whereas idling during activity is assumed to use 28 % of engine power (based on literature reviews);
- Total activity time is arrived at by multiplying number of trips with the time spent for each activity;
- Total transit time is arrived at by dividing distance (in this case Stornoway/*Steòrnabhagh* Port) with the average speed of vessel;
- SFC is taken as 0.226 L/kWh as a rule of thumb from standard research findings. This depicts how much fuel is used to convert a kWh of power from a marine vessel engine;
- For repair and maintenance activities, vessels are assumed to be similar to those used in construction phase for respective activity;

8.5.2.23 Emissions from helicopter usage for construction phase is calculated based on hourly fuel usage of a typical AW 139 model sourced from literature findings. For the O&M phase, emissions from daily trips across the year has been estimated using a flight distance of 16 miles (25 km) between Stornoway/*Steòrnabhagh* airport to the Array Area, and an average cruise speed of 161 mph based on literature findings.

Table 8-10 Indicative vessels chosen for calculations

| Construction/maintenance activity | Vessel chosen for calculations ¹ | Phase |
|--|---|----------------------|
| Installation for WTG/OSP, Jackets, Drilling, Grout and Pile, Pile Install | MPI adventure | Construction |
| Major component replacement-blades, gearboxes, transformers, generators | MPI adventure | O&M |
| Barge for installation support | Split Hopper Barge Johannis de Rijke | Construction |
| Cable Lay Installation; Trencher; Rock dumper; Offshore Cable protection installation | Fugro Global Symphony | Construction |
| Offshore Cables repairs, reburials | Fugro Global Symphony | O&M |
| Tug/Anchor Handler | CMS Thunderer | Construction |
| Guard Vessel | Commodore P | Construction |
| Survey vessel | Kommandor Susan | Construction |
| Survey vessel - inspections; pre-construction surveys | Kommandor Susan | O&M |
| Seabed Preparation | Seahorse | Construction |
| Export cables-installation and support vessels (Boulder clearance + gravelbed + trencher + rock dumber) | Seahorse | Construction |
| Crew Transfer | Windcat 19 | Construction |
| Crew Transfer - routine inspections; replacement of consumables (filters, oils, lubricants) | Windcat 19 | O&M |
| Service Operation Vessel (SOV) | Grampian Tyne | Construction |
| SOV - repairs and replacement of navigational eqp; corrosion protection; painting; access ladder replacement; J-Tubes; motors; pumps | Grampian Tyne | O&M |
| Scour Protection Installation | M/S Camilla HØJ | Construction |
| Helicopter | Augusta Westland AW139 | Construction and O&M |

Operation Phase

B1 – Operational Use

8.5.2.24 This stage includes emissions from non-energy-related impacts during the life of the Offshore Project. The GHG emissions related to the operational use were estimated by considering the use of consumables for WTGs and OSP across an operational lifetime of up to 35 years (as noted in **Chapter 3, Volume 1a**). Consumed materials and their respective quantities are specified in **Table 8-7**.

¹ These vessels are used due to data availability and provide representative examples of those which are expected to be used during the Offshore Project.

B2-B5 – Maintenance (B2), Repair (B3), Replacement (B4) and Refurbishment (B5)

8.5.2.25 The B2-B5 stages (Maintenance, Repair, Replacement, and Refurbishment) include the emissions associated with the activities such as routine inspections of foundations and turbines, surveys of seabed, assets and cables, repairs and maintenance of equipment, corrosion protection and painting, etc.

8.5.2.26 The most significant materials considered to be maintained, repaired or replaced during the O&M phase are listed in **Table 8-11** with the respective quantities and assumptions.

Table 8-11 Components of Offshore Project requiring maintenance, repair, replacement and refurbishment during the operational phase

| O&M Sub-Components | Smaller WTG | Larger WTG | Unit | Assumptions and Sources |
|--|-------------|------------|----------------|---|
| Array Cables repair | 48 | 55 | km | Assumed no. of lifetime repair events based on Offshore Project's operational lifetime of 35 years |
| Array Cables – rock replacement during operation | 327,187 | 327,187 | m ³ | Array Cable options have been averaged for their pre lay and post lay rock volumes. Assume 25% of rock protection around Array Cable may need replenishment during operation. Density of rock assumed to be 2,650 kg/m ³ |
| J-tubes replacement (WTG) | 132,617 | 97,252 | kg | Assumed 2 maintenance events per WTG over lifetime for a J-tube of 181.19 kg/m of max length 6 m. (FLAMCO, 2013) |
| Export Cables repair | 2.8 | 3.27 | km | No. of lifetime repair events based on Offshore Project's operational lifetime of 35 years. Assumes up to 4 lifetime events, 600 m per event. |
| Wind Turbines – Anode replacement | 13,500 | 9,900 | kg | Assumed aluminium anode weight of 45 kg from literature review. (Cathwell) Assume 5 No. lifetime repair events per turbine. |
| Wind Turbines - Ladder Replacement | 4,317,900 | 3,166,460 | kg | Assume 5 No. lifetime repair events per turbine in 35 years of operation. Weight of ladder assumed as 14,393 kg/turbine tower. |
| Wind Turbines – Exchange events | - | - | - | Assume 10 % as conservative factor for replacement of material components over lifetime of wind farm. |

8.5.2.27 The quantities of sub-components requiring repair or maintenance during the O&M phase were multiplied by the emissions factors of respective materials to estimate the GHG emissions.

8.5.2.28 Maintenance works associated with the OSP predominantly involve routine inspections, replacement of minor components and painting/coating repairs. The dominant source of emissions in this instance is associated with vessel movements and/or use of helicopters.

8.5.2.29 Emissions associated with vessel movements for maintenance works and worst-case use of helicopters have been estimated (including all works associated with the WTGs, OSP and Array Cables and Export Cables).

B6-- Operational Energy Use

8.5.2.30 GHG emissions from energy use during the O&M phase were not included in the assessment as there are no significant operational energy requirements.

B7 – Operational Water Use

8.5.2.31 GHG emissions from water use during the O&M phase were not included in the assessment as there are no significant operational water use requirements for the operation of WTGs.

B8 – Land Use, Land Use Change and Forestry

8.5.2.32 During the O&M phase, GHG emissions related to Land Use, Land Use Change and Forestry will be minimal, hence considered to be zero.

Decommissioning Phase

C1 – Decommissioning process

8.5.2.33 The decommissioning of an offshore wind farm involves the safe dismantling and removal of turbines, foundations, and associated infrastructure. Offshore, this process will require similar types and numbers of vessels and equipment as used during construction.

8.5.2.34 Emissions from decommissioning activities, both on-site and off-site, are assumed to be similar to those during construction and installation. This includes energy consumption for plant use and transport emissions for materials and labour. The removal process is expected to follow the reverse sequence of construction.

8.5.2.35 Since decommissioning will take place far in the future, predicting the exact fate of materials and associated activities is challenging. As a result, GHG emissions estimates are based on current assumptions, with offshore decommissioning mirroring construction logistics.

8.5.2.36 The decommissioning emissions assessment includes transport (A4), land use changes (A5), and energy use in deconstruction activities. Offshore, this covers vessel and helicopter movements for the removal of WTGs, foundations, cables, and substations. Transport emissions account for moving WTGs from the site to a marshalling harbour in Northern Europe. These factors are included to ensure a comprehensive assessment of GHG emissions related to decommissioning.

C4 – End-of-life transport and disposal of materials

8.5.2.37 The end-of-life stage for an offshore wind farm involves transporting dismantled materials to disposal or recycling facilities. It is anticipated that a considerable amount of wind farm components would be decommissioned following the waste hierarchy, with large amounts of materials being recycled or repurposed.

8.5.3 OTHER DATA LIMITATIONS AND ASSUMPTIONS

- 8.5.3.1 It is not possible to determine with certainty which form of conventional electricity generation will be displaced by the Offshore Project. Accordingly, the assessment of GHG emissions considers the carbon payback period relative to a range of conventional generation types, including coal, oil, gas and other solid fuels, including non-renewable waste generation mechanisms.
- 8.5.3.2 As WTG technology is continually evolving, it is difficult to definitively predict the generating capacity and model of WTG that will be commercially available at the point of procurement for construction. As such, the size and capacity of the WTG for the Offshore Project will be determined during the final project design stage prior to construction. The final WTG design will be selected in accordance with the parameters set out in the design.
- 8.5.3.3 The GHG emissions assessment assumes Stornoway/*Steòrnabhagh* Port as the preferred marshalling location, with vessel transit distances and associated emissions calculated accordingly. Should the marshalling port change, vessel transit distances and related emissions may increase or decrease. If a different port is selected, the assessment will be updated to reflect revised logistics and transport emissions. This approach is consistent with best practice for EIA assessments at this stage of project development.

8.6 BASELINE CONDITIONS

8.6.1 CURRENT BASELINE

- 8.6.1.1 The assessment baseline for GHG emissions in Scotland/*Alba* is established using the Climate Change (Scotland) Act 2009, as amended by the Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 (Energy and Climate Change Directorate, n.d.). No additional data has been gathered to inform the baseline. The scope covers existing GHG emissions before the construction, operation, and decommissioning of the assessed Offshore Project.
- 8.6.1.2 Specific targets and allocations in Scotland/*Alba* include achieving net zero emissions by 2045 (Energy and Climate Change Directorate, n.d.). Additionally, interim targets are set for a 56 % reduction by 2020, 75 % by 2030, and 90 % by 2040, all against the baseline year of 1990 (Energy and Climate Change Directorate, 2017).
- 8.6.1.3 The future baseline for GHG emissions in Scotland/*Alba* considers the impact of relevant Scottish Government policies throughout the project's lifetime and aligns with the established UK carbon budget trajectory. This ensures that future emissions reductions are measured against a realistic scenario that reflects ongoing efforts towards decarbonisation. Notably, the Scottish Government's commitment to decarbonisation is evident through the Climate Change Plan update (2020), which includes ambitious renewable energy goals, the 2019 climate emergency declaration, and various strategic investments such as the £1.6 billion for heat decarbonisation and the £100 million Green

Jobs Fund (Energy and Climate Change Directorate, 2017). These efforts ensure the baseline reflects a future with ongoing action towards achieving net zero emissions.

- 8.6.1.4 The current assessment focuses solely on GHG emissions originating from the Offshore Project itself. It is assumed that there are no significant existing sources of emissions within the current baseline. The change in GHG emissions associated with the Offshore Project is evaluated against national, regional, and local targets for decarbonisation (the future baseline).
- 8.6.1.5 To provide a context for GHG emissions arising from the Offshore Project, baseline data for local, regional and UK emissions is provided in **Table 8-12** sourced from the UK local authority and regional greenhouse gas emissions statistics, 2005-2022 (Department for Energy Security and Net Zero, 2024).

Table 8-12 Emission Estimates for Local Authority, Scotland and UK (2022)

| Emissions Sources | Local Authority: Comhairle nan Eilean Siar (ktCO₂e) | Scotland (ktCO₂e) | UK (ktCO₂e) |
|---|---|-------------------------------------|-----------------------------------|
| Industry Electricity | 3.2 | 754 | 11,642 |
| Industry Gas | 0.1 | 1,484 | 14,197 |
| Large Industrial Installations | 0.0 | 2,994 | 26,157 |
| Industry 'Other' | 3.6 | 843 | 10,347 |
| Industry Total | 6.9 | 6,075 | 62,343 |
| Commercial Electricity | 6.2 | 1,542 | 19,073 |
| Commercial Gas | 0.6 | 1,359 | 12,543 |
| Commercial 'Other' | 0.7 | 166 | 2,280 |
| Commercial Total | 7.5 | 3,067 | 33,896 |
| Public Sector Electricity | 2.4 | 333 | 3,611 |
| Public Sector Gas | 0.5 | 747 | 7,019 |
| Public Sector 'Other' | 0.7 | 99 | 1,064 |
| Public Sector Total | 3.6 | 1,179 | 11,694 |
| Domestic Electricity | 16.5 | 1,815 | 20,500 |
| Domestic Gas | 3.5 | 4,632 | 53,288 |
| Domestic 'Other' | 33 | 920 | 10,477 |
| Domestic Total | 53 | 7,367 | 84,265 |
| Road Transport (A Roads) | 24.3 | 4,158 | 44,173 |
| Road Transport (Motorways) | 0.0 | 1,777 | 23,978 |
| Road Transport (Minor Roads) | 14.1 | 3,766 | 41,783 |
| Diesel Railways | 0.0 | 132 | 1,593 |
| Transport 'Other' | 3.2 | 208 | 3,129 |
| Transport Total | 41.6 | 10,041 | 114,656 |
| Landfill | 11.1 | 1,028 | 13,473 |
| Waste 'Other' | 11.6 | 422 | 5,260 |
| Waste Total | 22.7 | 1,450 | 18,733 |
| Other Total (LULUCF and agriculture) | 738 | 9,676 | 50,340 |
| Grand Total* | 873 | 38,855 | 375,929 |

*Note: individual emission entries have been rounded, so rounding errors may occur in combined totals

8.6.2 FUTURE BASELINE

8.6.2.1 In terms of the future baseline, in the 'no development' scenario where the Offshore Project is not developed, the future baseline will be determined by the current GHG emissions. Since there is no physical development or activity within the PDE in this scenario, GHG emissions from the Offshore Project before construction and operation are considered negligible.

8.7 BASIS FOR ENVIRONMENT IMPACT ASSESSMENT

8.7.1 MAXIMUM DESIGN SCENARIO

- 8.7.1.1 Using a parameter-based design envelope approach means that the assessment considers a maximum design scenario recognising the ongoing nature of design works. The assessment of the maximum adverse scenario for each receptor establishes the maximum potential adverse impact and as a result impacts of greater adverse significance would not arise should any other development scenario (as described in **Chapter 3, Volume 1a**) be taken forward in the final scheme design.
- 8.7.1.2 The maximum design scenario identified in relation to GHG impact has been developed by selecting key project components with the highest anticipated embodied and operational emissions as shown in **Table 8-13**. Details reflect the worst case, having considered ranges in design details (such as, for example, the range of the number of WTGs that may be deployed), which are considered in Section 8.5.2.
- 8.7.1.3 Although pre-construction surveys may involve some limited and temporary interactions with the marine environment, the potential impacts of any such activities fall well within the MDS parameters assessed for this chapter. The MDS includes activities such as WTG foundation drilling and grouting, and Offshore Cable installation which represent a conservative upper bound on seabed disturbance, and vessel presence. These MDS activities therefore encompass the environmental footprint of pre-construction survey methods, which are significantly lower in magnitude, duration, and spatial extent.
- 8.7.1.4 For this reason, the potential environmental interactions of pre-construction surveys are not separately assessed, as they are already inherently accommodated within the worst case assumptions underpinning the MDS for this topic.
- 8.7.1.5 The difference in timing between pre-construction surveys and construction activities does not affect the assessment because the MDS represents the maximum magnitude of change, independent of phasing or scheduling. The pre-construction surveys occur over a much shorter duration and at materially lower intensities than the MDS bounding activities, and therefore do not introduce any temporal additive effects beyond those already assessed.

Table 8-13 Maximum Design Scenario considered for impacts on Greenhouse Gases

| Impact / Activity | Maximum Design Scenario | Justification |
|---|--|---|
| <p>Construction</p> <p>GHG emissions arising from the product stage (manufacture and transport of raw materials to suppliers) (A1-3)</p> | <p>The programme for the Construction phase of the Offshore Project is a 5 year period, between 2028/29 – 2032/2033.</p> <p>WTG and WTG Foundations</p> <ul style="list-style-type: none"> Up to 60 smaller WTGs Up to 60 Multi-Leg Jacket Foundations with HGB - total volume of material² (combined concrete and ballast) is 2,700,000 m³, with 900,000 m³ of bedding material (geotextile or mattress) and 1,440,000 m³ of scour protection. Mass of steel is 750 tonnes. GHG Emissions WTG - 409.5 ktCO₂e. GHG Emissions HGB - 1,227 ktCO₂e. <p>Offshore Cables</p> <ul style="list-style-type: none"> Scenario 2 - Up to 12 Array Cable circuits between the WTGs and Landfall Substation, with a maximum cable voltage of 132kv and diameter of 300 mm. Maximum cable length in the Array Area and OCAS is 350 km. GHG Emissions - 9.7 ktCO₂e. <p>Array Cable and Array Cable to Landfall: protection and stabilisation</p> <p>- Cable stabilisation</p> <ul style="list-style-type: none"> Pre-lay carpet will have a maximum width of 5 m, height of 0.3 m and volume of 1,130,000 m³. Cable protection: will be achieved using rock berms, rock bags, concrete mattresses or other inert material and will have a maximum width of 3 m, height of 1.1 m and volume 2,600,000 m³. Total volume cable stabilisation and protection: maximum total volume of hard substrate material introduced 3,730,000 m³. GHG Emissions - 1,126 ktCO₂e <p>HDD</p> <ul style="list-style-type: none"> Max HDD Duct length – 1500 m per duct Max HDD Duct diameter – 1 m Max number of Cable ducts – 13 Material – HDPE GHG Emissions – 345 ktCO₂e | <p>As presented in Section 8.5.2, the maximum design envelope with respect to GHG intensity has been determined through consideration of 2 WTG bounding scenarios (Smaller WTG - 60 No. WTG assumed for the purposes of assessment to be rated at 15 MW and Larger of 44 No. WTG assumed for the purposes of assessment to be rated at 22 MW), associated optionality in cabling approach (Scenario 1 – OSP, or Scenario 2 – no OSP) and foundation optionality (pin piles or HGB). The most GHG intensive parameters for the construction and installation of the Offshore Project are defined in this MDS to inform the assessment.</p> |
| <p>GHG emissions arising from the transport of materials to site (A4)</p> | <p>Transport of WTG from Northern Europe pre-assembly/marshalling harbour to site. GHG Emissions - 17.1 ktCO₂e</p> | <p>Impacts assessed account for the transport emissions associated with the movement of primary materials used in constructing the Offshore Project.</p> |

² Total volume of material is defined as the total for the Offshore Wind Farm.
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| Impact / Activity | Maximum Design Scenario | Justification |
|---|--|---|
| GHG emissions arising from plant and equipment used during construction (A5) | <p>Vessels</p> <ul style="list-style-type: none"> Maximum installation vessel movements (return trips) is 871 per year. Over the 5 year construction period, this is up to 4,355 total vessel movements. GHG Emissions - 2,467 ktCO₂e. Maximum helicopter movements (return trips) is 50 per year. Over the 5 year construction period, this is up to 250 total helicopter movements. GHG Emissions - 0.05 ktCO₂e. | Impacts assessed account for the emissions associated with the construction phases activities used in the Offshore Project. |
| Operation | | |
| Operational use (B1) | <p>The O&M phase of the Offshore Project duration to be 35 years.</p> <p>WTG Consumables (exchange interval)</p> <ul style="list-style-type: none"> Grease - 535,500 L (255 L / year per WTG) Hydraulic Oil - 66,000 L (10 years; 1100 L per WTG over 35 years) Gear Oil - 162,000 L (10 years; 2700 L per WTG over 35 years) Lubricants – 154,000 L (10 years; 1000 L per WTG over 35 years) Nitrogen - 63,000 L (lifetime) Water / Glycerol – 1,400 L (lifetime) SF6 - 1,440 kg (lifetime) GHG emissions (consumables) - 3.5 ktCO₂e <p>OSP Consumables</p> <ul style="list-style-type: none"> Transformer oil - 900,000 kg SF6 - 6,000 kg UPS batteries - 24,000 kg Grey water - 5,000 L Black water - 3,000 L Fire suppressant system - 10,000 L foam and 10,000 L Argonite HVAC cooling - 5,000 L GHG emissions (OSP Consumables) - 3 ktCO₂e | <p>Impacts assessed account for the emissions associated with WTG and OSP consumables as relevant to the Offshore Project.</p> <p>Maximum parameter for operational consumables taken from either the smaller WTG or larger WTG scenario and OSP Consumables, to ensure a precautionary maximum design envelope is assessed.</p> |
| GHG emissions arising from the consumption of materials and activities required to facilitate the operational use (B1) and maintenance, repair, replacement (B2-B5) | <p>Vessels</p> <p>Crew Transfer Vessels (CTVs) - 32,034 movements (return trips); up to 800 litres of fuel per day Service Operation Vessels (SOVs) and helicopters - 254 movements (return trips); SOVs up to 8,000 litres of fuel per day; helicopters up to 226 kg/hr of fuel GHG Emissions (all vessel movements and helicopters) - 23 ktCO₂e</p> <p>Components - repair or replacement during the operational lifetime of the Offshore Project: Array Cables/Array Cables to Landfall - 600 m per event; 90 lifetime events Array Cables/Array Cables to Landfall - Rock Protection Replacement - assume 25% of protection volume is replaced over operational lifetime Export Cables - 4 lifetime events; 600 m repaired per event Anode replacement - 5 lifetime events per WTG Ladder replacement - 5 lifetime replacements per WTG</p> | <p>Impacts assessed account for the emissions associated with repair and maintenance activities as relevant to the Offshore Project.</p> <p>Maintenance activities are expected to occur with a lower intensity than those during construction. It is assumed that Array Cables will require reburial/protection up to 6 times across the Offshore Project lifetime, and will be repaired or replaced up to 9 times across the Offshore Project lifetime.</p> |

| Impact / Activity | Maximum Design Scenario | Justification |
|--|--|---|
| | J-tube replacement - 2 lifetime events per WTG WTG major component exchange - 3 lifetime events per WTG GHG emissions - 150 ktCO ₂ e | |
| Decommissioning | | |
| GHG emissions arising from decommissioning process and End-of-life transport and disposal of materials (C1-C4) | Emissions from decommissioning activities, both on-site and off-site, are assumed to be similar to those during construction. This includes energy consumption for plant use and transport emissions for materials and labour. The removal process is expected to follow the reverse sequence of construction lifecycle stages GHG emissions arising from the transport of materials to site (A4) and GHG emissions arising from plant and equipment used during construction (A5) combined. | |
| Other | | |
| Carbon Payback Period and GHG Intensity of the Offshore Project | <ul style="list-style-type: none"> • Bounding WTG Scenarios - Smaller WTG - 60 No. WTG assumed for the purposes of assessment to be rated at 15 MW and Larger of 44 No. WTG assumed for the purposes of assessment to be rated at 22 MW • Design life of 35 years • Assumed indicative generation capacity of 900 MW • Predicted Annual Generation Capacity 4,684 GWh/year | Benefits to be assessed need to account for the annual energy generation from the Offshore Project. |

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8.7.2 EMBEDDED MITIGATION MEASURES

- 8.7.2.1 As part of the Offshore Project design process, a number of embedded mitigation measures have been adopted to reduce the potential for impacts on GHG emissions, and these have evolved over the development process as the EIA has progressed and in response to consultation.
- 8.7.2.2 The embedded mitigation measures also include those that have been identified as good or standard practice and include actions that would be undertaken to meet existing legislation requirements. As there is a commitment to implementing the embedded mitigation, and also to various standard sectoral practices and procedures, they are considered inherently part of the design of the Offshore Project and are set out in this EIA.
- 8.7.2.3 **Table 8-14 R** sets out the relevant embedded mitigation measures within the design and how these are relevant to the GHG assessment.

Table 8-14 Relevant GHG emissions embedded mitigation measures

| ID | Design and operational management measure proposed | Offshore Project phase measure introduced | How the environmental measures will be secured | Relevance to GHG assessment |
|------|--|---|--|--|
| M002 | A Cable Installation Plan will be produced to confirm routing, method of installation and aspects such as target Depth of Burial and need for/location of/type of external cable protection. This Plan will also contain the outputs of a formal Cable Burial Risk Assessment (CBRA). Data from the project-specific geophysical surveys will be used to identify the preferred route, with the use of natural crevasses or channels within the bedrock proposed, where feasible, and areas of thicker Quaternary sediments identified (to maximise opportunities for cable burial). | Pre-Construction, construction | Secured in the Section 36 Consent and/or Marine Licence conditions. Details will be provided within the Cable Installation Plan. | Minimising use of material and associated plant equipment use in the construction phase. |
| M005 | Relevant best practice techniques for seabed excavations, employed through all phases of the Project, and suspended solids monitoring to aid responsible management of excavation activities. | Construction | To be secured through a condition of the Section 36 consent and/or Marine Licence. | Minimising GHG emissions during the construction phase. |
| M019 | A final Offshore Environmental Management Plan (OEMP) will be developed prior to commencement of construction (building on Outline Offshore EMP, Volume 3) in compliance with legislative requirements and/or best practice standards and guidance and adhered to. | Pre-Construction, construction | Offshore EMP secured via Marine Licence Condition. | Measures to be implemented to reduce GHG emissions during the construction phase and define measures to reduce embodied carbon in construction materials and |

| ID | Design and operational management measure proposed | Offshore Project phase measure introduced | How the environmental measures will be secured | Relevance to GHG assessment |
|------|---|---|---|---|
| | | | | encourage circular economy principles. |
| M020 | A Decommissioning Plan will be developed prior to the construction of the Project in compliance with legislative requirements and/or best practice standards and guidance and adhered to. | Decommissioning | Secured in the Section 36 Consent and/or Marine Licence via the condition for a Decommissioning Plan to be submitted to MD-LOT for approval and the Energy Act 2004 | Minimising GHG emissions during decommissioning activities. |
| M022 | A final Navigational Safety and Vessel Management Plan (NSVMP) will be developed prior to commencement of construction (building on the Outline NSVMP, Volume 3) in compliance with legislative requirements and/or best practice standards and guidance and adhered to. | Construction | Secured in the Section 36 Consent and/or Marine Licence via the condition for an NSVMP to be submitted to MD-LOT for approval. | Appropriate management measures of vessel movements to minimise associated emissions. |
| M025 | A final Operational & Maintenance (O&M) Plan (building on Outline Operational & Maintenance Plan, Volume 3) will be developed in compliance with legislative requirements and/or best practice standards and guidance prior to the operation of the Project and adhered to. | O&M | Secured in the Section 36 Consent and/or Marine Licence via the condition for an EMP to be submitted to MD-LOT for approval. | Minimising GHG emissions during O&M activities. |

8.8 ASSESSMENT OF EFFECTS: CONSTRUCTION PHASE

8.8.1 CONSTRUCTION PHASE EMISSIONS

8.8.1.1 The GHG emissions associated with the construction phase of the Offshore Project as summarised in **Table 8-15**.

Table 8-15 Construction phase emissions

| Lifecycle Stage | Design Element / Activity | Emissions (ktCO _{2e}) # |
|--|--|-----------------------------------|
| A1-A3 (Embodied Carbon) ^{##} | WTGs | 409 |
| | WTG foundations | 1,227 |
| | Array Cables and Export Cables (including cable protection - HDD ducts, pre-lay and post-lay rock) | 1,136 |
| | OSP | 18 |
| Total A1-A3 emissions | | 2,957 |
| A4 (Material Transport to site) | Offshore – WTGs to site | 17 |
| Total A4 emissions | | 17 |
| A5 (Construction and Installation Processes) | Offshore vessel movements, energy use | 2,467 |
| Total A5 emissions | | 2,467 |

The 'Design Option Considered for the Assessment' for respective lifecycle stages is based on the worst-case scenario i.e. the design option with the higher potential GHG emissions impact.

Note that whole lifecycle stages A1 – A3 incorporates all aspect of manufacturing. Specifically: A1: Raw material supply, including processing of secondary material input; A2: Transport of raw material and secondary material to the manufacturer; A3: Manufacture of the construction products, and all upstream processes from cradle to gate.

8.8.1.2 The embodied carbon (A1-A3) in the materials is the largest contributor to the construction emissions, followed by the construction processes (A5). Most of the embodied carbon is associated with the use of steel and concrete required for WTGs and associated foundations.

Comparison against Relevant UK Carbon Budgets

8.8.1.3 In line with IEMA guidance, **Table 8-16** compares the GHG impact of the construction phase of the Offshore Project against the UK Government's 5 year carbon budgets.

8.8.1.4 The construction phase of the Offshore Project is planned during 2028/2029 – 2032/2033 which falls partly within the Fifth Carbon Budget period (2028-2032) and partly within the Sixth Carbon Budget period (2033-2037).

Table 8-16 Comparison of construction emissions with UK carbon budgets

| Offshore Project Phase | Estimated GHG emissions | GHG emission per Carbon Budget Period - Fifth Carbon Budget (2028-2032) | | GHG emission per Carbon Budget Period - Sixth Carbon Budget (2033-2037) | |
|------------------------|---------------------------|---|--------------------|---|--------------------|
| | | Emissions | % of carbon budget | Emissions | % of carbon budget |
| Construction | 5,441 ktCO ₂ e | 4,395 ktCO ₂ e | 0.26 % | 1,046 ktCO ₂ e | 0.10 % |

8.8.1.5 The assessment has highlighted that the GHG emissions during the Construction phase contribute 0.26% to the Fifth Carbon Budget period and 0.10% to the Sixth Carbon Budget.

Significance of Effect

8.8.1.6 As GHG emissions resulting from the construction of the Offshore Project have a negligible contribution to the 5th and 6th carbon budget, construction of the Offshore Project is unlikely to affect the UK's ability to meet its future carbon targets. On this basis the significance of effect is assessed as **Minor Adverse (Not Significant)**.

Further Environmental Mitigation and Residual Effect

8.8.1.7 No additional GHG mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 8-14**) is not significant in EIA terms.

8.9 ASSESSMENT OF EFFECTS: OPERATION AND MAINTENANCE

8.9.1 OPERATION AND MAINTENANCE PHASE EMISSIONS

8.9.1.1 This section presents the GHG emissions associated with the O&M phase of the Offshore Project as summarised in **Table 8-17**.

Table 8-17 Operation and maintenance emissions

| Lifecycle Stage | Design Element / Activity | Emissions (ktCO ₂ e) # |
|--------------------------------|--|-----------------------------------|
| B1 | Turbines - Consumables | 3.5 |
| | Offshore Substation - Consumables | 3 |
| B2-B5 O&M activities | Offshore vessel movements | 23 |
| B2-B5 O&M Materials | Array cables repair | 1.65 |
| | Array cables - rock replacement during operation | 68.50 |
| | J-tubes replacement (WTG) | 0.25 |
| | Export cables repair | 0.34 |
| | Wind Turbines - Anode replacement | 0.18 |
| | Wind Turbines - Ladder Replacement | 8 |
| | Wind Turbines - Exchange events | 41 |
| Total O&M emissions | | 150 |

The 'Design Option Considered for the Assessment' for respective lifecycle stages is based on the maximum design scenario i.e. the design option with the higher potential GHG emissions impact.

8.9.1.2 Total emissions of 150 ktCO₂e are estimated over an operational life of 35 years, which are largely due to the embodied carbon in the spare parts and marine vessel movement activities.

Comparison against Relevant UK Carbon Budgets

8.9.1.3 In line with IEMA guidance, **Table 8-18** compares the GHG impact of the O&M phase of the Offshore Project against the UK Government's 5 year carbon budgets.

8.9.1.4 The O&M phase of the Offshore Project (2033-2068) falls within the Sixth Carbon Budget period (2033-2037) only.

Table 8-18 Comparison of operational phase emissions with UK carbon budgets

| Offshore Project Phase | Estimated GHG emissions | GHG emission per Carbon Budget Period - Sixth Carbon Budget (2033-2037) | |
|------------------------|-------------------------|---|--------------------|
| | | Emissions | % of carbon budget |
| O&M | 150 ktCO ₂ e | 21 ktCO ₂ e | 0.002 % |

8.9.1.5 The assessment has highlighted that the GHG emissions during the O&M phase contribute 0.002% to the Sixth Carbon Budget period.

8.9.1.6 The Offshore Project will continue to offset GHG emissions throughout its operational life and therefore make a positive contribution to the UK Government target to reach net zero emissions in 2050. Further detail is provided in Section 8.11.

Significance of Effect

8.9.1.7 As GHG emissions resulting from the O&M phase of the Offshore Project have a negligible contribution to the sixth carbon budget. Operation of the Offshore Project is unlikely to affect the UK's ability to meet its future carbon targets. The significance of effect is assessed as **Minor Adverse (Not Significant)**.

Further Environmental Mitigation and Residual Effect

8.9.1.8 No additional GHG mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 8-14**) is not significant in EIA terms.

8.10 ASSESSMENT OF EFFECTS: DECOMMISSIONING

8.10.1 DECOMMISSIONING PHASE EMISSIONS

8.10.1.1 This section presents the GHG emissions associated with the decommissioning phase of the Offshore Project in **Table 8-19**.

8.10.1.2 As a worst-case scenario decommissioning activities are assumed to reflect the reverse of the construction phase combined A4 and A5 emissions.

Table 8-19 Emissions from decommissioning stage

| Lifecycle Stage | Design Element/Activity | Emissions (ktCO ₂ e) |
|-----------------|----------------------------------|---------------------------------|
| C | Decommissioning – Offshore works | 2,484 |

Significance of Effect

8.10.1.3 As mentioned earlier in this chapter (paragraph 8.5.2.37), it is anticipated that a considerable amount of wind farm components would be recycled or repurposed, which, although involving some emissions from processing, is expected to result in a net reduction in GHG emissions compared to disposal or use of virgin materials. As such, the effect on climate change is considered to be **Minor Adverse (Not Significant)** relative to a no-project baseline but represents a more sustainable end-of-life approach. Further quantification of the impacts and mitigations emission reduction potential should be undertaken as the decommissioning plan is developed further.

Further Environmental Mitigation and Residual Effect

8.10.1.4 No additional GHG mitigation is considered necessary because the likely effect in the absence of further mitigation (beyond the embedded commitments outlined in **Table 8-14**) is not significant in EIA terms.

8.11 CARBON PAYBACK PERIOD AND GHG INTENSITY OF THE OFFSHORE PROJECT

- 8.11.1.1 The carbon payback period represents the time required before displaced GHG emissions equal the life cycle GHG emissions for the Offshore Project, (i.e., the Offshore Project has saved more GHG emissions relative to electricity production by other means than will be produced by its construction, O&M, and decommissioning).
- 8.11.1.2 The GHG intensity and the payback period of the Offshore Project are estimated based on the available information, using the whole life GHG emissions and anticipated electricity generated by the wind farm across the operational life.
- 8.11.1.3 As set out in **Table 8-20**, the Offshore Project is expected to deliver significant lifecycle carbon savings through low-emission renewable electricity generation. Based on the estimated generation, the wind farm will have offset its lifecycle GHG emissions after approximately 49,798 GWh of electricity production. This milestone would be reached after approximately 30% of operational lifetime or around 120 months (~10 years) as shown in **Table 8-21**.
- 8.11.1.4 The GHG intensity estimated for the Offshore Project is 48 tCO₂e/GWh, which is substantially lower than conventional fossil-fuel-based generation methods. The GHG intensity of gas-fired conventional generation plants are typically estimated to be around 375 tCO₂e/GWh (DUKES, July 2024). A comparison of the carbon intensity of generation from a range of different electricity generation sources is provided in **Table 8-21**. Carbon intensity figures for these alternative generation sources are based on details reported in the Digest of UK Energy Statistics Table 5.14 (DUKES, July 2024).

Table 8-20 Key parameters of the Offshore Project including capacity, generation estimates, GHG emissions, and intensity based on worst-case scenario assumptions.

| Parameter | Value | Data Source |
|--|-----------|--|
| Total generation capacity of the Offshore Project (MW) | 900 | Assumed indicative value, informed by project parameters. |
| Load factor (%) | 62 | (DESNZ, THE CONTRACTS FOR DIFFERENCE (STANDARD TERMS) REGULATIONS 2014 CFD STANDARD TERMS NOTICE FOR THE SIXTH ALLOCATION ROUND, 6 March 2024) |
| Number of operational hours in a year (hours/year) | 8,353 | Aligned with project design parameters. |
| Predicted annual generation of the Offshore Project (GWh/yr) | 4,684 | Calculated value |
| Design life (yrs) | 35 | Aligned with project design parameters. |
| Predicted lifetime generation of the Offshore Project (GWh) | 163,923 | Calculated value |
| GHG emission of the Offshore Project (tCO ₂ e) | 7,908,275 | Calculated value |

| Parameter | Value | Data Source |
|---|-----------|---------------------|
| GHG intensity of the Offshore Project (tCO₂e/GWh) | 48 | Worst-case scenario |
| Emissions from all fossil fuels (tCO ₂ e/GWh) | 437 | (DUKES, July 2024) |
| Carbon reduction of Offshore Project (tCO ₂ e/year) | 2,046,701 | Calculated value |

Table 8-21 Comparison of GHG emissions from the Offshore Project against conventional fuel sources (coal, gas, and others), including annual and lifetime carbon reductions and carbon payback period.

| Fuel Source for Generation | Carbon Intensity (tCO ₂ e/GWh) | Estimated Annual GHG Emissions from generation (tCO ₂ e/GWh) | Estimated Operational Lifetime Emissions from generation (tCO ₂ e) | Net Difference vs Project (tCO ₂ e/yr) | Net Operational Lifetime Difference vs. Project (tCO ₂ e) |
|---|---|---|---|---|--|
| Project | 48 | 225,951 | 7,908,275 | N/A | N/A |
| Coal | 1,046 | 4,901,124 | 171,539,332 | 4,675,173 | 163,631,057 |
| Gas | 375 | 1,758,009 | 61,530,306 | 1,532,058 | 53,622,030 |
| All non-renewable fuels* | 437 | 2,046,655 | 71,632,908 | 1,820,704 | 63,724,632 |
| All fuels (including nuclear and renewables)** | 171 | 801,960 | 28,068,612 | 576,010 | 20,160,337 |
| Carbon Payback Period (GWh) – All fuels | | | | | 46,185 |
| % of operational lifetime – All fuels | | | | | 28 |
| Payback period (months) – All fuels | | | | | 118 |

* Coal, oil, gas and other solid fuels, including non-renewable waste.

** All fuels listed in DUKES Table 5.6 excluding net pumped storage supply and supply from net imports.

8.12 BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY

8.12.1.1 The use of electricity generated by the Offshore Project is a benefit that is reported beyond the lifecycle stages included within the construction, operation & maintenance and decommissioning stages summarised in Sections 8.8, 8.9, and 8.10. Details of this benefit are summarised in Section 8.11, which shows that the benefit of the lifetime electricity generation of the Offshore Project is larger than the emissions arising from the lifecycle stages.

8.12.1.2 Given a design lifetime of 35 years, and an estimated carbon payback of 10 years, the net outcome of the Offshore Project will be a reduction in overall GHG emissions.

8.12.1.3 On this basis the significance of effect of the entire Offshore Project is assessed as **Beneficial (Significant)**.

8.13 ASSESSMENT OF COMBINED EFFECTS

8.13.1.1 The combined effects assessment considers likely significant effects from multiple impacts and activities from the construction, O&M, and decommissioning phases of the Offshore Project on the same receptor, or group of receptors. The overall method following in identifying and assessing

potential Combined Effects in relation to the offshore environment is set out in **Chapter 5, Volume 1a**.

8.13.1.2 Combined effects could potentially arise in one of two ways. The first type of combined effect is a Project lifetime effect, where multiple phases of the Project (construction, O&M and decommissioning) interact to create a potentially more significant effect on a receptor than in one phase alone.

8.13.1.3 The second type of combined effect is receptor-led effects. Receptor-led effects are where effects from different environmental aspects combine spatially and temporally on a receptor. These effects may be short-term, temporary, transient, or longer-term.

8.13.1.4 Full results of the Project lifetime effects and receptor-led effects assessment can be found in **Chapter 23: Combined Effects Assessment, Volume 2a**.

8.14 CONSIDERATION OF ONSHORE TRANSMISSION WORKS PROJECT

8.14.1.1 A separate application for the Project's onshore elements (the OTW Project) that includes all infrastructure landwards of Mean Low Water Springs (MLWS) within the Onshore Transmission Works Boundary will be made, under the Town and Country Planning (Scotland) Act 1997 to Comhairle nan Eilean Siar (CnES). The OTW Project EIAR will provide a full description of the onshore elements of the Project landward of MLWS, and include an assessment of the associated likely significant effects.

8.14.1.2 This EIAR has considered the additive interactions between the Offshore Project and OTW Project to understand if there is the potential for any change to the assessment outcomes as a result of both elements of the Project. The approach to identify and consider potential interactions between the Offshore Project and OTW Project is set out in **Chapter 5, Volume 1a** and key design parameters associated with the OTW Project are summarised in **Chapter 3, Volume 1a**.

8.14.1.3 The potential for effects identified in **Table 8-3** to interact with effects associated with the OTW Project at a common receptor has been considered for the GHG assessment. **Table 8-22** provides a summary the pathways considered in this chapter and the potential for interaction. Where required, this table provides the relevant MDS information for the OTW Project that has been used to inform this assessment.

Table 8-22 Summary of Greenhouse Gas pathways and potential for interaction with the OTW Project

| Assessment pathways considered and receptors | Maximum Design Scenario |
|--|--|
| Construction | |
| <p>Resultant GHG emissions from the construction of the Offshore Project, together with the proposed Onshore Project, to the global atmosphere: <i>Materials [A1-A3], Transport of Material to Site [A4], Plant equipment used in construction works [A5], Staff travel to site [A5]</i></p> | <p><u>Offshore Project</u> See MDS table (see Table 8-13)</p> <p><u>OTW Project</u></p> <ul style="list-style-type: none"> - Up to 13 Horizontal Directional Drilling (HDD) entry points near a coastal cliff at Barvas/<i>Barabhas</i> (Scenario 2) - Transition Joint Bays - An onshore temporary construction HDD compound (approximately 465 m x 480 m) and associated temporary access road. - Up to 12 circuits of buried Onshore Cables will connect from the TJBs to the Landfall Substation located near Barvas/<i>Barabhas</i> (Scenario 2). - Construction of a permanent road access to the substation from A857 will be constructed. This road will be either removed and the land re-instated or transformed into a multi-use pathway post construction of the Onshore Cables. - Construction of a Landfall Substation with a platform of approximately 150 m by 150 m and a maximum height of 15 m, plus several other, smaller buildings housing electrical and other equipment. Within the site compound, there will also be safety features such as lightning masts and access paths/roads. |
| Operation and maintenance | |
| <p>Resultant GHG emissions from the operation and maintenance of the Offshore Project, together with the proposed OTW Project, to the global atmosphere: <i>Maintenance, repair and replacement activities [B2 – B5]</i></p> | <p><u>Offshore Project</u> See MDS table (see Table 8-13)</p> <p><u>OTW Project</u></p> <ul style="list-style-type: none"> - Repair and maintenance visits once per 3 years. |
| Decommissioning | |
| <p>Resultant GHG emissions from the decommissioning of Offshore Project, together with the proposed OTW Project, to the global atmosphere: <i>Decommissioning activities [C1 – C4]</i></p> | <p><u>Offshore Project</u> See MDS table (see Table 8-13)</p> <p><u>OTW Project</u></p> <ul style="list-style-type: none"> - Decommissioning activities for the OTW Project are not publicly available at this stage, however it is anticipated that decommissioning of the OTW Project will follow the waste hierarchy. |

Construction

Resultant GHG emissions from the Construction of the Offshore Project, together with the proposed Onshore Project, to the global atmosphere: Materials [A1-A3], Transport of Material to Site [A4], Plant equipment used in construction works [A5]; Staff travel to site [A5]

- 8.14.1.4 There is the potential for temporary adverse effects associated with the construction of the Offshore Project in combination with the OTW Project. The construction phase of the OTW Project will overlap with the construction phase of the Offshore Project.
- 8.14.1.5 The global atmosphere is the receptor for the GHG assessment. Emissions of GHGs to the atmosphere have the potential to contribute to climate change, and therefore the effects are global and cumulative in nature. This is considered in defining the receptor (i.e. the global atmosphere) as High sensitivity.
- 8.14.1.6 The GHG assessment for the Offshore Project has considered all relevant aspects of construction works offshore, up to MHWS to estimate the GHG assessment associated with GHG lifecycle stages. Following the inclusion of mitigation measures, the Offshore GHG assessment has concluded that the impact from the Offshore Project is Minor Adverse (Not Significant).
- 8.14.1.7 It is recognised that although full details of the OTW Project are not publicly available, there will be additional GHG emissions associated with the Project, in terms of embedded carbon in materials required to construct the onshore components, as identified in **Table 8-22**. However, it is anticipated that the magnitude of impact as a result of the Onshore Project will have a negligible contribution to the Fifth and Sixth Carbon Budgets. In-combination this will result in an effect which is **Minor Adverse (Not Significant)**, which is of no greater in significance than is concluded for the Offshore Project.

Operation and Maintenance

Resultant GHG emissions from the Construction of the Offshore Project, together with the proposed Onshore Project, to the global atmosphere: Maintenance, repair and replacement activities [B2 – B5]

- 8.14.1.8 There is the potential for temporary adverse effects associated with the O&M of the Offshore Project in combination with the OTW project. The O&M phase of the OTW Project will overlap with the construction phase of the Offshore Project.
- 8.14.1.9 If the haul road is transformed into a multi-use pathway, it has the potential to support a modal shift of transport use on the Island which promotes active travel.
- 8.14.1.10 The global atmosphere is the receptor for the GHG assessment. Emissions of GHGs to the atmosphere have the potential to contribute to climate change, and therefore the effects are global and cumulative in nature. This is considered in defining the receptor (i.e. the global atmosphere) as High sensitivity.

- 8.14.1.11 The GHG assessment for the Offshore Project has considered all relevant aspects of operation and maintenance works offshore, up to MHWS to estimate the GHG assessment associated with GHG lifecycle stages. Following the inclusion of mitigation measures, the Offshore GHG assessment has concluded that the impact from the Offshore Project is **Minor Adverse (Not Significant)**.
- 8.14.1.12 It is recognised that although full details of the OTW Project are not publicly available, there will be additional GHG emissions associated with the Project, in terms of embedded carbon in materials required to construct the onshore components, as identified in **Table 8-22**. However, it is anticipated that the magnitude of impact as a result of the Onshore Project will have a Negligible contribution to the Sixth Carbon Budget. In-combination this will result in an effect which is **Minor Adverse (Not Significant)**, which is of no greater in significance than is concluded for the Offshore Project.

Decommissioning

Resultant GHG emissions from the decommissioning of Offshore Project, together with the proposed OTW Project, to the global atmosphere: Decommissioning activities [C1 – C4]

- 8.14.1.13 For the Offshore Project, decommissioning activities are anticipated to follow the reverse of the construction phase. It is anticipated that a considerable amount of the OTW Project components would be recycled or repurposed, which, although involving some emissions from processing, is expected to result in a net reduction in greenhouse gas emissions compared to disposal or use of virgin materials. As such, as the Receptor is of High sensitivity, the effect on climate change is considered to be **Minor Adverse (Not Significant)** relative to a no-project baseline but represents a more sustainable end-of-life approach.
- 8.14.1.14 This conclusion is of no greater in significance than is concluded for the Offshore Project. Further quantification of the impacts and mitigations emission reduction potential should be undertaken as the decommissioning plan is developed further.

8.15 ASSESSMENT OF CUMULATIVE EFFECTS

- 8.15.1.1 The global atmosphere is the receptor for the GHG assessment. Emissions of GHGs to the atmosphere have the potential to contribute to climate change, and therefore the effects are global and cumulative in nature. This is considered in defining the receptor (i.e. the global atmosphere) as high sensitivity.
- 8.15.1.2 The IEMA guidance (IEMA, 2022) states that effects of GHG emissions from specific cumulative projects should not be individually assessed, as there is no basis for selecting which projects to assess cumulatively over any other. The GHG assessment is therefore considered to be inherently cumulative, and no additional consideration of cumulative effects is required.

8.16 TRANSBOUNDARY EFFECTS

8.16.1.1 Transboundary effects occur when a development in one European Economic Area (EEA) State impacts the environment of another EEA State(s). A screening of potential transboundary effects was undertaken within the Scoping Report.

8.16.1.2 The Greenhouse Gas assessment assesses the effects of GHG emissions on the global atmosphere as a receptor and therefore there is no basis for assessing impacts on other EEA States.

8.17 SUMMARY OF RESIDUAL EFFECTS

8.17.1.1 **Table 8-23** presents a summary of the assessment of significant impacts, relevant mitigation measures, and residual effects on the global atmosphere (as the single receptor relevant to GHG emissions).

Table 8-23 Summary of residual effects for the Greenhouse Gases assessment

| Activity and impact | Receptor | Embedded mitigation measures | Significance of effect (significance) | Further environmental mitigation | Significance of residual effect (significance) |
|--|-------------------|------------------------------|---|----------------------------------|--|
| Construction | | | | | |
| Construction activities [A1 – A5] | Global atmosphere | M002, M005, M019, M022 | Minor Adverse (Not Significant) | N/A | Minor Adverse (Not Significant) |
| Operation | | | | | |
| Operational activities [B1, B2 – B5] | Global atmosphere | M025 | Minor Adverse (Not Significant) | N/A | Minor Adverse (Not Significant) |
| Decommissioning | | | | | |
| Decommissioning activities [C1-C4] | Global atmosphere | M020 | Minor Adverse (Not Significant) | N/A | Minor Adverse (Not Significant) |
| Benefits/Loads Beyond System Boundary | | | | | |
| Exported electricity [D2] | Global atmosphere | N/A | Beneficial (Significant) | N/A | Beneficial (Significant) |



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8.18 GLOSSARY OF TERMS AND ABBREVIATIONS

8.18.1.1 A list of key terms and acronyms used in this chapter are provided in **Table 8.24** and **Table 8.25**.

Table 8.24 Acronyms and abbreviations

| Term | Definition |
|-------------------|--|
| BSI | British Standards Institution |
| CBRA | Cable Burial Risk Assessment |
| C | Carbon emissions factor |
| CO ₂ | Carbon Dioxide |
| CO ₂ e | Carbon Dioxide Equivalent |
| DEFRA | Department for the Environment, Food and Rural Affairs |
| DESNZ | Department for Energy Security and Net Zero |
| EIA | Environmental Impact Assessment |
| EIAR | Environmental Impact Assessment Report |
| EMP | Environmental Management Plan |
| EPD | Environmental Product Declaration |
| GHG | Greenhouse Gases |
| HDD | Horizontal Direct Drilling |
| HDPE | High Density Polyethylene |
| ICE | Inventory of Carbon and Energy |
| IEMA | Institute of Environmental Management & Assessment |
| LCA | Life Cycle Assessment |
| MD-LOT | Marine Directorate Licensing Operations Team |
| MDS | Maximum Design Scenario |
| MSL | Mean Sea Level |
| No. | Number |
| O&M | Operation and Maintenance |
| OCAS | Offshore Cable Area of Search |
| OSP | Offshore Substation Platform |
| PAS | Publicly Available Standard |
| PDE | Project Design Envelope |
| RICS | Royal Institution of Chartered Surveyors |
| SFC | Specific Fuel Consumption |
| SOV | Service Operation Vessel |
| SSEN | Scottish and Southern Electricity Networks |
| TJBs | Transition Joint Bays |
| UK | United Kingdom |
| WLCA | Whole Life Carbon Assessment |
| WTG | Wind Turbine Generator |

Table 8.25 Glossary

| Term | Meaning |
|---|---|
| the Applicant | Spiorad na Mara Limited (the Project owner) |
| Array Area | The offshore area within which the offshore wind turbine generators (WTGs), associated foundations, Offshore Cables, and Offshore Substation Platform (OSP) (if required), will be located. This area encompasses the Turbine Area that will contain all above water surface infrastructure (WTGs / OSP) and an additional area within which further below water infrastructure (foundations and cables) may also be located. |
| Array Cables | The offshore electrical and communication cables that connect infrastructure located within the Array Area, for: <ul style="list-style-type: none"> • Scenario 1: Array Cables will be used to connect Wind Turbine Generators (WTGs) to each other, and to connect WTGs to the OSP. • Scenario 2: Array Cables will be used to connect WTGs to each other. |
| Array Cables to Landfall | The offshore electrical and communication cables located in the Array Area and Offshore Cables Area of Search that connect the wind turbine generators (WTGs) directly to Landfall for Scenario 2. |
| Carbon | A chemical element with the symbol C and atomic number 6. 'Carbon' is used as short-hand to refer to the six greenhouse gases (GHGs) recognised by the Kyoto Protocol. GHGs are converted to CO ₂ e based on their global warming potential per unit as compared to one unit of CO ₂ . |
| Carbon dioxide equivalent (CO ₂ e) | Carbon dioxide equivalent (CO ₂ e) is a term for describing different GHGs in a common unit. For any quantity and type of GHG, CO ₂ e represents the amount of carbon dioxide (CO ₂) which would have the equivalent global warming impact. |
| Carbon payback period | The period required before displaced GHG emissions equal the life cycle GHG emissions for the Project. |
| Combined Effects | Combined effect of the individual development on one particular receptor; for example noise, dust and visual. This includes Project-Lifetime Effects and Receptor-Led Effects. |
| Cumulative Effects | Considers the likely significant effects of multiple impacts and activities from several developments. |
| Cumulative Effects Assessment (CEA) | Assessment of effects as a result of the incremental changes caused by other past, present and reasonably foreseeable human activities and natural processes together with the Offshore Project. |
| Cumulative impact | Impacts resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the Offshore Project. |
| Decommissioning phase | The period during which a development and its associated processes are withdrawn from service. |

| Term | Meaning |
|---|---|
| Embodied carbon | The embodied carbon describes the carbon footprint of a material, allowing for the sum of the energy required in resource extraction, and any processing required, as well as the transport and supply logistics to the factory gate (prior to transport to the Project for use), to be accounted for within the overall GHG estimation. |
| Effect | Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria |
| EIA Regulations | <p>Terminology used in the Environmental Impact Assessment Report to refer to three sets of EIA regulations:</p> <ul style="list-style-type: none"> • The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017, with regard to the Section 36 consent application for the Offshore Project; • The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017, in relation to the Offshore Project with regard to marine licence applications; • Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017, with regard to consent for the Onshore Transmission Works (OTW). |
| Environmental Impact Assessment Report (EIAR) | The Environmental Impact Assessment Report (EIAR) prepared to assess the likely significant effects of the Project on the environment. |
| Embedded or 'Designed-in' Mitigation | Mitigation measures to avoid or reduce environmental effects that are directly incorporated into the preferred design for the Project. This can include standard practice in accordance with or without guidance. Embedded Mitigation is considered as part of the impact assessment, before effect significance is identified. |
| Embodied Carbon | The embodied carbon describes the carbon footprint of a material, allowing for the sum of the energy required in resource extraction, and any processing required, as well as the transport and supply logistics to the factory gate (prior to transport to the Project for use), to be accounted for within the overall GHG estimation. |
| Export Cable | The offshore electrical and communication cables located in the Array Area and Offshore Cables Area of Search that connect the Offshore Substation Platform (OSP) (if required) to Landfall for Scenario 1. |
| Future Baseline | Refers to the situation in future years without the Offshore Project. |
| Global Warming Potential | A measure of how much heat a greenhouse gas traps in the atmosphere over a specific time period, relative to carbon dioxide (CO ₂). |
| Greenhouse Gas (GHG) emissions | GHG emissions are determined by the Kyoto Protocol (1997) to include six categories of gases: carbon dioxide, methane, nitrous oxide, F-gases (hydrofluorocarbons and perfluorocarbons), sulphur hexafluoride and nitrogen trifluoride. To provide consistent reporting |

| Term | Meaning |
|--|--|
| | of these gases, each is weighted by its global warming potential and converted to a carbon dioxide equivalent (CO ₂ e). |
| Greenhouse Gas (GHG) emission factor | The GHG emissions factors relate a given level of activity, or amount of fuel, energy or materials used, to the mass of GHGs released as a consequence. It is measured in the amount of GHG emissions (in gCO ₂ e, tCO ₂ e, ktCO ₂ e, MtCO ₂ e, etc.) relative to the activity unit (e.g. tonnes, km, kgs etc.). |
| Institute of Sustainability and Environmental Professionals (ISEP) | ISEP is an international membership organisation for environment and sustainability professionals (formerly known as IEMA). |
| Landfall | This consists of works from offshore Horizontal Directional Drill (HDD) exit pits (located below MLWS) to onshore at the Transition Joint Bays (TJB) (located above MHWS). The infrastructure and installation methods associated with the Landfall involves both onshore and offshore components. |
| Landfall Exit Pit Area | The offshore area in which all HDD Exit Pits will be located within. |
| Landfall Substation | The optional onshore substation located on the west side of the Isle of Lewis/ <i>Eilean Leòdhais</i> . Includes the platform, buildings and associated components which allows the voltage to be increased to meet onward transmission requirements. |
| Likely Significant Effects | With respect to the Electricity Works (EIA (Scotland) Regulations 2017 and The Marine Works (EIA) Regulations 2017, a significant effect that may reasonably be predicted as a consequence of a plan or project, on the receiving environment. |
| Maximum Design Scenario | The scenario within the Project Design Envelope with the potential to result in the greatest impact on a particular topic receptor, and therefore the one that should be assessed for that topic receptor. See Chapter 3: Project Description, Volume 1a for detailed description. |
| Offshore Application | The application for a marine licence under the Marine (Scotland) Act 2010 (between 0 and 12nm) and a Section 36 consent under the Electricity Act 1989. |
| Offshore Cables | Electrical and communication cables located within the Array Area and Offshore Cable Area of Search. The Offshore Cables consist of Array Cables, Array Cables to Landfall, and Export Cables. |
| Offshore Cable Area of Search (OCAS) | The area within which the offshore cable infrastructure between the Array Area and Landfall up to Mean High Water Springs (MHWS) will be located. |
| Offshore Landfall Area | The area seaward of Mean High Water Springs (MHWS) within the Offshore Cable Area of Search (OCAS) that includes works associated with the Horizontal Directional Drill (HDD) installation, including HDD exit pit(s) (located below MLWS) and offshore cable connection to the onshore (TJB) (located above MHWS). |

| Term | Meaning |
|--|--|
| Offshore Project | The offshore components of the Spiorad na Mara offshore wind farm (the Project) located seaward of Mean High Water Springs (MHWS). |
| Offshore Project Boundary | The 'red line boundary' encompassing the Offshore Project. |
| Offshore Substation Platform (OSP) | The optional offshore substation located within the Turbine Area. Includes the platform and associated components which allows the voltage to be increased to meet onward transmission requirements. |
| Offshore Wind Farm (OWF) | A group of WTGs located offshore. |
| Onshore | Pertaining to landward of MLWS. |
| Onshore Application | The application for consent under the Town and Country Planning (Scotland) Act 1997 (as amended). |
| Onshore Transmission Works (OTW) / Onshore Project | The onshore components of the Spiorad na Mara offshore wind farm (the Project) located landward of Mean Low Water Springs (MLWS). The Applicant will seek consent for the OTW Project through a separate application and so does not form part of this application. |
| Operation and Maintenance (O&M) phase | The period during which a development is operational and being maintained. |
| Project | The Spiorad na Mara offshore wind farm development. This term describes the whole development, including all offshore and onshore components. |
| Project Boundary | The 'red line boundary' encompassing all offshore and onshore components of the Project. |
| Project Design Envelope (PDE) | A description of the range of possible components that make up the Project design options under consideration when the exact engineering parameters are not yet known. |
| Receptor | Any physical, biological or anthropogenic element of the environment that may be affected or impacted by the Project. Receptors can include natural features such as the seabed and wildlife habitats as well as man-made features like fishing vessels and cultural heritage sites. |
| Receptor-Led Effects | Assessment of the scope for all combined effects to interact, spatially and temporally, to create an effect on a receptor of greater significance than when the effects are considered in isolation. Receptor-led effects may be short term, temporary or transient effects, or incorporate longer term effects. |
| Scoping Opinion | A report presenting the written opinion of the Scottish Ministers, with input from Comhairle nan Eilean Siar (CnES) for the OTW, as to the scope and level of detail of information to be provided in the Environmental Impact Assessment (EIA) for the Project. |
| Scoping Report | A document submitted by a developer that outlines the potential environmental issues and effects of a proposed project to determine which topics, methods, and level of detail should be included in the full Environmental Impact Assessment (EIA). |

| Term | Meaning |
|---|---|
| Scottish and Southern Electricity Networks (SSEN) Lewis Hub | This is the National Grid Electricity Transmission (NGET) interface. A transmission system operator substation into which the Project will connect for onward transmission through the existing grid network. |
| Significance | A measure of the importance of the environmental effect, defined by criteria specific to the environmental aspect. |
| Significant effect | <p>It is a requirement of the EIA Regulations 2017 to determine the likely significant effects of the development on the environment, which should relate to the level of an effect and the type of effect. Where possible significant effects should be mitigated.</p> <p>The significance of an effect gives an indication as to the degree of importance (based on the magnitude of the effect and the sensitivity of the receptor) that should be attached to the impact described. Whether or not an effect should be considered significant is not absolute and requires the application of professional judgement. Significant – ‘noteworthy, of considerable amount or effect or importance, not insignificant or negligible’ (The Concise Oxford Dictionary).</p> <p>Those levels and types of landscape and visual effect likely to have a major or important / noteworthy or special effect of which a decision maker should take particular note.</p> |
| Study Areas | Study Areas are determined for each technical discipline and are described within each technical chapter. |
| Transboundary effects | Assessment of changes to the environment caused by the combined effect of past, present and future human activities and natural processes on other European Economic Area Member States. |
| Turbine Area | A reduced area within the Array Area where above water surface infrastructure would be located i.e. wind turbine generators (WTG) or Offshore Substation Platform (OSP) (if required). This area has been developed and refined through stakeholder consultation and environmental assessment. |
| Wind Turbine Generator (WTG) | The wind turbines that generate electricity consisting of tubular towers and blades attached to a nacelle housing mechanical and electrical generating equipment. |

8.19 REFERENCES

Autronica (2024). Argonite - inert gas suppression systems. [Online] Available at: <https://product.autronicafire.com/products/fire-suppression-systems/argonite-inert-gas-suppression-systems/> [Accessed January 2026].

Department for Energy Security and Net Zero, 2023. National Policy Statement for renewable energy infrastructure (EN-3). [Online] Available at: <https://www.gov.uk/government/publications/national-policy-statement-for-renewable-energy-infrastructure-en-3> [Accessed January 2026].

Energy and Climate Change Directorate, 2017. Scottish Energy Strategy: The future of energy in Scotland. [Online] Available at: <https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/> [Accessed January 2026].

European Parliament and the Council of the European Union, 2018. Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources. [Online] Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG [Accessed January 2026].

British Standards Institution (BSI), 2023. Carbon Management in Infrastructure and Built Environment - PAS 2080. [Online] Available at: <https://www.bsigroup.com/en-GB/insights-and-media/insights/brochures/pas-2080-carbon-management-in-infrastructure-and-built-environment/> [Accessed January 2026].

Building Design, 2017, CPD 6 2017: Sustainable steel buildings, <https://www.bdonline.co.uk/cpd/cpd-6-2017-sustainable-steel-buildings/5087723.article> [Accessed January 2026].

Cathwell, n.d. Sacrificial Anodes for Seawater Applications. [Online] Available at: <https://cathwell.com/product-category/wind-turbines/sacrificial-anodes-wind-turbines/anodes-sacrificial-anodes-wind-turbines/> [Accessed January 2026].

Chapman, S. S. B., 2015. Carbon assessment of wind power. Environmental Science, Engineering.

DEFRA, n.d. Emissions Factors Toolkit. [Online] Available at: <https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/> [Accessed January 2026].

Department for Energy Security and Net Zero, 2023. National Policy Statements for energy infrastructure. [Online] Available at: <https://www.gov.uk/government/collections/national-policy-statements-for-energy-infrastructure> [Accessed January 2026].

Department for Energy Security and Net Zero, 2024. UK local authority and regional greenhouse gas emissions statistics, 2005 to 2022. [Online] Available at: <https://www.gov.uk/government/statistics/uk-local-authority-and-regional-greenhouse-gas-emissions-statistics-2005-to-2022> [Accessed January 2026].

Department for Energy Security and Net Zero, 6 March 2024. The Contracts for Difference (Standard Terms) Regulations 2014 CFD Standard Terms Notice for the Sixth Allocation Round. [Online] Available at: <https://assets.publishing.service.gov.uk/media/65e85ee662ff48001a87b243/cfd-ar6-standard-terms-notice.pdf> [Accessed January 2026].

Department for Energy Security and Net Zero, July 2024. Greenhouse gas reporting: conversion factors 2024. [Online] Available at: <https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2024> [Accessed January 2026].

Department for Energy Security and Net Zero, July 2024. Digest of UK Energy Statistics (DUKES). [Online] Available at: https://www.data.gov.uk/dataset/894d91a9-5d13-4220-b9a2-e124e6436304/digest_of_uk_energy_statistics [Accessed January 2026].

Energy and Climate Change Directorate, 2017. Climate change: legislation. [Online] Available at: <https://www.gov.scot/publications/climate-change-legislation/> [Accessed January 2026].

Energy and Climate Change Directorate, 2020. Offshore Wind Policy Statement. [Online] Available at: <https://www.gov.scot/publications/offshore-wind-policy-statement/> [Accessed January 2026].

Energy and Climate Change Directorate, n.d. Reducing greenhouse gas emissions. [Online] Available at: <https://www.gov.scot/policies/climate-change/reducing-emissions/> [Accessed January 2026].

Environmental Product Declaration (EPD) Library. [Online] Available at: <https://api.environdec.com/api/v1/EPDLibrary/Files/4afd723c-2d04-47b7-f4b0-08da17f54cd6/Data> [Accessed January 2026].

Flamco, 2013. J-Tube Product sheet. [Online] Available at: https://flamcogroup.com/media/files/documentation/doc_exp_dimensionsandweightstubes.pdf [Accessed January 2026].

Government, U., 2017. The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017. [Online] Available at: <https://www.legislation.gov.uk/ssi/2017/102/contents/made> [Accessed January 2026].

Greenhouse Gas Protocol, 2004. Corporate Standard. [Online] Available at: <https://ghgprotocol.org/corporate-standard> [Accessed January 2026].

Harrison, GP, Maclean, EJ, Karamanlis, S & Ochoa, LF 2010, 'Life cycle assessment of the transmission network in Great Britain', Energy Policy, vol. 38, no. 7, pp. 3622-3631. <https://doi.org/10.1016/j.enpol.2010.02.039> [Accessed January 2026].

HDPE Datasheet, n.d. [Online] Available at: <https://www.directplastics.co.uk/pub/pdf/datasheets/HDPE%20Data%20Sheet.pdf> [Accessed January 2026].

Hsin-Hung Chen, R.-Y. Y. H.-H. H., 2014. Study of Hard and Soft Countermeasures for Scour Protection of the Jacket-Type Offshore Wind Turbine Foundation. *Journal of Marine Science and Engineering*, 2(3), pp. 551-567.

Institute of Environmental Management and Assessment (IEMA), 2022. Environmental Impact: Assessing Greenhouse Gas Emissions and Evaluating their Significance. [Online] Available at: <https://www.iema.net/resources/blogs/2022/02/28/iema-launch-of-the-updated-eia-guidance-on-assessing-ghg-emissions-february-2022/> [Accessed January 2026].

IPCC AR6, 2022. Climate Change 2022, Mitigation of Climate Change. [Online] Available at: https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_FullReport.pdf [Accessed January 2026].

IPCC, 2014. Technology-specific Cost and Performance Parameters: Table A.III.2 Emissions of selected electricity supply technologies (gCO₂eq/kWh) Available at: https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf#page=7 [Accessed January 2026].

Marine Directorate - Licensing Operations Team, 2024. Scoping Opinion adopted by the Scottish Ministers under: The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 And The Marine Works (Environmental Impact Assessment) (Scotland) Regulations 2017 - Spiorad na Mara Offshore Wind Farm.

Mianzan, E., 2023. Spiorad na Mara Offshore Wind Farm. [Online] Available at: <https://marine.gov.scot/node/24540> [Accessed January 2026].

Product Environmental Profile (2024). [Online] Available at: [UPS Battery Environmental Performance PEP-ecopassport](#) [Accessed January 2026].

RICS, 2020. Benchmarking in the infrastructure sector. [Online] Available at: <https://www.rics.org/content/dam/ricsglobal/documents/to-be-sorted/benchmarking-in-the-infrastructure-sector---1st-edition.pdf> [Accessed January 2026].

Royal Institution of Chartered Surveyors (RICS), 2023. Whole life carbon assessment for the built environment. [Online] Available at: <https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/whole-life-carbon-assessment> [Accessed January 2026].

Scottish Environment Protection Agency v2.14.1. Full carbon calculator for wind farms on peatlands - Version 2.14.1. [Online] Available at: <https://www.gov.scot/publications/carbon-calculator-for-wind-farms-on-scottish-peatlands-factsheet/> [Accessed January 2026].

Siemens Gamesa Renewable Energy, 2023. Environmental Product Declaration - Electricity from a European offshore wind farm using SG 14-222 wind turbines. [Online] Available at: <https://api.environdec.com/api/v1/EPDLibrary/Files/c84b3d1c-6bc9-4e74-da39-08dbb377d685/Data> [Accessed January 2026].

Spiorad na Mara Ltd, 2023. Spiorad na Mara Offshore Wind Farm Scoping Report.

UK Government, 2008. The Climate Change Act 2008 (2050 Target Amendment) Order 2019. [Online] Available at: <https://www.legislation.gov.uk/ukdsi/2019/9780111187654> [Accessed January 2026].

UK Government, 2017. The Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2017. [Online] Available at: <https://www.legislation.gov.uk/ssi/2017/102/contents> [Accessed January 2026].

UK Government, 2019. Climate Change (Emissions Reduction Targets) (Scotland) Act 2019. [Online] Available at: <https://www.legislation.gov.uk/asp/2019/15/enacted> [Accessed January 2026].

UK Government, 2024. Planning practice guidance. [Online] Available at: <https://www.gov.uk/government/collections/planning-practice-guidance> [Accessed January 2026].

United Nations, 1992. United Nations Framework Convention on Climate Change. [Online] Available at: <https://unfccc.int/resource/docs/convkp/conveng.pdf> [Accessed January 2026].

University of Strathclyde, G., n.d. Steel Jacket Structure - Typical Design. [Online] Available at: https://www.esru.strath.ac.uk/EandE/Web_sites/98-9/offshore/steel.htm [Accessed January 2026].

Vestas, 2024. Life Cycle Assessment of Electricity Production from an offshore V236-15 MW Wind Plant. [Online] Available at: <https://www.vestas.com/content/dam/vestas-com/global/en/sustainability/environment/LCA%20of%20Electricity%20Production%20from%20an%20offshore%20V236-15MW.pdf.coredownload.inline.pdf> [Accessed January 2026].

Wood, Ramboll, Cowi (2020). The use of PFAS and fluorine-free alternatives in fire-fighting foams. [Online] Available at: https://echa.europa.eu/documents/10162/28801697/pfas_flourine-free_alternatives_fire_fighting_en.pdf/d5b24e2a-d027-0168-cdd8-f723c675fa98 [Accessed January 2026].