# White Cross Offshore Wind Farm Environmental Statement

## Chapter 25: Climate Change

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## Table of Contents



## Table of Tables

## Appendices

## Glossary of Acronyms

| Acronym | Definition |
|---|---|
| **BEIS** | Department for Business, Energy and Industrial Strategy |
| **CCC** | Committee on Climate Change |
| **CCRA** | Climate Change Resilience Assessment |
| **CEA** | Cumulative Effects Assessment |
| **COP** | Conference of Parties |
| **$CO_2$** | Carbon dioxide |
| **$CO_2e$** | Carbon dioxide-equivalent |
| **DECC** | Department for Energy and Climate Change |
| **Defra** | Department for Environment, Food and Rural Affairs |
| **EIA** | Environmental Impact Assessment |
| **ES** | Environmental Statement |
| **EU** | European Union |
| **GHG** | Greenhouse Gas |
| **GW** | Gigawatts |
| **GWP** | Global Warming Potential |
| **IAC** | Inter-array Cable |
| **ICE** | Inventory of Carbon and Energy |
| **IEMA** | Institute of Environmental Management and Assessment |
| **IPC** | Infrastructure Planning Commission |
| **IPCC** | Intergovernmental Panel on Climate Change |
| **km** | Kilometre |
| **$km^2$** | Square kilometre |
| **LCA** | Life Cycle Analysis |
| **LPA** | Local Planning Authority |
| **m** | Metre |
| **MCCIP** | Marine Climate Change Impact Partnership |
| **MGO** | Marine Gas Oil |
| **MHWS** | Mean High-Water Springs |
| **MMO** | Marine Management Organisation |
| **MW** | Megawatts |
| **NAP** | National Adaptation Programme |
| **NPS** | National Policy Statement |
| **NPPF** | National Planning Policy Framework |
| **NREL** | National Renewable Energy Laboratory |
| **NRMM** | Non-road Mobile Machinery |
| **O&M** | Operation and Maintenance |
| **OSP** | Offshore Substation Platform |

| Acronym | Definition |
| --- | --- |
| **RCP** | Representative Concentration Pathways |
| **UK** | United Kingdom |
| **UKCP18** | UK Climate Projections 2018 |
| **UNFCCC** | United Nations Framework Convention on Climate Change |

## Glossary of Terminology

| Defined Term | Description |
|---|---|
| **Applicant** | Offshore Wind Limited |
| **Commitment** | A term used interchangeably with mitigation. Commitments are Embedded Mitigation Measures. Commitments are either Primary (Design) or Tertiary (Inherent) and embedded within the assessment at the relevant point in the EIA (e.g. at Scoping). The purpose of commitments is to reduce and/or eliminate Likely Significant Effects (LSE's), in EIA terms. |
| **$CO_2$e** | Carbon dioxide equivalent is a metric measure that is used to compare emissions from various greenhouse gases (GHGs) on the basis of their global warming potential by converting amounts of other GHGs to the equivalent amount of carbon dioxide ($CO_2$). |
| **Cumulative effects** | The effect of the Project taken together with similar effects from a number of different projects, on the same single receptor/resource. Cumulative impacts are those that result from changes caused by other past, present or reasonably foreseeable actions together with the Project. |
| **Department for Business, Energy and Industrial Strategy (BEIS)** | Government department that is responsible for business, industrial strategy, science and innovation and energy and climate change policy and consent under Section 36 of the Electricity Act. |
| **Project Design Envelope** | A description of the range of possible elements that make up the Project design options under consideration. The Project Design Envelope, or 'Rochdale Envelope' is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact parameters are not yet known but a bounded range of parameters are known for each key project aspect. |
| **Development Area** | The area comprising the Onshore Development Area and the Offshore Development Area |
| **Environmental Impact Assessment (EIA)** | Assessment of the potential impact of the proposed Project on the physical, biological and human environment during construction, operation and decommissioning. |
| **Export Cable Corridor** | The area in which the export cables will be laid, either from the Offshore Substation or the inter-array cable junction box (if no offshore substation), to the WPD Onshore Substation comprising both the Offshore Export Cable Corridor and Onshore Export Cable Corridor. |
| **Floating substructure** | The floating substructure acts as a stable and buoyant foundation for the WTG. The WTG is connected to the substructure via the transition piece and the substructure is kept in position by the mooring system. |
| **Generation Assets** | The infrastructure of the Project related to the generation of electricity within the windfarm site, including wind turbine generators, substructures, mooring lines, seabed anchors and inter-array cables |
| **g $CO_2e.kWh^{-1}$** | Grams (g) of carbon dioxide equivalent ($CO_2$e) per kilowatt-hour (kWh) of electricity generated |

| Defined Term | Description |
|---|---|
| **In-combination effects** | In-combination effects are those effects that may arise from the development proposed in combination with other plans and projects proposed/consented but not yet built and operational. |
| **Inter-array cables** | Cables which link the wind turbines to each other and the Offshore Substation Platform, or at the inter-array cables junction box (if no offshore substation). Array cables will connect the wind turbines to one and other and to the Offshore Substation (if utilised). The initial section for the inter-array cables will be freely suspended in the water column below the substructure (dynamic sections) while the on seabed sections of the cables will be buried where possible. |
| **Landfall** | Where the offshore export cables come ashore |
| **Load Factor** | The load factor is the actual output of a turbine benchmarked against its theoretical maximum output in a year. The load factor for new build offshore wind (2025 to 2029) is 63.1%, as outlined in Appendix 3 of the 'Contracts for Difference Scheme for renewable electricity generation Allocation Round 4: Allocation Framework, 2021' (BEIS, 2021d) |
| **Mean high water springs** | The average tidal height throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest. |
| **Mean low water springs** | The average tidal height throughout a year of two successive low waters during those periods of 24 hours when the range of the tide is at its greatest. |
| **Mean sea level** | The average tidal height over a long period of time. |
| **Mooring system** | The equipment (mooring lines and seabed anchors) that keeps the floating substructure in position during operation through a fixed connection to the seabed. |
| **Mitigation** | A term used interchangeably with Commitment(s). Mitigation measures (Commitments) are embedded within the assessment at the relevant point in the EIA (e.g. at Scoping). |
| **Offshore Development Area** | The Windfarm Site (including wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and Offshore Export Cable Corridor to MHWS at the Landfall. This encompasses the part of the project that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009 |
| **Offshore Export Cables** | The cables which bring electricity from the Offshore Substation Platform or the inter-array cables junction box to the Landfall |
| **Offshore Export Cable Corridor** | The proposed offshore area in which the export cables will be laid, from Offshore Substation Platform or the inter-array cable junction box to the Landfall |
| **Offshore Infrastructure** | All of the offshore infrastructure including wind turbine generators, substructures, mooring lines, seabed anchors, Offshore Substation Platform and all cable types (export and inter-array). This encompasses |

| Defined Term | Description |
|---|---|
| | the infrastructure that is the focus of this application and Environmental Statement and the parts of the project consented under Section 36 of the Electricity Act and the Marine and Coastal Access Act 2009 |
| **Offshore Substation Platform** | A fixed structure located within the Windfarm Site, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore |
| **Offshore Transmission Assets** | The aspects of the project related to the transmission of electricity from the generation assets including the Offshore Substation Platform (as applicable)) or offshore junction box, Offshore Export Cable Corridor to MHWS at the landfall |
| **Offshore Transmission Owner** | An OFTO, appointed in UK by Ofgem (Office of Gas and Electricity Markets), has ownership and responsibility for the transmission assets of an offshore windfarm. |
| **Onshore Development Area** | The onshore area above MLWS including the underground onshore export cables connecting to the White Cross Onshore Substation and onward to the WPD grid connection at East Yelland. The onshore development area will form part of a separate Planning application to the Local Planning Authority (LPA) under the Town and Country Planning Act 1990 |
| **Onshore Export Cables** | The cables which bring electricity from MLWS at the Landfall to the White Cross Onshore Substation and onward to the WPD grid connection at East Yelland |
| **Onshore Export Cable Corridor** | The proposed onshore area in which the export cables will be laid, from MLWS at the Landfall to the White Cross Onshore Substation and onward to the WPD grid connection at East Yelland |
| **Onshore Infrastructure** | The combined name for all infrastructure associated with the Project from MLWS at the Landfall to the WPD grid connection point at East Yelland. The onshore infrastructure will form part of a separate Planning application to the Local Planning Authority (LPA) under the Town and Country Planning Act 1990 |
| **Onshore Transmission Assets** | The aspects of the project related to the transmission of electricity from MLWS at the Landfall to the WPD grid connection at East Yelland including the Onshore Export Cable, the White Cross Onshore Substation and onward connection to the WPD grid connection at East Yelland |
| **Project** | The Project for the offshore Section 36 and Marine Licence application includes all elements offshore of MHWS. This includes the infrastructure within the windfarm site (e.g. wind turbine generators, substructures, mooring lines, seabed anchors, inter-array cables and Offshore Substation Platform (as applicable)) and all infrastructure associated with the export cable route and landfall (up to MHWS) including the cables and associated cable protection (if required). |
| **Safety zones** | A marine zone outlined for the purposes of safety around a possibly hazardous installation or works / construction area |
| **Scour protection** | Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water |

| Defined Term | Description |
|---|---|
| **White Cross Offshore Windfarm** | Up to 100MW capacity offshore windfarm including associated onshore and offshore infrastructure |
| **White Cross Onshore Substation** | A new substation built specifically for the White Cross project. It is required to ensure electrical power produced by the offshore windfarm is compliant with WPD electrical requirements at the grid connection at East Yelland. |
| **Wind Turbine Generators (WTG)** | The wind turbine generators convert wind energy into electrical power. Key components include the rotor blades, naccelle (housing for electrical generator and other electrical and control equipment) and tower. The final selection of project wind turbine model will be made post-consent application |
| **Windfarm Site** | The area within which the wind turbines, Offshore Substation Platform and inter-array cables will be present |
| **Works completion date** | Date at which construction works are deemed to be complete and the windfarm is handed to the operations team. In reality, this may take place over a period of time. |

# 25. Climate Change

## 25.1 Introduction

1. This chapter of the Environmental Statement (ES) presents the impact of the Offshore Project (seaward of Mean High Water Spring (MHWS)) of White Cross Offshore Windfarm Project (hereafter referred to as 'the Offshore Project') on climate change. The chapter comprises a greenhouse gas (GHG) assessment and climate change resilience assessment (CCRA) of its construction, operation and maintenance, and decommissioning phases.

2. This chapter differs slightly to the assessment presented in other topics of the ES, as instead of the impact on a specific receptor being considered, it considers (a) the impacts of the Project on climate change, through a GHG assessment, and (b) any potential impact of climate change on the Project, through a CCRA. The GHG assessment predicts the contribution of the offshore aspects of the Project to national and regional GHG emissions in England and the UK, and its 'net effect' compared to a baseline of 'do nothing'. The CCRA considers the resilience of the design and infrastructure associated with the Project to the projected effects of climate change over the lifespan of the Project.

3. The ES has been finalised with due consideration of pre-application consultation to date (see **Chapter 7: Consultation**) and the ES will accompany the application to the Marine Management Organisation (MMO) on behalf of the Secretary of State for Business for The Department for Business, Energy and Industrial Strategy (BEIS) for Section 36 Consent and relevant Marine Licenced under the Marine and Coastal Access Act 2009.

4. This ES chapter:

- Presents the existing environmental baseline (**Section 25.4**)
- Presents the potential environmental effects (a) on climate change arising from the Project and (b) of climate change on the Project, based on the information gathered and the analysis and assessments undertaken
- Identifies any assumptions and limitations encountered in compiling the environmental information (**Section 25.3.8**)
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

5. This GHG assessment was undertaken in accordance with Institute of Environmental Management and Assessment (IEMA) 'Guide: Assessing Greenhouse Gas Emissions and Evaluating their Significance' (IEMA, 2022). This guidance document provides a topic-specific methodology for assessment of GHGs and determining the significance of GHG emissions generated by a project, and therefore the assessment methodology differs from that presented in **Chapter 6: EIA Methodology**.

6. The CCRA was undertaken in accordance with methodology provided in IEMA's 'Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation' guidance (IEMA, 2020).

## 25.2 Policy, Legislation and Guidance

7. **Chapter 3: Policy and Legislative Content** describes the wider policy and legislative context for the Project. The principal policy and legislation used to inform the assessment of potential impacts on climate change for the Project are outlined in this section.

### 25.2.1 International Agreements

#### 25.2.1.1 United Nations Framework Convention on Climate Change (UNFCCC)

8. The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty addressing climate change which entered into force on 21st March 1994. Its main objective is *'to stabilize greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system'*. In its early years it facilitated intergovernmental climate change negotiations and now provides technical expertise. Its supreme decision-making body, the Conference of the Parties (COP) meets annually to discuss and assess progress in addressing climate change.

9. The first agreement was the Kyoto Protocol, which was signed in 1997 and entered into force in 2005, and committed industrialised countries to limit and reduce GHG emissions in accordance with individual targets to reduce the rate and extent of global warming. It applies to seven GHGs: carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride ($SF_6$) and nitrogen trifluoride ($NF_3$) which was incorporated into the second Kyoto Protocol compliance period in 2012. The Kyoto Protocol recognises that the economic development of a country is an important determinant in the country's ability to combat, and adapt to, climate change. Therefore, developed countries have an obligation to reduce their current emissions particularly due to their historic responsibility for the current concentrations of atmospheric GHGs.

10. Subsequently, the meetings of COP have resulted in several important and binding agreements, including the Copenhagen Accord (2009), the Doha Amendment (2012) and the Paris Agreement (2015).

11. The Copenhagen Accord raised climate change policy to the highest political level and expressed a clear political intent to constrain carbon and respond to climate change in the short and long term. It introduced the potential commitment to limiting global average temperature increase to no more than 2°C above pre-industrial levels.

12. The Doha Amendment to the Kyoto Protocol in 2012 included a commitment by parties to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The UK Climate Change Act 2008 has an interim 34% reduction target for 2020, which would allow the UK to meet and exceed its Kyoto agreement target.

13. The United Nations Climate Change Conference in Paris in 2015 (known as 'COP21') led to the following key areas of agreement (the Paris Agreement):

- Limit global temperature increases to below 2°C, while pursuing efforts to limit the increase to 1.5°C above the pre-industrial average temperature
- Parties to aim to reach a global peak of GHG emissions as soon as possible alongside making commitments to prepare, communicate and maintain a Nationally Determined Contribution
- Contribute to the mitigation of GHG emissions and support sustainable development whilst enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change
- Commitment to transparent reporting of information on mitigation, adaptation and support which undergoes international review
- In 2023 and every five years thereafter, a global stocktake will assess collective progress toward meeting the purpose of the Agreement.

14. At the 22nd Climate Change Conference of the Parties (COP22) in November 2016, the UK ratified the Paris Agreement to enable the UK to *"help to accelerate global action on climate change and deliver on our commitments to create a safer, more prosperous future"* (BEIS, 2016). At the COP24 meeting, held in Katowice, Poland in December 2018, a set of rules for the Paris climate process were agreed.

15. COP26 was held in 2021 in Glasgow. The four specific objectives that were aimed to be achieved for COP26 were (UK Parliament, 2022):

- Securing global net zero by mid-century and keep 1.5°C within reach by:

    - Accelerating the phase-out of coal
    - Curtailing deforestation
    - Speeding up the switch to electric vehicles
    - Encouraging investment in renewables

- Adapt to protect communities and natural habitats
- Mobilise at least $100 billion in climate finance per year
- Work together to deliver through finalising the Paris Rulebook and accelerating action to tackle the climate crisis through collaboration between governments, businesses, and civil society.

16. For the first time, nations have been called upon to 'phase down' unabated coal power and inefficient subsidies for fossil fuels (UNFCCC, 2022). The main headlines of COP26 were:

- Signing of the Glasgow Climate Pact, which is a series of decisions and resolutions that build on the Paris Agreement setting out what needs to be done to tackle climate change but does not specify what each country must do and is not legally binding
- Agreeing the Paris Rulebook, which gives the guidelines on how the Paris Agreement is delivered. Agreements in the finalised Rulebook include enhanced transparency framework for the reporting of emissions, common timeframes for emissions reduction targets and mechanisms and standards for international carbon markets (UK Parliament, 2022).

### 25.2.2 National Policy Statement

17. The specific assessment requirements for climate change are set out within the current and draft versions of the Overarching National Policy Statement (NPS) for Energy (EN-1) and NPS for Renewable Energy Infrastructure (EN-3) and summarised in **Table 25.1**.

18. Reference to the particular requirement's location within the current and draft NPS and to where within this chapter or wider ES it has been addressed has also been provided in **Table 25.1**. Minor wording changes within the draft version which do not materially influence the NPS requirements have not been reflected.

*Table 25.1 Summary of NPS EN-1 and EN-3 provisions relevant to climate change*

| Summary | How and where this is considered in the ES |
|---|---|
| **Current NPS** | |
| **EN-1, Paragraph 3.3.11**<br>An increase in renewable electricity is essential to enable the UK to meet its commitments under the EU Renewable Energy Directive. It will also help improve our energy security by reducing our dependence on imported fossil fuels, decrease greenhouse gas emissions and provide economic opportunities. | The purpose of the Project is to contribution to climate change mitigation by replacing existing high carbon energy generation, with a renewable form of energy, which will improve energy security and help the UK meet its net zero commitments. |
| **EN-1, Paragraphs 4.8.5 and 4.8.6**<br>New energy infrastructure will typically be a long-term investment and will need to remain operational over many decades, in the face of a changing climate. Consequently, applicants must consider the impacts of climate change when planning the location, design, build, operation and, where appropriate, decommissioning of new energy infrastructure. The ES should set out how the proposal will take account of the projected impacts of climate change. While not required by the EIA Directive, this information will be needed by the IPC.<br>The IPC should be satisfied that applicants for new energy infrastructure have taken into account the potential impacts of climate change using the latest UK Climate Projections available at the time the ES was prepared to ensure they have identified appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure. | The impacts of climate change to the Project are considered in the CCRA in this chapter, see **Section 25.6**. |
| **EN-3, Paragraphs 2.3.1, 2.3.4 and 2.3.5**<br>Part 2 of EN-1 covers the Government's energy and climate change strategy, including policies for mitigating climate change. Section 4.8 of EN-1 sets out generic considerations that applicants and the IPC should take into account to help ensure that renewable energy infrastructure is resilient to climate change.<br>Offshore [and onshore] windfarms are less likely to be affected by flooding, but applicants should particularly set out how the proposal would be resilient to storms.<br>Section 4.8 of EN-1 advises that the resilience of the project to climate change should be assessed in the Environmental Statement (ES) accompanying an application. | The impacts of climate change to the Project are considered in the CCRA in this chapter, see **Section 25.6**. |
| **Draft NPS** | |

| Summary | How and where this is considered in the ES |
|---|---|
| **Draft EN-1, Paragraph 5.3.4:**<br>*Applicant's Assessment*<br>All proposals for energy infrastructure projects should include a carbon assessment as part of their ES (See Section 4.2). This should include:<br>• A whole life carbon assessment showing construction, operational and decommissioning carbon impacts<br>• An explanation of the steps that have been taken to drive down the climate change impacts at each of those stages<br>• Measurement of embodied carbon impact from the construction stage<br>• How reduction in energy demand and consumption during operation has been prioritised in comparison with other measures<br>• How operational emissions have been reduced as much as possible through the application of best available technology for that type of technology<br>• Calculation of operational energy consumption and associated carbon emission<br>• Whether and how any residual carbon emissions will be (voluntarily) offset or removed using a recognised framework<br>• Where there are residual emissions, the level of emissions and the impact of those on national and international efforts to limit climate change, both alone and where relevant in combination with other developments at a regional or national level, or sector level, if sectoral targets are developed. | This chapter presents the GHG assessment for the Project. The elements included in the GHG assessment at this stage of the application are outlined in **Section 25.2.3**. |
| **Draft EN-1, Paragraphs 5.3.5 to 5.3.7:**<br>*Secretary of State decision making*<br>The Secretary of State must be satisfied that the applicant has as far as possible assessed the GHG emissions of all stages of the development.<br>The Secretary of State should be content that the applicant has taken all reasonable steps to reduce the GHG emissions of the construction and decommissioning stage of the development. The Secretary of State should also give positive weight to projects that embed nature-based or technological processes to mitigate or offset the emissions of construction and decommissioning within the proposed development. However, in light of the vital role energy infrastructure plays in the process of economy wide decarbonisation, the Secretary of State accepts that there are likely to be some residual emissions from construction and decommissioning of energy infrastructure.<br>Operational GHG emissions are a significant adverse impact from some types of energy infrastructure which cannot be totally avoided (even with full deployment of CCS technology). Given the characteristics of these and other technologies, as noted in Part 3 | The GHG assessment has considered emissions during construction, operation and decommissioning of the Project. |

| Summary | How and where this is considered in the ES |
|---|---|
| of this NPS, and the range of non-planning policies aimed at decarbonising electricity generation such as UK ETS (see Sections 2.4 and 2.5 above), government has determined that operational GHG emissions are not reasons to prohibit the consenting of energy projects including those which use these technologies or to impose more restrictions on them in the planning policy framework than are set out in the energy NPSs (e.g. the CCR requirements). Any carbon assessment will include an assessment of operational GHG emissions, but the policies set out in Part 2, including the UK ETS, apply to these emissions. Operational emissions will be addressed in a managed, economy-wide manner, to ensure consistency with carbon budgets, net zero and our international climate commitments. The Secretary of State does not, therefore need to assess individual applications for planning consent against operational carbon emissions and their contribution to carbon budgets, net zero and our international climate commitments. | |
| **Draft EN-1, Paragraphs 5.3.8 to 5.3.10:**<br>*Mitigation*<br>A carbon assessment should be used to drive down GHG emissions at every stage of the proposed development and ensure that emissions are minimised as far as possible for the type of technology, taking into account the overall objectives of ensuring our supply of energy always remains secure, reliable and affordable, as we transition to net zero.<br>Applicants should look for opportunities within the proposed development to embed nature-based or technological solutions to mitigate or offset the emissions of construction and decommissioning.<br>To be taken into account in Secretary of State decision making, steps taken to minimise and offset emissions should be set out in a GHG Reduction Strategy, secured under the development consent order. | GHG mitigation has been considered as part of the design of the Project, further details are provided in **Section 25.3.6**. |

### 25.2.3 Other Legislation, Policy and Guidance

19. In addition to the NPS, there are a number of pieces of other legislation, policy and guidance applicable to the assessment of GHGs which are discussed in the following sections. Further detail is provided in **Chapter 3: Policy and Legislative Context**.

#### 25.2.3.1 Legislative Background

20. The requirement to consider climate and GHG emissions has resulted from the 2017 amendment to the Marine Works (Environmental Impact Assessment) Regulations 2007 (as amended), which includes the requirement to include an estimate of

expected emissions and the impact of a project on climate, including consideration of the nature and magnitude of the release of GHGs during construction and operation.

#### 25.2.3.1.1 The Climate Change Act 2008

21. The Climate Change Act 2008 established a legally binding target to reduce the UK's GHG emissions by at least 80% in 2050 from 1990 levels, and a system of Carbon Budgets were introduced in order to drive progress towards this target.

22. On 12 December 2015, the UK along with 195 other parties signed the 'Paris Agreement', a legally binding international treaty on climate change committing all parties to the goal of limiting global warming to well below 2 degrees Celsius, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. The Agreement requires all parties to submit plans to reduce their emission (along with other climate action) every 5-years, starting in 2020. The carbon budgets are set by the Committee on Climate Change (CCC) and provide a legally binding five-year limit for GHG emissions in the UK. The six carbon budgets that have been placed into legislation and will run up to 2037, and are identified in **Table 25.2**.

*Table 25.2 The Six UK Carbon Budgets*

| Budget | Carbon Budget Level (Mt CO2e) | Reduction Below 1990 Level | |
|---|---|---|---|
| | | UK Targets | Achieved by the UK |
| **1st Carbon Budget (2008 to 2012)** | 3,018 | 25% | 30% |
| **2nd Carbon Budget (2013 to 2017)** | 2,782 | 31% | 38% |
| **3rd Carbon Budget (2018 to 2022)** | 2,544 | 37% by 2020 | 44% |
| **4th Carbon Budget (2023 to 2027)** | 1,950 | 51% by 2025 | - |
| **5th Carbon Budget (2028 to 2032)** | 1,725 | 68% by 2030 | - |
| **6th Carbon Budget (2033 to 2037)** | 965 | 78% by 2035 | - |

23. The UK outperformed its emission reduction targets set by the first, second and third Carbon Budgets, achieving a 30%, 38% and 44% reduction compared to 1990 levels in 2011, 2015 and 2019 respectively.

24. In December 2020, the UK set a Sixth Carbon Budget, recommending a reduction in UK GHG emissions of 78% by 2035 relative to a 1990 baseline (a 63% reduction from 2019) (CCC, 2020). This target which has already been enshrined in UK law

has been set in line with the UK commitments in relation to the Paris Agreement and with the goal of achieving a target of reaching net zero GHG emissions by 2050.

25. As part of this Budget, the role of the offshore wind sector and the construction industry are both the focus of action to contribute to meeting these targets.

26. The CCC publishes annual progress reports on the UK's progress against GHG emissions reduction targets to 2050. The most recent published report 'Progress in reducing emissions: 2022 Report to Parliament' (CCC, 2022) identifies that emissions in 2021 rose to some extent after the Covid-19 pandemic, but remain 10% below 2019 levels. This report also reiterates the Governments commitment to electricity generation being 95% low-carbon by 2030 and fully decarbonised by 2050. The report also acknowledges the Governments ambition for offshore wind generation by 2030 has increased from 40 GW to 50GW, including up to 5 GW of floating offshore wind.

27. The Climate Change Act 2008 requires the UK Government to produce a Climate Change Risk Assessment every five years. The Climate Change Risk Assessment assesses current and future risks to, and opportunities for, the UK from climate change (to inform "climate adaptation" actions). In response to the Climate Change Risk Assessment, the Climate Change Act 2008 also requires Government to produce a National Adaptation Programme (NAP) (both discussed further in the following sections).

#### 25.2.3.1.2 Climate Change Risk Assessment 2022

28. The Government produced its latest Climate Change Risk Assessment in 2022 (Department for Environment, Food & Rural Affairs (Defra), 2022), the third assessment to be produced for the UK following the first and second releases in 2012 and 2017 respectively. The report concluded that among the most urgent risks for the UK are risks to people and the economy from climate-related failure of the power systems and multiple risk to the UK from climate change impacts overseas. It identifies suggestions for reducing these risks, including the consideration of climate change in developing new infrastructure.

#### 25.2.3.1.3 National Adaptation Programme

29. The NAP (Defra, 2018) sets the actions that the UK government will undertake to adapt to the challenges of climate change in the UK as identified in the Climate Change Risk Assessment. The NAP details the range of climate risk which may affect the natural environment, infrastructure, communities, buildings and services. Key actions are set out in the NAP which aim to address the identified high-risk areas, which include:

- flooding and coastal change risks to communities, businesses and infrastructure
- risks to health, well-being and productivity from high temperatures
- risks in shortages in the public water supply for agriculture, energy generation and industry
- risks to natural capital
- risks to domestic and international food production and trade.

#### 25.2.3.2 National Planning Policy Framework (NPPF)

30. The National Planning Policy Framework (NPPF) was first published on 27th March 2012 and most recently updated on 20th July 2021. The revised NPPF advises that the planning system should support the transition to a low carbon future. With respect to planning for climate change, the NPPF states:

*"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures"*

31. The NPPF also states:

*"New development should be planned for in ways that:*

*a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and*

*b) can help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards."*

#### 25.2.3.3 Guidance

##### 25.2.3.3.1 IEMA Assessing Greenhouse Gas Emissions and Evaluating their Significance (2022)

32. Recently published IEMA 'Assessing Greenhouse Gas Emissions and Evaluating their Significance' guidance (2022) has been used in this ES chapter for the evaluation and significance of GHG emissions from the Project. This guidance is a revision of the first iteration of the guidance released in 2017 (IEMA, 2017).

33. The 2022 IEMA guidance presents guidelines for undertaking GHG assessments and to distinguish different levels of significance. The guidance does not update IEMA's position that all emissions contribute to climate change, however it now provides

relative significance descriptions to assist assessments specifically in the EIA context (detailed further in **Section 25.3.2**).

#### 25.2.3.3.2 IEMA Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation (2020)

34. IEMA has also published a framework for the consideration of climate change resilience and adaptation in the EIA process. The guidance advises that the future climate at the development site should be identified, and how adaptation and resilience measures have been built into the design of a development (IEMA, 2020).

## 25.3 Assessment Methodology

35. The climate change assessment comprised two separate assessments: a GHG assessment and a CCRA. The methodologies for both assessments are detailed in the following sections.

36. The GHG assessment was undertaken to predict emissions arising from construction, operational and decommissioning phase activities associated with the Project. To help determine the significance and contextualise the outcomes of the GHG assessment, emissions from a 'do nothing' or 'without Project' scenario were also quantified (see **Section 25.4.1**). Emissions from this scenario were compared to the GHG assessment for the Project to determine the GHG savings or carbon offset as a result of the Project, the GHG payback period and the GHG intensity of electricity produced.

37. A CCRA was undertaken to evaluate the resilience and vulnerability of the design and infrastructure of the Project to the projected effects of climate change during the operational phase. The construction phase is anticipated to be up to 10 months for the Offshore Project, commencing as early as 2025. Effects of climate change, as distinct from weather, are not considered to be significant during construction and are therefore excluded from consideration in the CCRA.

### 25.3.1 Study Area

38. Details of the location of the Offshore Project and the offshore components are set out within **Chapter 5: Project Description**.

#### 25.3.1.1 GHG Assessment

39. The scope of the assessment quantified GHG emissions from the offshore components of the Project, including material extraction and manufacturing, transport and installation, operation and maintenance and end of life and decommissioning. The offshore components of the Project comprise the wind

turbine generators (WTGs) (and associated infrastructure), the inter-array and offshore export cables and the offshore substation.

40. A schematic diagram of the Projects boundary is provided in **Plate 25.1**. Emissions within the pale green box are included within the assessment. The study area is defined both geographically, as the asset project area, and by the processes that create the offshore windfarm (i.e. construction), and its operation and maintenance and decommissioning.

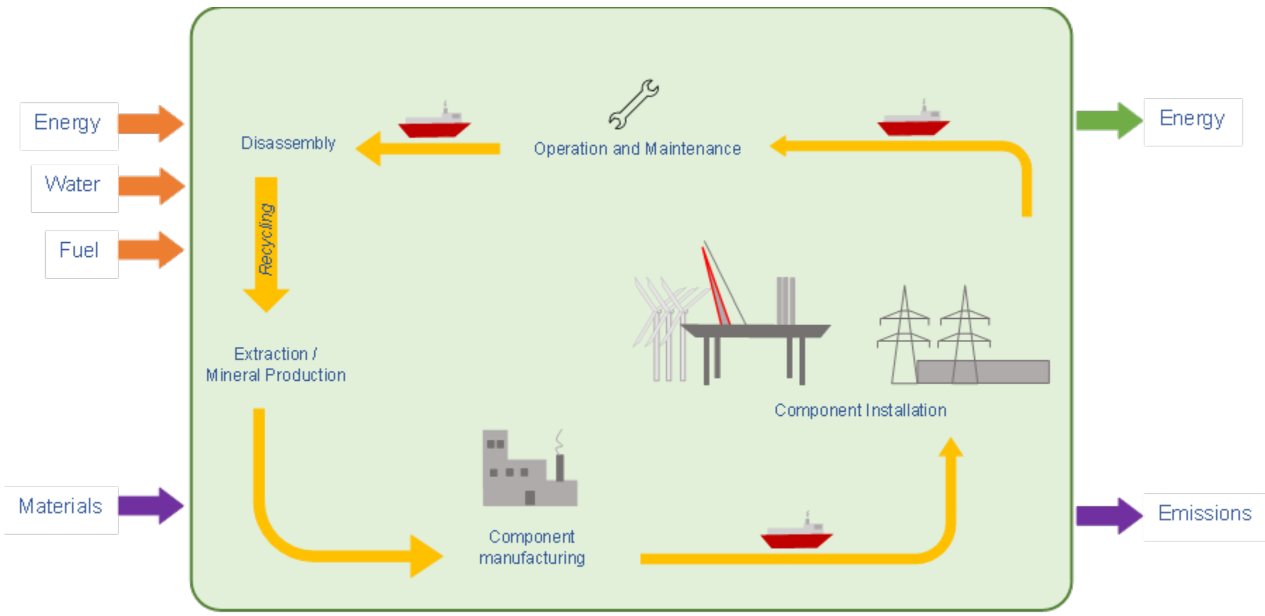


*Plate 25.1 System boundary for the Project's GHG assessment*

#### 25.3.1.2 CCRA

41. The study area for the CCRA is defined as the Offshore Development Area, which includes the WTGs, OSP, inter-array cables and export cable corridor.

### 25.3.2 GHG Assessment Methodology

42. The assessment methodology for climate change was undertaken in accordance with that presented in in **Chapter 6: EIA Methodology**. However, a topic-specific assessment methodology and approach to determining impact significance is provided within IEMA guidance (IEMA, 2022), as set out in the following sections.

43. The purpose of this assessment is to consider the impact on climate change caused by the Project. The following sections describe the methods used to assess any likely significant effects on climate change and GHG emissions, both offset and created by the Project.

#### 25.3.2.1 Context

##### 25.3.2.1.1 GHG Emission Sources for Offshore Windfarms

44. The construction, operation and maintenance and decommissioning of windfarm projects results in the generation of GHG emissions, both from the standpoint of:

- Embedded carbon and GHGs from the offshore components of the Project:
  - Emissions caused by the extraction and refinement of raw materials and their manufacture into the commodities and products that make up the offshore components such as WTGs (and their associated physical infrastructure), cables, etc.
- Carbon and other GHG emissions arising from the combustion of fuels and energy used in constructing, operating and maintaining the Project components over its lifetime and in decommissioning:
  - These are associated with marine vessels transporting offshore components of the Project from ports to the Offshore Project.

45. These emissions are small in comparison to emissions from fossil fuels and the emissions saved during the generation of electricity from wind (over fossil fuel sources) significantly outweigh construction, operation and maintenance and decommissioning GHG emissions.

46. There are inherent uncertainties associated with carrying out GHG footprint assessments for offshore wind power projects, although the approach to determine emissions from individual source groups is well defined.

47. A report published by the University of Edinburgh in 2015 (Thomson & Harrison, 2015) examined the lifecycle costs and GHG emissions associated with offshore wind energy projects, comparing data gleaned from the analysis of some 18 studies carried out over the period 2009 to 2013 (Thomson & Harrison, 2015). This report provided useful context for the project's GHG assessment, and benchmark figures which were used to verify the outcomes of the assessment. It is acknowledged that advancements and efficiencies have been gained in the offshore wind sector since this study was undertaken, however the figures and details within this study still provide useful context for the GHG assessment.

48. **Table 25.3** provides a summary of the percentage of total GHG emissions associated with the different phases of an offshore windfarm development as provided within the report (Thomson & Harrison, 2015).

*Table 25.3 Summary of Offshore Windfarm GHG Emissions (Thomson & Harrison, 2015)*

| Phase | % of total GHG emissions |
|---|---|
| **Manufacture and Installation** | 78.4 |
| **O&M** | 20.4 |
| **Decommissioning** | 1.2 |

49. The report highlighted that the greatest proportion of emissions are associated with the manufacture and installation of the windfarm components. Decommissioning accounted for the smallest proportion, only 1.2%, of total life cycle GHG emissions. A more detailed breakdown of emissions is given in Thomson & Harrison (2015) for an offshore windfarm with steel foundations.

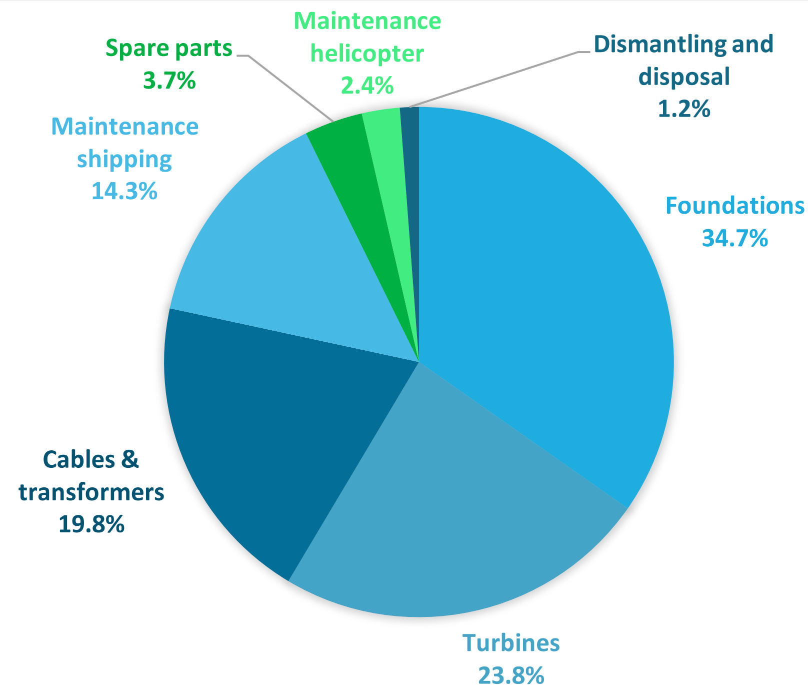


*Plate 25.2 Summary of Offshore Windfarm GHG Emissions (Thomson & Harrison, 2015)*

50. Of the components or phases shown in **Plate 25.2**, GHG emissions associated with foundation fabrication and installation accounted for the largest proportion of emissions (34.7%), followed by manufacture and installation of the turbines (23.8%) and the cables and transformers (19.8%).

51. GHG emissions from shipping movements during maintenance operations over the operational lifetime of the windfarm contributed 14.3%. This value may appear to be unexpectedly high, but the vessel movements contribution is associated with an assumed 20-year operational lifespan of the windfarms considered in the studies. Emissions derived from spare parts (3.7%), helicopter movements (2.4%) and

dismantling and disposal (1.2%) are all small in comparison. The operation and maintenance phase of the project is anticipated to be 25 years, and is therefore slightly longer than the windfarms considered in these studies.

52. A recent report by Catapult (Spyroudi, 2021) investigated the carbon and GHG implications of end-of-use management after decommissioning, as well as some context to carbon Life Cycle Analysis of offshore windfarms. Turbines contribute to 50% of the total GHG footprint of materials used in windfarm components. The Catapult report references the National Renewable Energy Laboratory (NREL) report (NREL, 2015) which states that WTGs are predominantly made of steel (71-79% of total turbine mass), fiberglass, resin or plastic (11-16%), iron or cast iron (5-17%), copper (1%) and aluminium (0-2%). The Catapult report (Spyroudi, 2021) says that recycling can save, on average, at least 35% of $CO_2e$ per kWh from assets in an offshore windfarm (operating 6MW and 10MW turbines) as opposed to new manufacturing of components.

#### 25.3.2.1.2GHG Intensity of Offshore Wind Energy

53. In the University of Edinburgh report (Thomson & Harrison, 2015), additional analysis of the data extracted from the 18 technical studies expressed the GHG emissions as grammes (g) of $CO_2e$ per kilowatt-hour (kWh) of electricity generated. These were found to vary quite widely, between approximately 5 and 33 g $CO_2e.kWh^{-1}$. There was no clear relationship between the metrics for either turbine rating (in MW) or capacity factor.

54. A further study in 2012 (Dolan & Heath, 2012), amassed the results of over 200 studies of carbon emissions from wind power and attempted to "harmonise" the results to use only the most robust and reliable data and to align methodological inconsistences. The harmonised results of this study revealed that the range in GHG emissions per kWh of electricity generated varied between approximately 7 and 23 g $CO_2e.kWh^{-1}$, with a mean value of around 12 g $CO_2e.kWh^{-1}$.

55. It is noted that these studies (Dolan & Heath (2012); Thomson & Harrison (2015)) were undertaken in 2012 and 2015, and there have been significant advances in the technology, infrastructure and components used for offshore windfarms. Other available published sources were reviewed to evaluate average the GHG intensity of energy produced offshore windfarms, and these are presented in **Table 25.4**. As shown, the range of energy intensities for offshore windfarms across the range of studies is 7.8 to 25.5 g $CO_2e.kWh^{-1}$, which is comparable with the range of energy intensities identified in Thomson & Harrison (2015) and Dolan & Heath (2012).

*Table 25.4 Review of Average Carbon Emissions per kWh*

| Windfarm sizes | Energy intensity ($g\ CO_2e.kWh^{-1}$) | Source |
|---|---|---|
| 12x 5MW | 32 | Chen et al. (2011), referenced in Bhandari et al. (2020) |
| N/A | 6 | IEA World Energy Outlook (2012), referenced in Siemens Gamesa (no date) and Orsted (2021) |
| 100x 2.5MW | 13.7 | Arvesen & Hertwich (2012), referenced in Bhandari et al. (2020) |
| 80x 4MW | 10.9* | Bonou et al. (2016), referenced in Bhandari et al. (2020) |
| 100x 6MW | 7.8* | Bonou et al. (2016), referenced in Bhandari et al. (2020) |
| 28x 3.6MW | 25.5* | Yang et al. (2018), referenced in Bhandari et al. (2020) |
| *offshore windfarm studies published from 2016 onwards | | |

56. To place these metrics into context, comparable values for electricity generation by gas and coal are around 372 and 1,002 g $CO_2.kWh^{-1}$ (31 and 83.5 times that of offshore wind respectively, using the mean value from Dolan & Heath (2012)) (BEIS, 2022b). These values are unlikely to take account of the construction materials (e.g. concrete) required for the power stations.

57. Although robust and fit for the purposes of an EIA, this assessment should not be taken to be a comprehensive, detailed Life Cycle Analysis (LCA) of the Project. The reason that this assessment does not take the form of a detailed LCA is, because it is not possible to fully define the supply chain for the Project and undertake the relevant detailed assessments at this stage in the Project. Therefore, assumptions and simplifications to the methodology were made in certain areas and a precautionary approach was adopted for the assessment to allow for this. These assumptions and simplifications are referred to in **Section 25.3.8** and the worst-case scenario is set out in **Table 25.8**.

#### 25.3.2.2 GHG Assessment Approach

58. In this assessment the term 'GHG' or 'carbon' encompasses $CO_2$ and the six other gases as referenced in the Kyoto Protocol ($CH_4$, $N_2O$, HFCs, PFCs, $SF_6$ and $NF_3$). The results in this assessment are expressed in carbon dioxide equivalent ($CO_2e$), which recognises that different gases have notably different global warming potentials (GWP).

59. GHG emissions arising from the construction and operational phase of the Project were predicted within a defined 'project boundary', in accordance with the GHG

Protocol (World Resources Institute and World Business Council on Sustainable Development, 2015), explained in further detail in **Section 25.3.1**.

60. To assist with the determination of the significance of the project in relation to GHG emissions (as discussed in **GHG Assessment: Section**), three parameters were calculated to contextualise the GHGs emitted during the life cycle of the Project in relation to the benefits of providing renewable energy. These include:

- The emissions saved as a result of the Project when compared to fossil generated sources
- The GHG intensity of the energy produced by the Project, which takes into account the amount of energy generated by the Project over its lifetime in relation to its total GHG emissions and
- GHG 'payback' period, which is the time it would take for electricity generated by fossil fuels to be displaced.

#### 25.3.2.3 Emission Calculations

61. GHG emission sources arising from the Project were categorised into two main source groups, as detailed in **Table 25.5**.

*Table 25.5 Emission Source Groups Considered in the Assessment*

| Source Name | Phase | Definition | Project Sources |
|---|---|---|---|
| **Embodied carbon in materials** | Construction | Embodied emissions within materials comprise GHGs released throughout the supply chain, and includes the extraction of materials from the ground, transport, manufacturing, assembly and its end-of-life profile. | Embodied emissions were quantified for the main construction materials to be used for the offshore components of the Project. The components that were considered included the main infrastructure associated with the project, such as WTGs (including tower, nacelle, rotor, blades), foundations, scour protection, cables (inter-array and export cables) and the OSP.<br><br>The requirement for spare (or replacement) parts during operation is not known at this stage, therefore the likely composition of emissions in terms of the overall footprint of the Project was obtained from existing literature. |
| **Marine vessels** | Construction and operation and maintenance | GHG emissions are released in exhaust gases from the combustion of | Emissions associated with the movement of marine vessels for the offshore component of the Project were calculated. Vessels associated with installation of foundations, WTGs and cables, as well as supply and |

| Source Name | Phase | Definition | Project Sources |
|---|---|---|---|
| | | fossil fuels on marine vessels. | support, accommodation and commissioning vessels were also quantified. |

62. Details on all the activities that will take place during the construction, operation and maintenance and decommissioning phases are not fully known at this stage, therefore some assumptions have been made in order to quantify GHG emissions as detailed **Section 25.3.8**. These assumptions are based on indicative data from similar projects provided by the project's design team or professional judgement. Emissions from decommissioning were derived from previous studies (Thomson & Harrison, 2015), which quantified them to be approximately 1.2% of the carbon footprint.

63. The approach to quantifying GHG emissions for each of the source groups detailed in **Table 25.5** are provided in **Appendix 25.A**. The total operational life of the Project is anticipated to be up to 25 years.

#### 25.3.2.4 GHG Assessment: Definitions of sensitivity, value and magnitude

64. This assessment was undertaken in accordance with the general methodology presented within **Chapter 6: EIA Methodology**; however, a topic-specific assessment methodology and approach to determining significance of effect is provided within IEMA guidance (2022), and is detailed in the Sections below.

##### 25.3.2.4.1 Sensitivity

65. The receptor for the GHG assessment is the global atmosphere. As such, it is affected by all global sources of GHGs, and is therefore considered to be of 'high' sensitivity to additional emissions.

##### 25.3.2.4.2 Effect Significance

66. Guidance on the assessment of GHG emissions was first released by IEMA in 2017 (IEMA, 2017), which stated that *"…in the absence of any significance criteria or defined threshold, it might be considered that all GHG emissions are significant…"*. However, the recently updated IEMA guidance (IEMA, 2022) recognises *"when evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects will replace existing development or baseline activity that has a higher GHG profile. The significance of a project's emissions should therefore be based on its net impact over its lifetime, which may be positive, negative or negligible"*.

67. Significance can be evaluated in a number of ways depending on the context of the assessment, i.e. sector-based, locally, nationally, policy goals or against performance standards. The IEMA guidance recommends that significance criteria align with Paris Agreement, the UK's Carbon Budgets up to 2037 and net zero commitments: *"the crux of significance is not whether a project emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050"* (IEMA, 2022).

68. The updated IEMA guidance provides relative significance descriptions to assist assessments, specifically in the EIA context. Section VI of the updated IEMA guidance (IEMA, 2022) describes five distinct levels of significance which are not solely based on whether project emits GHG emissions alone, but how the Project makes a relative contribution towards achieving a science-based 1.5°C aligned transition towards net zero. These are presented below in **Table 25.6**.

*Table 25.6 Assessment significance criteria*

| Source | Summary |
|---|---|
| Major adverse | The project's GHG impacts are not mitigated or are only compliant with do-minimum standards set through regulation, and do not provide further reductions required by existing local and national policy for projects of this type. A project with major adverse effects is locking in emissions and does not make a meaningful contribution to the UK's trajectory towards net zero. |
| Moderate adverse | The project's GHG impacts are partially mitigated and may partially meet the applicable existing and emerging policy requirements but would not fully contribute to decarbonisation in line with local and national policy goals for projects of this type. A project with moderate adverse effects falls short of fully contributing to the UK's trajectory towards net zero. |
| Minor adverse | The project's GHG impacts would be fully consistent with applicable existing and emerging policy requirements and good practice design standards for projects of this type. A project with minor adverse effects is fully in line with measures necessary to achieve the UK's trajectory towards net zero. |
| Negligible | The project's GHG impacts would be reduced through measures that go well beyond existing and emerging policy and design standards for projects of this type, such that radical decarbonisation or net zero is achieved well before 2050. A project with negligible effects provides GHG performance that is well 'ahead of the curve' for the trajectory towards net zero and has minimal residual emissions. |
| Beneficial | The project's net GHG impacts are below zero and it causes a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the without-project baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact. |

69. Major or moderate adverse ,and beneficial effects are deemed to be significant in EIA terms within this chapter. Whilst only one level of significance criteria for beneficial effects is provided, further context with respect to the level of emissions offset compared to the baseline scenario is provided in **Section 25.5**.

### 25.3.3 CCRA Methodology

70. An assessment of the resilience and vulnerability of the design and infrastructure to the projected effects of climate change was undertaken over the operational lifespan of the Offshore Project. The CCRA identifies the likelihood of climate hazards occurring within the study area, and the consequences of the effect will be highlighted. The methodology for the CCRA is provided in **B.**

71. If required, an assessment of the resilience and vulnerability of the design and infrastructure of the Onshore Project will be undertaken, which are being applied for under a separate Town and Country Planning Application.

### 25.3.4 Cumulative Effects Assessment (CEA) Methodology

#### 25.3.4.1 In-combination with the Onshore Project

72. It has already been noted that this chapter provides a GHG assessment for the offshore aspects of the Project only, and does not take into consideration GHGs associated with the Onshore Project (i.e. onshore cables or substation construction materials, road traffic vehicle movements, plant and equipment, etc.). The Onshore Project (i.e. landward of MLWS) is being applied for under a separate Town and Country Planning Application to North Devon District Council. As detailed in the **CCRA Methodology Section**, an assessment of the resilience and vulnerability of the design and infrastructure of the Onshore Project will be assessed in the Town and Country Planning Application assessment, if required.

73. It is expected that the Offshore Project would be the most intensive in GHG terms due to the embodied GHGs within the offshore infrastructure. However, to provide a complete GHG assessment for the Project, emissions associated with the Onshore Project has also been considered and are presented in **Section 25.7**, where relevant Project information is available at this stage of the Application.

74. The methodology for including the Onshore Project within the GHG assessment is the same as in detailed in **Section 25.3.2**. The additional sources included within the Onshore Project are summarised in **Table 25.7** and the approach to quantifying GHG emissions for the onshore elements are detailed in **Appendix 25.A**.

*Table 25.7 Additional Onshore Emission Source Groups Considered as part of the in-combination CEA for the Project*

| Source Name | Phase | Definition | Project Sources |
|---|---|---|---|
| **Embodied carbon in materials** | Construction | Embodied emissions within materials comprise GHGs released throughout the supply chain, and includes the extraction of materials from the ground, transport, manufacturing, assembly and its end-of-life profile. | Embodied emissions were quantified, where possible, for the main construction materials to be used for the onshore components of the Project. Where specific information on the quantity of materials in cables could not be supplied, assumptions were made based on the cable diameter and the quantities of cable materials used on other offshore windfarm projects. |
| **Road traffic** | Construction and operation and maintenance | Emissions associated with the movement of road vehicles. | Emissions associated with the movement of heavy goods vehicles (HGVs) and staff travel during construction and operation were calculated. |
| **Plant and equipment** | Construction | Emissions are released from non-road mobile machinery (NRMM) as a result of fuel combustion. | Emissions from the use of NRMM during construction of the onshore components of the project were calculated. This included the landfall, trenchless crossing, cable installation and onshore substation works. |

75. The Offshore Project application is further progressed than the Onshore Project application and, at the time of writing, some elements of the Onshore Project have yet to be finalised. Therefore, there could be differences between GHG emissions presented in the two assessments, as aspects of the Onshore Project are further refined. The current working assumptions that have been used in this chapter are detailed in **Appendix 25.A**. Where possible, these will be updated and refined for the separate Town and Country Planning Application for the Onshore Project. It is not anticipated that these differences will change the significance of effects concluded in this chapter.

#### 25.3.4.2 CEA with Other Projects

76. The global atmosphere is the receptor for the GHG assessment, therefore there are no common receptors between this assessment and other disciplines considered in the ES. GHG emissions have the potential to contribute to climate change, and

therefore the effects are global and cumulative in nature. This is taken into account in defining the receptor (i.e. the global atmosphere) as high sensitivity.

77. The IEMA guidance (IEMA, 2022) states that effects of GHG emissions from specific cumulative projects should therefore 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 impacts is required.

78. The CCRA focuses on the potential for climate change to impact the infrastructure and assets associated with the Project. Due to its setting, the offshore components of the Project are not considered to change the vulnerability or resilience of other developments, therefore a CEA for the CCRA was not undertaken.

### 25.3.5 Worst-Case Scenario

79. In accordance with the assessment approach to the Project Design Envelope (PDE), or 'Rochdale Envelope', set out in **Chapter 6: EIA Methodology**, the impact assessment for Fish and Shellfish Ecology has been undertaken based on a realistic worst-case scenario of predicted impacts. The PDE for the Offshore Project is detailed in **Chapter 5: Project Description**.

80. The realistic worst case scenarios for the likely significant effects scoped into the EIA for the GHG assessment are summarised in **Table 25.8**. These are based on the project parameters described in **Chapter 5: Project Description**, which provides further details regarding specific activities and their durations.

*Table 25.8 Realistic Worst Case Scenario*

| Potential Impact Construction | Parameter | Notes |
|---|---|---|
| GHG emissions during construction | Infrastructure:<br>Installation of up to:<br>• 8x 12MW WTG<br>• 7x 14MW WTG<br>• 6x 16MW WTG<br>• 6x 18MW WTG<br>Assumes one floating substructure per WTG<br>Number of mooring lines, assuming 6 mooring lines per substructure:<br>• 48 for 12MW scenario<br>• 42 for 14MW scenario | Maximum amount of construction materials required |

| Potential Impact | Parameter | Notes |
|---|---|---|
| | • 36 for 16MW or 18MW WTG scenario<br>Installation of 1 offshore substation platform (OSP), with a fixed jacket substructure<br>Total length of IAC:<br>• 29.76km for 12MW WTG scenario (8 IAC, plus 2 IAC for contingency)<br>• 26.8km for 14MW WTG scenario (7 IAC, plus 2 IAC for contingency)<br>• 23.8km for 16MW or 18MW WTG scenario (6 IAC, plus 2 IAC for contingency)<br>Offshore export cables – maximum cable length of 93.6km, with up to two export cables (maximum length of installation corridors = 187.2km) | |
| | Construction/assembly ports:<br>• There are several ports currently under consideration (i.e. H&W Belfast, Port Talbot, Hunterston, Falmouth and Bristol Port).<br>• Hunterston was used as a worst case scenario as it is the furthest away from the Offshore Project. | Maximum vessel transit distance during construction |
| GHG savings or cardon offset by the project | Assumed electricity supplied by the project would otherwise be generated from gas, as this is the most common form of new plant in terms of fossil fuel combustion (see **Section 25.4.2.1** for further details) | To determine the carbon offset as a result of the project |
| **Operation and Maintenance** | | |
| GHG emissions during operation | Operational life = 25 years<br>Total maximum capacity of up to 100MW<br>Operational port – it was assumed that Falmouth Port would be the operation and maintenance port used for the Offshore Project | |
| **Decommissioning** | | |
| The contribution from decommissioning was scaled based on the total GHG contribution, as detailed in **Section 25.3.2**. | | |

## 25.3.6 Summary of Mitigation

### 25.3.6.1 Embedded in the Design

81. The IEMA GHG guidance (IEMA, 2022) notes the importance of incorporating embedded mitigation in minimising GHG emissions from a development or project. The IEMA GHG Management Hierarchy sets out a structure to eliminate, reduce, substitute and compensate (IEMA, 2022).

82. In response to these principles, the need for the Offshore Project in relation to achieving net zero targets by 2050 for the UK and decarbonisation of the energy sector is well established and set out within **Chapter 2: Need for the Project**. Furthermore, project level GHG mitigation is being incorporated into the design development process for the Offshore Project wherever it is practicable to do so. Taking into account the primary purpose of the Offshore Project is to generate low carbon renewable energy, the process of reducing GHG emissions from the Offshore Project itself is guided by the hierarchy summarised in **Table 25.9**.

*Table 25.9 IEMA GHG Guidance (IEMA, 2022) – Mititgation Hierarchy Specific to the Offshore Project*

| | Hierarchy | Principle | Project Response |
|---|---|---|---|
| ↓ | Do not build (Eliminate) | Evaluate the basic need for the proposed project and explore alternative approaches to achieve the desired outcome(s). | The purpose and rationale for the Offshore Project is to tackle climate change by replacing existing high carbon energy generation. So in this case of 'do not build' could have the effect of perpetuating and exacerbating climate change. |
| | Build less (Reduce) | Realise potential for re-using and/or refurbishing existing assets to reduce the extent of new construction required. | Offshore windfarms by their design are efficient in their use of materials. Minimising the use of steel is a key design feature of the approach to project design and procurement. |
| | Build clever (Substitute) | Apply low carbon solutions (including technologies, materials and products) to minimise resource consumption and embodied carbon during the construction, operation, user's use of the project, and at end-of-life. | The Offshore Project will use the latest, most efficient and effective turbines and offshore substation platforms. |
| | Construction efficiently (compensate) | Use techniques (e.g. during construction and operation) that reduce resource consumption and associated GHG emissions over the life cycle of the project. | Offshore construction is by its nature expensive and relies on the use of highly specialised, efficient vessels and equipment with a dedicated and highly trained workforce. |

83. In response to these principles, the need for the Offshore Project in relation to achieving net zero targets for the UK and decarbonisation of the energy sector is well established and set out within **Chapter 2: Need for the Project**.

### 25.3.7 Baseline Data Sources

#### 25.3.7.1 Desktop Study

84. The sources that have been used to inform the assessment are listed in **Table 25.10**.

*Table 25.10 Data sources used to inform the climate change assessment*

| Data Source | Data Set | Summary |
|---|---|---|
| **BEIS, 2022a** | Conversion factors for reporting of GHG emissions | Emission factors for use in the GHG assessment, in particular for fuel consumption. This emission factor database is commonly used for GHG assessments in the UK, and is considered to be representative of activities in the UK. |
| **Dolan and Heath, 2012** | Life Cycle Greenhouse Gas Emissions of Utility Scale Wind Power | Benchmarking of results from the GHG assessment. |
| **Jones & Hammond, 2019** | Inventory of Carbon and Energy (ICE) | Emission factors for embodied carbon in materials used in construction. The ICE database is conventionally used in GHG assessments to estimate emissions of embodied carbon. |
| **Thompson & Harrison, 2015** | Life Cycle Costs and Carbon Emissions of Offshore Wind Power | Benchmarking of results from the GHG assessment and likely contribution of decommissioning activities to the over Project footprint. |
| **Met Office (2018)** | UK Climate Projections (UKCP) Database | Climate change projection data. IEMA (2020) guidance recommends the use of these in climate change resilience assessments, however they are most applicable to coastal and onshore areas. |
| **Marine Climate Change Impacts Partnership (MCCIP)** | Reports prepared and published by MCCIP | Publishes evidence reviews and summaries on marine climate change, including the Celtic Sea. |

#### 25.3.7.2 Site Specific Survey

85. No site-specific surveys were undertaken for this EIA Chapter.

### 25.3.8 Data Limitations

86. A number of assumptions were made in the GHG assessment, as set out in **Table 25.11**. Further details of the methodology adopted to quantify GHG emissions from the Offshore Project are presented in **Appendix 25.A**.

*Table 25.11 Assumptions and Limitations for the Climate Change Assessment*

| Assumption or Limitation | Discussion |
| --- | --- |
| **Quantities for all materials to be used during construction were not available at the time of the assessment** | Quantities of the main and most GHG intensive materials were included in the assessment, and where Project-specific information was not available, indicative quantities from other offshore windfarm projects have been utilised. Furthermore, precautionary assumptions were adopted for quantities of known materials (i.e. using the maximum quantity). |
| **The recycled content of construction materials is unknown** | As an example, it has been assumed that all steel used on the Offshore Project is virgin steel to provide a conservative assessment. It is likely that materials that will be used in construction such as steel will have a high recycled content, and thus a lower embodied carbon content than has been assumed in this assessment. |
| **Lack of emission factors for future year activities, such as fuel consumption and material extraction.** | The most recent and available emissions factors were used in the assessment to provide a precautionary assessment. |
| **The specific nature and composition of some materials, such as the type of concrete or steel to be used, was unknown which may affect the embodied carbon within a material.** | If there was variation across different compositions of the same material, the 'General' option within the ICE database was chosen, if available, or the median value if not. |
| **The origin port of some of the marine vessels was not known at the time of the assessment, which affects how far the vessels have to travel to the site, and subsequently the quantity of emissions released.** | The majority of emissions will be released from vessels whilst at the site during installation, changes to the transit time for marine vessels will have a limited effect in terms of the overall GHG footprint.<br>The most likely origin construction/assembly ports under consideration were used to derive GHG emissions during vessel transit during construction at the time of the assessment. These ports are H&W Belfast, Port Talbot, Hunterston, Falmouth and Bristol Port. As a conservative case, Hunterston port was used to derive GHG emissions during transit, as this resulted in the greatest distance for vessels to travel<br>The most likely O&M base ports under consideration at the time of the assessment were used to derive GHG emissions during vessel transit during operation and maintenance. These ports are Port Talbot, Falmouth, Bristol Port. As a |

| Assumption or Limitation | Discussion |
|---|---|
| | conservative case, Falmouth was used to derive GHG emissions during transit, as this resulted in the greatest distance for vessels to travel |
| **Emissions from vessels associated with transporting scour protection or undertaking dredging activities were not included in this assessment.** | Emissions associated with (1) the delivery of scour protection to the site and (2) dredging activities during construction and operation and maintenance have not been quantified, as this level of information is not known at this stage of the Application. |
| **Helicopter trips** | No helicopter trips will be required for the operation and maintenance phase of the Offshore Project; therefore it has also been assumed that no helicopter trips will be required for the construction phase. |
| **Operation and maintenance emissions** | Many sectors are anticipated to decarbonise over the next 25 years, and during operation and maintenance, it is likely that the emissions intensity of producing materials and the movement of marine vessels will be less than the present day. Therefore, emissions associated with the operation and maintenance phase of the Offshore Project are likely to be a significant overestimation. |
| **Where there are multiple options for possible project parameters, the worst-case scenario (see Table 25.8) was selected in terms of material quantities** | This approach provides a conservative assessment as there may be unrealistic combinations of Project specific parameters which were used in determining the worst-case scenario. |
| **The Onshore Project (landward of MLWS)** | The GHG assessment presented in **Section 25.3.2** and **Section 25.5** includes the Offshore Project only (i.e. the Offshore Project being applied for under the Section 36 Application). While it is expected that the Offshore Project would be the most intensive in GHG terms due to the embodied GHGs within the offshore infrastructure, to ensure a comprehensive and robust GHG assessment for White Cross, GHG emissions associated with the Onshore Project have been quantified and assessed as part of an 'in-combination' CEA, as detailed in **Section 25.3.4** and presented in **Section 25.7**.<br>The Offshore Project application is further progressed than the Onshore Project application and, at the time of writing, some elements of the Onshore Project have yet to be finalised. Therefore, there could be differences between GHG emissions presented in the assessment for each application, as aspects of the Onshore Project are further refined. The current working assumptions that have been used in this chapter are detailed in **Appendix 25.A**. Where |

| Assumption or Limitation | Discussion |
|---|---|
| | possible, these will be updated and refined for the separate Town and Country Planning Application for the Onshore Project.<br>It is not anticipated that these differences will change the significance of effects concluded in this chapter. |
| **Climate change projections** | A key assumption of the climate change projection data from the UKCP is that the model is strongly dependent on future global GHG emissions. The RCP scenarios cover a recent set of assumptions based upon future population dynamics, economic development and account for international targets on reducing GHG emissions. Each RCP scenario has a different climate outcome, given they are based upon different set of assumptions. The three RCP scenarios presented within this chapter (RCP 2.6, RCP 6.0 and RCP 8.5) are considered the most likely to occur over the lifespan of the Offshore Project. However, the UKCP guidance cautions that the scientific community cannot reliably place probabilities on which scenario of GHG emissions is most likely.<br>Due to the intrinsic uncertainty within climate projections, the UKCP data is based upon probabilistic projections generating a normally-distributed model per output. The projections give values for the $10^{th}$, $50^{th}$ and $90^{th}$ percentiles, which covers the range of uncertainty. |

### 25.3.9 Scope

87. Upon consideration of the baseline environment, the project description outlined in **Chapter 5: Project Description**, and Scoping Opinion. Potential impacts upon human health that are "Scoped in" are shown in **Table 25.12**. Text from the Scoping Report has been quoted verbatim and thus includes some reference to onshore effects. No impacts have been "Scoped out" for climate change.

*Table 25.12 Summary of impacts scoped in relating to climate change*

| Potential Impact | Scope in or out | Justification |
|---|---|---|
| GHG Assessment – assessment of the impact of the Offshore Project (during construction, operation and maintenance and decommissioning) on the global atmosphere receptor | Scoped in | • Quantification of the Offshore Project's GHG emissions<br>• Quantification of GHG Savings or 'Carbon' offset as a result of the Offshore Project |

| Potential Impact | Scope in or out | Justification |
|---|---|---|
| CCRA – assessment of the direct impacts of climate change during the operation and maintenance phase of the Offshore Project | Scoped in | • Assessment of the Offshore Project's vulnerability to climate change. |

### 25.3.10 Consultation

88. Consultation has been a key part of the development of the Offshore Project. Consultation has been conducted throughout the EIA. An overview of the project consultation process is presented within **Chapter 7: Consultation**. No specific consultation meetings have been undertaken for climate change.

89. A summary of the key issues raised during consultation specific to climate change is outlined below in **Table 25.13**, together with how these issues have been considered in the production of this ES.

*Table 25.13 Consultation responses*

| Consultee | Date, Document, Forum | Comment | Where addressed in the ES |
|---|---|---|---|
| **MMO** | MMO Scoping Opinion (2022) | **Climate Impacts** The ES should include a description and assessment of the likely significant effects the Proposed Development has on climate (for example having regard to the nature and magnitude of greenhouse gas emissions) and the vulnerability of the Offshore Project to climate change. Where relevant, the ES should describe and assess the adaptive capacity that has been incorporated into the design of the Proposed Development | This chapter presents the climate change assessment including GHG assessment and CCRA for Offshore Project (i.e. seaward of MHWS). |
| | | **Natural Environment** The ES should identify how the development affects the ability of the natural environment (including habitats, species, and natural processes) to adapt to climate change, including its ability to provide adaptation for people. The ES should set out the measures that will be adopted to address impacts. | The offshore components of the Offshore Project are considered to be unlikely affect habitats, species and natural processes to adapt to climate change, Any relevant adaptation considerations for these matters will be assessed (if required) in the Town and Country Planning |

| Consultee | Date, Document, Forum | Comment | Where addressed in the ES |
|---|---|---|---|
| | | | Application to be submitted to North Devon County Council. |
| | | **Carbon sequestration** The ES should also identify how the development impacts the natural environment's ability to store and sequester greenhouse gases, in relation to climate change mitigation and the natural environment's contribution to achieving net zero by 2050. | It is not anticipated that the Offshore Project will impact the natural environment's ability to store and sequester GHGs, therefore it has been scoped out of the assessment. Any onshore impacts to GHG sequestration and storage will be assessed (if required) in the Town and Country Planning Application to be submitted to North Devon County Council. |
| | | **Vulnerability of infrastructure to climate change during construction and decommissioning.** The Applicant states that as the construction phase is anticipated to occur within the next 2-4 years, the impact of effects arising from climate change on construction activities to the project is considered to be unlikely and is scoped out of the assessment.<br><br>The MMO considers that there is potential for climate change impacts to have likely significant effects on the construction phase, for example in respect of increased flood risk that may require mitigation in the planning of construction compounds and temporary drainage strategies. The operational lifetime of the windfarm is expected to be a minimum of 25 years and on that basis would expect the | Effects of climate change, as distinct from weather, are not considered to be significant during construction. Climate conditions are considered to be averages of weather parameters over a 20 and 30 year horizon. Therefore, although the effects of climate change are likely to be experienced in present day conditions, it is considered unlikely that climate conditions will change significantly within a two – two year construction window. Therefore, the construction phase has been excluded from consideration in the CCRA. |

| Consultee | Date, Document, Forum | Comment | Where addressed in the ES |
|---|---|---|---|
| | | decommissioning to occur in 2050. The decommissioning phase may be vulnerable to the impacts of climate change given the timescales involved. | |
| | | **Potential cumulative effects**<br>The Scoping Report states that a cumulative assessment of greenhouse gas (GHG) emissions with other projects is proposed to be scoped out of the ES as the proposed development will be responsible for GHG emissions associated with its activities only. This approach is in line with IEMA guidance 'Assessing Greenhouse gas Emissions and Evaluating Their significance' (IEMA, 2017).<br><br>The MMO considers the ES should include a description of the likely significant cumulative effects of the proposed development with other projects scoping into the assessment, including in relation to GHG emissions where significant effects are likely to occur. | Standard practice for GHG assessments is to only consider the development itself, as the 'receptor' for the assessment is the global atmosphere. IEMA guidance (2022) states that *"effects of GHG emissions from specific cumulative projects… in general should not be individually assessed, as there is no basis for selecting any particular (or more than one) cumulative project that has emissions for assessment over any other."* Therefore, a cumulative assessment of GHG emissions has not been carried out, in accordance with the approach detailed in IEMA guidance. |
| | | **Assessment methodology**<br>The MMO notes that a GHG assessment will be prepared to support the assessment of effects during construction, operation and decommissioning of the Proposed Development. It is unclear from the Scoping Report as to which elements or activities will be specifically included within the GHG assessment, eg whether this will road traffic emissions, materials, energy used, any supporting activities or infrastructure, and which gases would be considered, | The GHG assessment presented in this chapter has included embodied carbon in materials and vessels during construction, operation and maintenance and decommissioning. The sources considered in the assessment are detailed in **Section 25.3.2** and in **Appendix 25.A**. To ensure a robust and comprehensive GHG assessment, the CEA has |

| Consultee | Date, Document, Forum | Comment | Where addressed in the ES |
|---|---|---|---|
| | | given that there a range of gases that are considered to be GHGs. This should be explained in the ES and justification should be provided for any exclusions. | included in-combination GHG emissions associated with the Offshore Project. This is detailed further in **Section 25.3.2** and **Section 25.7**. |

## 25.4 Existing Environment

### 25.4.1 Existing Climate

90. The Offshore Project is located in the Celtic Sea, approximately 52.5 km west of the North Devon coast. Existing climate data for the period 1991 to 2020 has been obtained from the Chivenor (Devon) onshore meteorological recording station which is the closest station to the Offshore Project, located approximately 6.3 km from the Offshore Project at its closest location.

91. Annual average temperatures over the most recent decade (2009 to 2018) have been on average 0.3°C warmer than the 1981-2010 average and 0.9°C warmer than the 1961-1990 average. All the top ten warmest years for the UK, in the series from 1884, have occurred since 2002. The most recent decade (2009-2018) has been on average 1% wetter than 1981-2010 and 5% wetter than 1961-1990 for the UK overall (Met Office, 2022a). The Met Office UK Climate Averages (2022b) are only publicly available for onshore meteorological sites. Climate data for Chivenor, England and the UK are provided in **Table 25.14**.

*Table 25.14 Existing local, regional and national climate for the 1991 to 2020 period (Met Office, 2022)*

| Climate variable | Units | Annual average | | | |
|---|---|---|---|---|---|
| | | Chivenor | England South | England | UK |
| **Maximum temperature (average over 12 months)** | °C | 14.69 | 14.36 | 13.82 | 12.79 |
| **Minimum temperature (average over 12 months)** | °C | 7.97 | 6.42 | 6.12 | 5.53 |
| **Days of air frost** | Days | 20.77 | 41.89 | 45.14 | 53.36 |
| **Rainfall** | mm | 1,669 | 1,594 | 1,538 | 1,403 |

| Climate variable | Units | Annual average | | | |
|---|---|---|---|---|---|
| | | Chivenor | England South | England | UK |
| **Days of rainfall ≥ 1mm** | Days | 934 | 808 | 870 | 1,163 |
| **Mean wind speed at 10m** | Knots | 151.8 | 128.8 | 135.2 | 159.1 |

92. **Table 25.14** displays the influence of the maritime setting of the Offshore Project. Annual average maximum and minimum temperatures are both higher than the south of England, England and UK averages, and there are fewer days of air frost. As the Offshore Project is located on the west coast of England, it experiences a wetter climate than the regional and national average, however the UK has more days on average with rainfall greater than 1mm. Mean wind speed (at 10m) is greater than the England South and England average, but slightly lower than the UK average.

## 25.4.2 Do Nothing Scenario

### 25.4.2.1 GHG Assessment – Future Baseline

93. The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 require that *"an outline of the likely evolution thereof without implementation of the development as far as natural changes from the baseline scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge"* is included within the ES (EIA Regulations, Schedule 4, Paragraph 3). From the point of assessment, over the course of the development and operational lifetime of the Offshore Project (operational lifetime anticipated to be a minimum of 25 years), long-term trends mean that the condition of the baseline environment is expected to evolve. This section provides a qualitative description of the evolution of the baseline environment, on the assumption that the Offshore Project is not constructed, using available information and scientific knowledge of climate change and GHG emissions.

#### 25.4.2.1.1 Energy Produced by the Offshore Project

94. The approximate amount of energy produced by the Offshore Project both annually and over the lifetime of the Offshore Project was quantified from the approach advocated by RenewableUK (2022), where the installed capacity (up to 100 MW) was multiplied by the hours in the year (8,760) and by the appropriate average load or capacity factor for the Offshore Project. For new build floating offshore windfarms, BEIS advises that the load factor is 57.1% for those delivered between 2025 and 2029 (BEIS, 2021d).

95. The anticipated energy produced by the Offshore Project is:

- Approximately: 500,196 MWh/year
- Approximately: 12,504,900 MWh over the 25 year lifetime of the Offshore Project.

#### 25.4.2.1.2GHG Emissions from the 'Do Nothing' Scenario

96. In the 'do nothing' scenario, where the Offshore Project is not constructed, it has been assumed that the energy produced by the Offshore Project would be produced using gas instead, as this is the most common form of new plant in terms of fossil fuel combustion. An alternative approach would be to use the future electricity emission factors of the UK grid, for which projections are available from BEIS (2021e). However, these projections will account for renewable energy projects such as the Offshore Project becoming operational and decarbonising the UK electricity grid. Therefore, the use of the future projection of the UK grid is not considered to be reasonable approach when determining a 'do nothing' or without project baseline scenario.

97. The quantity of GHG emissions produced from the generation of electricity that the Offshore Project would provide by gas in the 'do nothing' scenario is presented in **Table 25.15**. This has been quantified by multiplying the anticipated energy generated by the Offshore Project by the estimated $CO_2$ emissions from gas supplied electricity (372 t $CO_2$/GWh) (BEIS, 2021d). It is noted that the electricity supplied by gas emission factor is in units of $CO_2$, however $CO_2$ is likely to form the main contribution to generation of electricity from gas and the factor is likely higher, were other GHGs to be included.

*Table 25.15 Do Nothing Scenario Baseline GHG Emissions*

| **Timeframe** | **Anticipated energy produced by Project** | **GHG emissions from electricity generated from gas (tonnes $CO_2$)** |
|---|---|---|
| Per year | 500 GWh/year | 186,198 |
| Duration of the Offshore Project (25 years) | 12,505 GWh/25 years of Project | 4,654,959 |

### 25.4.2.2 CCRA – Projected Climate Change

98. Climate change projections were used to identify future risk to existing climatic variability within the study area. It is anticipated that the Offshore Project will have an operational lifespan of at least 25 years. As such, climate forecasts and impacts

to the baseline conditions arising from the operation of the Offshore Project have been based on a 25-year lifespan.

99. The UKCP database uses representative concentration pathways (RCP) which align with the emissions scenarios used in the IPCC's latest 5th Assessment report (AR5) (IPCC, 2014). The likelihood of individual RCPs occurring is dependent on current and future GHG emissions and the implementation of mitigation strategies. Data were obtained for RCP scenarios, which are defined in **Table 25.16**. For each of these RCPs, where relevant and available, three probabilities were considered, 10% (unlikely), 50% (central estimate of projections) and 90% (projections unlikely to be less than).

*Table 25.16 Summary of the RCP emission scenarios*

| RCP | Scenario Description | Increase in global mean surface temperature (°C) by 2081-2100 | Parameters |
|---|---|---|---|
| **2.6** | Stringent mitigation scenario | 1.6<br>(0.9 – 2.3) | GHG emissions stay at present levels until 2020, and then start to decline |
| **4.5** | Intermediate scenario 1 | 2.4<br>(1.7 – 3.2) | GHG emissions peak around 2040 and then start to decline |
| **6.0** | Intermediate scenario 2 | 2.8<br>(2.0 – 3.7) | Decline of global GHG emissions begins around 2080 |
| **8.5** | Very high GHG emission scenario | 4.3<br>(3.2 – 5.4) | Increasing global GHG emissions throughout the 21st century |

100. Future climate projections are modelled projections and are strongly dependent on future global GHG emissions, and uncertainties associated with these are detailed in **Table 25.11**. Where possible, climate changes over the 25 year operational phase of the Offshore Project are detailed. In some cases, projections to the year 2100 (or later) are presented, as this is the only data available for some climate variables.

#### 25.4.2.2.1 Meteorological Projections – Temperature, Precipitation and Wind Projections (UKCP)

101. By the end of this century, all areas in the UK are projected to be warmer, with more warming expected in the summer than in the winter (Met Office, 2022a). During the summer, probabilistic projections show a north/south contrast, with greater increases in maximum summer temperatures over the southern UK compared to northern Scotland (Met Office, 2019a). Under a high emissions scenario, by 2070 the frequency of hot spells (i.e. maximum daytime temperatures exceeding 30°C for two or more consecutive days) increases. Currently, these are

largely confined to south-east UK (Met Office, 2022a). Under a RCP8.5 scenario, where global GHG emissions continue to increase throughout the 21st century, it is projected that annual temperatures by 2070 could increase by between 0.7°C and 4.2°C in the winter and 0.9°C and 5.4°C in the summer, compared to a 1981 to 2000 mean (Lowe et al., 2018).

102. For precipitation, the probabilistic projections provide low (10% probability) to high (90% probability) changes across the UK. These project that by 2070, under RCP8.5, UK average changes are -1% to +35% for winter and -47% to +2% for summer, in comparison to the 1981 to 2000 mean. Negative and positive values indicate reduced and increased precipitation respectively. This means that precipitation levels are expected to continue to increase in the winter but decrease during the summer (Lowe et al., 2018). Future climate change is expected to bring about a change in the seasonality of extremes, such as increases in heavy hourly rainfall intensity in the autumn, and significant increases in hourly precipitation extremes (Met Office, 2022a).

103. Global projections over the UK indicate that the second half of the 21st century will experience an increase in near surface wind speed during the winter season. This is also accompanied by an increase in the frequency of winter storms over the UK (Met Office, 2021).

#### 25.4.2.2.2 Marine Projections – Sea-level rise, storm surge and coastal erosion

104. Global sea levels have risen over the 20th century, and are projected to continue rising over the coming centuries. Under all emission pathway scenarios, sea levels around the UK will continue to rise to 2100 (Met Office, 2022a), and sea levels are projected to continue rising beyond 2100 even with large reductions in GHG emissions over the 21st century (Met Office, 2019c).

105. The UKCP climate projections are most applicable to onshore and coastal areas. Data from the coastal grid square covering where the export cable corridor reaches landfall (51.17°, -4.25°) were obtained for average sea level rise from 2007 to 2100 for three RCP scenarios and plot graphs of these data are displayed in **Plate 25.3**. Under RCP2.6, average sea level rise where the Offshore Project is located by 2050 is predicted to be between 0.16m and 0.32m (5th and 95th percentile respectively). Under RCP8.5, this projection increases to a sea level rise of between 0.20m and 0.39m by 2050 (5th and 95th percentile respectively) (Met Office, 2018).

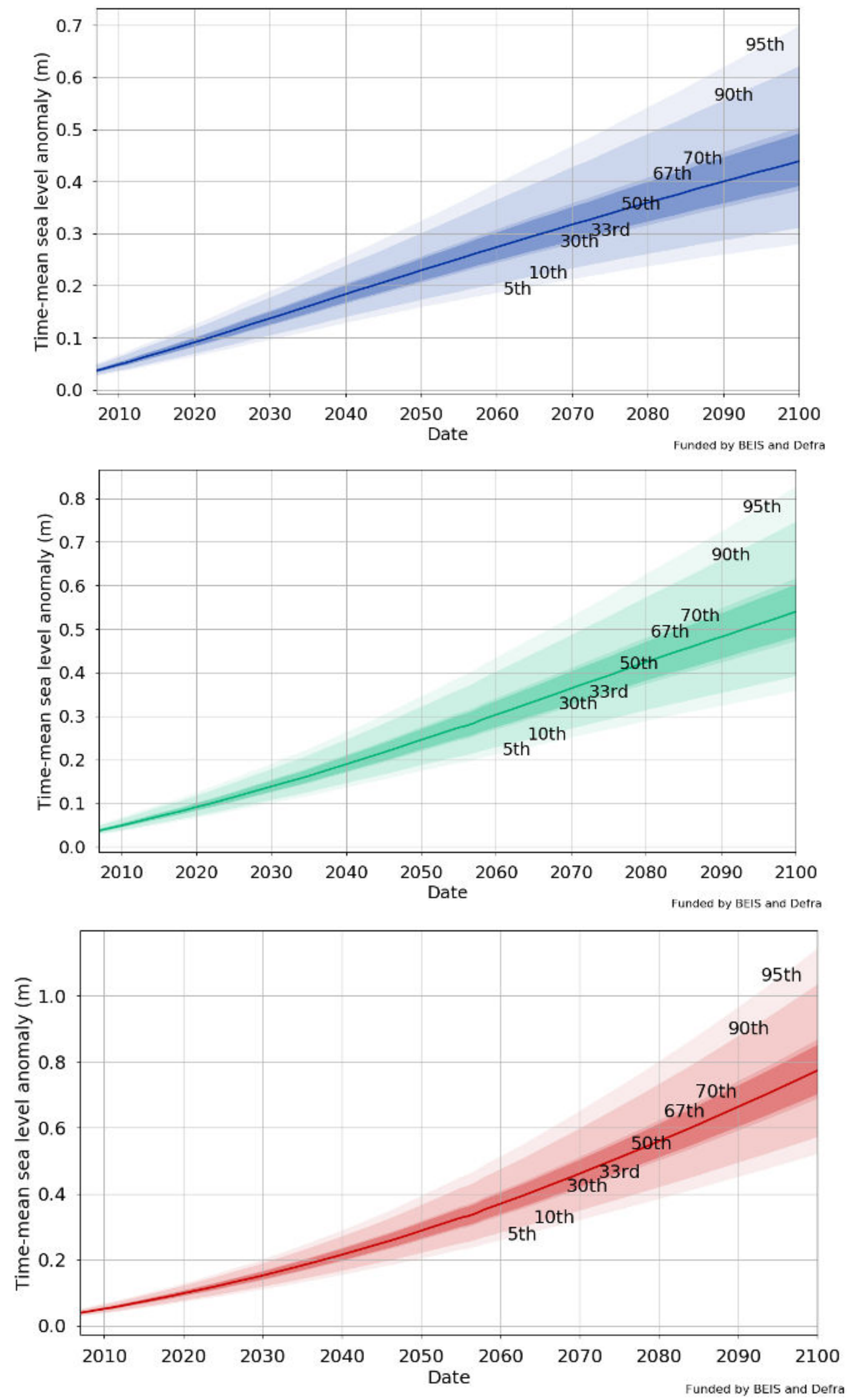


*Plate 25.3 Time mean sea level anomaly (m) for years 2007 up to and including 2100, for Project coastal grid square (51.17º, -4.25º), using baseline 1981-2000, and scenarios RCP2.6 (blue), RCP4.5 (green), RCP8.0 (red), showing the 5th to 95th percentiles (Met Office, 2018)*

106. It is predicted that future extreme sea levels will be as a result of changes in mean sea level, and not by the storm surge component or changes to tides. It is estimated that currently regional rates of sea level rise around the UK are between 1mm to 2mm per annum, and rates in the south of the UK are higher than some parts of Scotland when vertical land movement (glacial isostatic adjustment since the last ice age) is also taken into consideration (Horsburgh et al., 2020).

107. Horsburgh et al. (2020) concluded that there is no observational evidence for long-term trends in either storminess across the UK or resultant storm surges and storm surge stimulations for the 21st century suggest a best estimate of no significant changes to storm surge. Wolf et al. (2020) summary on future projections on storms and waves concluded that future projections in waters surrounding the UK are sensitive to climate model projections for the North Atlantic storm track, which contains considerable uncertainty. In the near future, natural variability dominates any climate-related trends in storms and waves, and towards the end of the 21st century, there is some consensus that mean significant wave height is decreasing while most extreme wave height is increasing.

108. Sea level rise, in addition to other factors such as storms, anthropogenic disturbance and reduced sediment supply, will also results in more erosion of the coast. 17% of the UK coastline is undergoing erosion and it is approximated that 28% of the 3,700km England and Wales coastline is experiencing erosion greater than 10cm per year (Masselink et al., 2020). The future baseline for coastal erosion in the Offshore Project study area is discussed in **Chapter 8: Marine and Physical Processes**.

## 25.5 GHG Assessment

109. The potential effects during construction, operation and decommissioning of the Offshore Project have been assessed. This section presents the GHG emissions associated with the construction, operation and decommissioning of the Offshore Project. The carbon benefits of the Offshore Project are then listed, including the amount of GHG emissions saved (or offset) and the GHG intensity of the electricity produced by the Offshore Project, in addition to the carbon payback period.

### 25.5.1 Quantification of Project's GHG Emissions

110. The results of the GHG assessment for the Offshore Project are shown in **Table 25.17**. These values include emissions associated with the Offshore Project lifetime, including construction, an operational lifetime of 25 years and decommissioning.

*Table 25.17 GHG emissions for the Offshore Project (including a 25 year Operational Phase)*

| Phase | Source | GHG Emissions (tonnes $CO_2e$)* | % of Phase GHG Footprint** | Total GHG Emissions per Phase (tonnes $CO_2e$)* | % of Overall GHG Footprint** |
|---|---|---|---|---|---|
| **Construction** | Embodied emissions in materials | 293,971 | 92.8% | 316,722 | 69.3% |
| | Marine vessels | 22,751 | 7.2% | | |
| **Operation and maintenance** | Marine vessels | 129,866 | 96.3% | 134,856 | 29.5% |
| | Spare parts | 4,989 | 3.7% | | |
| **Decommissioning** | 1.2% of total*** | 5,638 | 100% | 5,487 | 1.2% |
| **Total*** | | 457,065 | | | |
| *Figures presented in this table have been rounded to the nearest whole number<br>** Percentages rounded to one decimal place<br>***refer to **Table 25.3** | | | | | |

111. The results in **Table 25.17** show that the construction phase of the Offshore Project is anticipated to have the highest emissions contribution. Embodied carbon in construction materials is expected to be the largest source of emissions to the overall Offshore Project footprint, contributing approximately 93% of the overall construction phase emissions. As stated in **Appendix 25.A** and **Section 25.3.8**, there is likely to be an overestimation of embodied carbon in materials, particularly as it is likely that recycled materials will be used for some of the Offshore Project infrastructure.

112. Emissions from the sources considered in the assessment are predicted to be approximately 457,000 tonnes $CO_2$e. Contextualization of the results are presented in **Section 25.5.3**.

113. Emission factors used in the assessment such as for the manufacturing of materials and the movement of marine vessels are representative of present day conditions. It is highly likely that the emission factors would reduce as sectors within the UK decarbonise over the temporal scope of approximately 25 years considered in the assessment. The results from the assessment are therefore considered to be conservative.

### 25.5.2 GHG Intensity of the electricity produced

114. The GHG intensity per unit electricity (kWh) produced by the Project was determined by dividing the predicted quantity of emissions by the anticipated energy produced over its lifespan.

115. The approach to estimating the amount of energy produced by the Project was derived from the approach advocated by RenewableUK (2023), where the installed capacity (assumed to be up to 100 MW) was multiplied by the hours in the year and by the appropriate average load or capacity factor for the Project. For new build floating offshore wind farms, BEIS advises that the load factor is 57.1% (BEIS, 2021d).

116. The approach and calculations estimating the amount of energy produced is presented in **Section 25.4.2**, and the GHG intensity of electricity generated by the Offshore Project is presented in **Table 25.18**.

*Table 25.18 Electricity generation and GHG intensity for the Offshore Project*

| Project | Annual electricity generation (MWh p.a.) | Electricity generated by Project over 25 years (MWh) | GHG intensity of electricity produced by project (g $CO_2e.kWh^{-1}$) |
|---|---|---|---|
| **White Cross** | 500,196 | 12,504,900 | 36.6 |

117. The GHG intensity of the electricity produced by the Offshore Project is 36.6 g $CO_2e.kWh^{-1}$. As detailed in **Section 25.3.8**, **Table 25.11** and **Appendix 25.A**, a number of very conservative assumptions were adopted in the assessment, therefore the GHG footprint of the Offshore Project, particularly during the operation and maintenance phase, is likely to be an overestimation.

### 25.5.3 GHG Emission Savings or Carbon Offset

118. In the 'do nothing' scenario, it was assumed that the electricity generated by the Offshore Project would be produced using gas, as this is the most common form of new plant in terms of fossil fuel combustion. The quantity of GHG emissions produced from the generation of electricity from gas is presented in **Table 25.15**, along with the GHG footprint of the Offshore Project as presented in **Section 25.5.1**. These values are used to derive the total carbon offset by the Offshore Project. It is noted that the emission factor for electricity supplied by gas is in units of $CO_2$ rather than $CO_2e$, however, $CO_2$ is likely to form the main contribution to the generation of electricity.

*Table 25.19 GHG savings from the Offshore Project*

| Project | Anticipated energy produced by the Offshore Project (GWh) | GHG emissions from electricity generated from gas (tonnes $CO_2$) | Project GHG emissions (tonnes $CO_2e$) | GHG emission saved (tonnes $CO_2e$) |
|---|---|---|---|---|
| **White Cross** | 12,505 | 4,654,959 | 457,065 | 4,197,894 |

119. The data presented in **Table 25.19** shows that the estimate level of GHG savings over the lifespan of the Offshore Project would be approximately 4.2 million tonnes $CO_2e$. The Project would therefore support the UK's transition to a low to zero-carbon energy generation mix.

### 25.5.4 GHG 'payback' period

120. To estimate the 'GHG payback' of the Offshore Project, it was also assumed that electricity produced by gas is displaced (as detailed in the 'do nothing' scenario in **Table 25.15**). Using this approach, the GHG payback of the Offshore Project is 2.45 years from the time when the Offshore Project becomes fully operational, as set out in

121. **Table** 25.20.

122. As described in Section 25.4.2.1, it is noted that the electricity supplied by gas emission factor is in units of CO2, rather than CO2e. However, CO2 is likely to form the main contribution to generation of electricity from gas and the emission factor is likely to be higher, if other GHGs were included.

*Table 25.20 GHG 'payback' (Offshore aspects)*

| Parameter | Value | Unit |
|---|---|---|
| **Energy produced by Offshore Project** | 500 | GWh/year |
| **$CO_2$* intensity of electricity generated by natural gas** | 372 | tonnes $CO_2$/GWh |
| **Yearly $CO_2$* from gas-generated electricity (i.e. saved per year)** | 186,198 | tonnes per year |
| **Total CO2e released by the Offshore Project (total: construction/25 year operation and maintenance/ decommissioning)** | 457,065 | tonnes |
| **Time taken for Project-generated $CO_2$e to be paid back** | 2.45 | years |

### 25.5.5 Comparison to UK Carbon Budget

123. The provision of renewable energy will play an important role in meeting the UK Carbon Budgets (see **Section 25.2.3.1.1** and **Table 25.2**) and contributing to net zero aspirations.

124. During construction, total GHG emissions from the Offshore Project (316,722 tonnes $CO_2$e) were predicted to contribute approximately 0.02% of the 4th UK Carbon Budget (between 2023 and 2027) over the five year period. This assumes that all of the construction activities take place within the period 2023 – 2027, which is likely to be an overestimation as some emission activities will take place in beyond 2027. GHG emissions during construction are temporary and form a relatively small component of the 4th UK Carbon Budget.

125. The total GHG saving associated with the Offshore Project is estimated to be 4.2 million tonnes $CO_2$e. For context, this GHG saving (over a five year period equates

to approximately 839,579 tonnes $CO_2e$) as a result of the Offshore Project equates to 0.1% of the 6th UK Carbon Budget (2033-2037).

### 25.5.6 Significance of effect

126. As noted in **Section 25.3.2.4.2**, the significance of a Project in relation to GHG emissions is dependent on the net GHG impacts and comparisons to the without project or 'do nothing' baseline and net zero aspirations.

127. As noted above, the Offshore Project would result in a reduction in the release of GHG's to the atmosphere by approximately 4.2 million tonnes $CO_2e$, compared to the without-project baseline (i.e. electricity produced by gas), and will provide a renewable source of electricity which beneficially contributes to the UK's goal of achieving net zero emissions by 2050. It was therefore considered that the effects of the Offshore Project would be of **beneficial significance** in relation to reducing GHG emissions, when compared to the relevant baseline scenario, in accordance with IEMA guidance (2022). This is considered significant in EIA terms.

128. Due to the extent of GHG emissions saved, the Project and the wider offshore wind sector, is anticipated to contribute towards the UK meeting its emission reduction targets set out in the Carbon Budgets and Climate Change Act 2008.

#### 25.5.6.1 Further Mitigation

129. No further mitigation is recommended for the Offshore Project.

## 25.6 CCRA

130. The potential effects of climate change on the operation and maintenance of the Offshore Project have been assessed. This section provides a summary of projected climate change variables and the associated hazards anticipated to interact with the Offshore Project during its operational phase.

### 25.6.1 Step 1: Identifying Climate Variables

131. The susceptibility of the Offshore Project to climate change has been considered. While wind is needed for the Offshore Project to generate energy, wind and waves can also affect the regular maintenance and repair access requirement for the Offshore Project to continue operating. As identified in the **CCRA – Projected Climate Change Section**, the main climate hazards over the operational lifespan of the Offshore Project are likely to be:

- Extreme weather events (such as storm surge and waves)
- Changes in weather patterns or sea conditions

- Sea level rise and coastal erosion.

132. The vulnerability, and by extension the resilience, of the Offshore Project to these climate parameters was therefore considered in Step 2 of the CCRA. As construction is anticipated to start in 2025 and is scheduled to take approximately two years, climate variables are anticipated to remain the same as current conditions.

### 25.6.2 Step 2: Climate Vulnerability Assessment

#### 25.6.2.1 Extreme Weather Events

133. As noted in **Section 25.4.2**, there is no observational evidence for long-term trends in either storminess across the UK or resultant storm surges. In addition, future climate projections related to wind conditions and storminess are considered to be uncertain.

134. Given its location, the Offshore Project is considered to have a moderate exposure to extreme weather events, as key components of the infrastructure will experience events such as storm surges and high wind speeds. The Offshore Project is however considered to have a low sensitivity to such climatic change, as the design of key infrastructure such as foundations and WTG design has accounted for these extreme weather events. The substructures, WTG, moorings and inter-array cables have been designed using metocean hindcast data as a basis for all loadcasts. Hindcast models synthesise long term time series of the wind, waves and sea currents, and using this data the Applicant has determined 10-, 50- and 100-year extreme event parameters for wind, waves and sea currents, and the offshore infrastructure will be designed to withstand these events.

135. Overall, the current design of the Offshore Project is considered to have a low vulnerability to extreme weather events using the criteria identified in **B**.

136. Given the vulnerability rating of the Offshore Project is low, an assessment of the predicted effects and associated risks of extreme weather events (Step 3) was not carried out.

#### 25.6.2.2 Changes in Weather Patterns or Sea Conditions

137. As previously stated, there is uncertainty in some climate projections related to wind speeds and storminess. The design of the Offshore Project has however accounted for a range of sea conditions over its operational lifespan.

138. The Offshore Project is therefore considered to have a low exposure to changes in weather patterns or sea conditions, and a low sensitivity to such climatic change. Overall, the current design of the Offshore Project is considered to have a low

vulnerability to changes in weather patterns or sea conditions using the criteria identified in **B**.

139. Given the vulnerability rating of the Offshore Project is low, an assessment of the predicted effects and associated risks of changes in weather patterns or sea conditions (Step 3) was not carried out.

#### 25.6.2.3 Sea Level Rise and Coastal Erosion

140. Sea level rise where the Offshore Project is located is predicted to be between 0.16 – 0.39m depending on the emission scenario and probability rating (Met Office, 2018). The offshore components of the Offshore Project are not considered to be likely to be affected by coastal erosion. Therefore, the Offshore Project is considered to have a low exposure to sea level rise and coastal erosion, and a low sensitivity to such climatic change. Overall, the current design of the Offshore Project is considered to have a low vulnerability to sea level rise and coastal erosion using the criteria identified in **B**.

141. Given the vulnerability rating of the Offshore Project is low, an assessment of the predicted effects and associated risks of sea level rise and coastal erosion (Step 3) was not carried out.

### 25.6.3 Significance of effect

142. The CCRA identified the vulnerability and resilience, of the Offshore Project to the main climate hazards that are likely to occur over its operational lifespan. The assessment determined that the vulnerability rating for each climate hazard would be low. Therefore, steps 3 and 4 of the methodology for the CCRA assessment are not required, and the effect from climate change variables is assessed as not significant.

### 25.6.4 Further Mitigation

143. No further mitigation is recommended for the Offshore Project.

## 25.7 Potential cumulative effects

### 25.7.1 In-combination with the Onshore Project

144. As noted throughout, this chapter presents the GHG assessment for the Offshore Project and does not take into consideration GHGs associated with the Onshore Project (i.e. onshore cables or substation construction materials, road traffic vehicle movements, plant and equipment, etc.). The Onshore Project (i.e. landward of MLWS) is being applied for under a separate Town and Country Planning Application

to North Devon District Council. An assessment of the resilience and vulnerability of the design and infrastructure of Onshore Project will be assessed in the Town and Country Planning Application assessment, if required.

145. It is expected that the Offshore Project will be the most intensive in GHG terms, as a result of embodied carbon in offshore infrastructure materials. However, to provide a complete GHG assessment for the Project, emissions associated with the Onshore Project have also been considered and are presented in the following Sections. This includes GHG emissions from onshore construction materials, road traffic vehicle movements and the use of plant and equipment, where relevant Project information is available at this stage of the Application. These data will be further refined where possible for the Town and Country Planning Application assessment, if required. Therefore, there are likely to be differences between the GHG emissions presented in the Offshore Project and Onshore Project applications; however, it is not anticipated that these differences will change the significance of effects concluded in this chapter.

#### 25.7.1.1 Impact 26.3: Project's In-combination Offshore and Onshore GHG Assessment

##### 25.7.1.1.1 Quantification of Project's In-combination Offshore and Onshore GHG Emissions

146. The results of the GHG assessment for the offshore and onshore aspects of the Project are shown in **Table 25.21**. These values include emissions associated with the Project lifetime, including construction, an operational lifetime of 25 years and decommissioning.

*Table 25.21 GHG emissions for the Offshore Project and Onshore Project (25 year Operational Phase)*

| Phase | Offshore or Onshore | Source | GHG Emissions (tonnes $CO_2e$)* | % of Phase GHG Footprint** | Total GHG Emissions per Phase (tonnes $CO_2e$)* | % of Overall GHG Footprint** |
|---|---|---|---|---|---|---|
| **Construction** | Offshore | Embodied emissions in materials | 293,971 | 84.9% | 346,163 | 71.1% |
| | Onshore | Embodied emissions in materials | 27,860 | 8.0% | | |
| | Offshore | Marine vessels | 22,751 | 6.6% | | |
| | Onshore | Plant and equipment | 1,383 | 0.4% | | |
| | Onshore | Road traffic | 199 | 0.1% | | |
| **Operation** | Offshore | Marine vessels | 129,866 | 96.3% | 134,860 | 27.7% |
| | Onshore | Road traffic | 4 | 0.003% | | |
| | Offshore | Spare parts | 4,990 | 3.7% | | |
| **Decommissioning** | Both | 1.2% of total*** | 5,844 | 100% | 5,844 | 1.2% |
| **Total*** | | | 486,868 | | | |
| **Offshore Total (excluding spare parts and decommissioning as these are a proportion of both the onshore and offshore total)** | | | 446,589 | | 91.7% | |
| **Onshore Total (excluding spare parts and decommissioning as these are a proportion of both the onshore and offshore total)** | | | 29,445 | | 6.0% | |
| *Figures presented in this table have been rounded to the nearest whole number<br>** Percentages rounded to a one decimal place<br>***refer to **Table 25.3** | | | | | | |

147. The results in **Table 25.21** show that the construction phase of the Offshore Project and Onshore Project is anticipated to have the highest emissions contribution. Embodied carbon in construction materials is expected to be the largest source of emissions to the overall offshore Project footprint, contributing approximately 93% of overall construction phase emissions. As stated in **Appendix 25.A** and **Section 25.3.8**, there is likely to be an overestimation of embodied carbon in materials.

148. Emissions from the sources considered in the assessment are predicted to be approximately 486,868 tonnes. Contextualisation of the results are presented in the following Sections.

149. Emission factors used in the assessment such as for manufacturing of materials and the movement of marine vessels are representative of present day conditions. It is highly likely that the emission factors would reduce as sectors within the UK decarbonise over the temporal scope of approximately 25 years considered in the assessment. The results from the assessment are therefore considered to be conservative.

###### 25.7.1.1.1.1 GHG intensity of the electricity produced for the Offshore and Onshore Project

150. The GHG intensity per unit electricity (kWh) produced by the Offshore Project and Onshore Project was determined as described in **Section 25.5.2**. The anticipated levels and associated GHG intensity of electricity generated by the Offshore Project and Onshore Project is presented in **Table 25.22**.

*Table 25.22 Electricity generation and GHG intensity for the Offshore Project and Onshore Project*

| Project | Annual electricity generation (MWh p.a.) | Electricity generated by Project over 25 years (MWh) | GHG intensity of electricity produced by project (g $CO_2$e.kWh$^{-1}$) |
|---|---|---|---|
| **White Cross** | 500,196 | 12,504,900 | 38.9 |

151. The GHG intensity of the electricity produced by the Offshore Project is therefore 38.9 g $CO_2$e.kWh$^{-1}$, this is greater than that presented in **Section 25.5.1** due to the inclusion of GHG emissions from the Onshore Project. As noted in **Section 25.3.8**, **Table 25.11** and **Appendix 25.A**, a number of very conservative assumptions were adopted in the assessment, therefore the GHG footprint of the Project, particularly during the operation and maintenance phase, is likely to be an overestimation.

#### 25.7.1.1.2 GHG Emission Savings or Carbon Offset for the Offshore Project and Onshore Project

152. In the 'do nothing' scenario, it was assumed that the electricity generated by the Offshore Project and Onshore Project would be produced using gas, as this is the most common form of new plant in terms of fossil fuel combustion. The quantity of GHG emissions produced from the generation of electricity from gas is presented in **Table 25.15**, along with the GHG footprint of the Project as presented in **Section 25.5.1**. These values are used to derive the total carbon offset by the Project. It is noted that the emission factor for electricity supplied by gas is in units of $CO_2$ rather than $CO_2e$, however, $CO_2$ is likely to form the main contribution to the generation of electricity.

*Table 25.23 GHG savings from the Offshore Project*

| Project | Anticipated energy produced by the Offshore Project (GWh) | GHG emissions from electricity generated from gas (tonnes $CO_2$) | Project GHG emissions (tonnes $CO_2e$) | GHG emission saved (tonnes $CO_2e$) |
|---|---|---|---|---|
| **White Cross** | 12,505 | 4,654,959 | 486,868 | 4,168,091 |

153. The data presented in **Table 25.23** shows that the estimate levels of GHG savings over the lifespan of the Offshore Project and Onshore Project would be approximately 4.2 million tonnes $CO_2e$.

##### 25.7.1.1.2.1 GHG 'payback' period for offshore and onshore aspects of Project

154. To estimate the 'GHG payback' of the Offshore Project and Onshore Project, it was assumed that electricity produced by gas is displaced (as detailed in the 'do nothing' scenario in **Table 25.15**). Using this approach, the GHG payback of the Offshore Project and Onshore Project is 2.61 years from the time when the Offshore Project and Onshore Project becomes fully operational, as set out in **Table 25.24**. This is slightly longer than the 'payback' period presented in **Section 25.5.3** due to the inclusion of GHG emissions associated with the Onshore Project.

*Table 25.24 GHG 'payback' (Offshore Project and Onshore Project)*

| Parameter | Value | Unit |
|---|---|---|
| **Energy produced by Project** | 500 | GWh/year |

| Parameter | Value | Unit |
|---|---|---|
| **$CO_2e$ intensity of electricity generated by natural gas** | 372 | tonnes $CO_2e$/GWh |
| **Yearly $CO_2e$ from gas-generated electricity (i.e. saved per year)** | 186,198 | tonnes per year |
| **Total $CO_2e$ released by Offshore Project and Onshore Project (total: construction/25 year operation and maintenance/ decommissioning)** | 486,868 | tonnes |
| **Time taken for Project-generated $CO_2e$ to be paid back** | 2.61 | years |

#### 25.7.1.1.2.2 Comparison to UK Carbon Budget – Project Offshore and Onshore Aspects

155. The provision of renewable energy will play an important role in meeting the UK Carbon Budgets (see **Section 25.2.3.1.1** and **Table 25.2**) and contributing to net zero aspirations.

156. During construction, total GHG emissions from the Offshore Project and Onshore Project (346,163 tonnes $CO_2e$) were predicted to contribute approximately 0.02% of the 4th UK Carbon Budget (between 2023 and 2027) over the five year period. This assumes that all of the construction activities take place within the period 2023 – 2027, which is likely to be an overestimation as some emission activities will take place in beyond 2027. GHG emissions during construction are temporary and form a relatively small component of the 4th UK Carbon Budget.

157. The total GHG saving associated with the Offshore Project and Onshore Project is estimated to be 4.168 million tonnes $CO_2e$. For context, this GHG saving (over a five year period equates to approximately 833,618 tonnes $CO_2e$) as a result of the Offshore Project and Onshore Project equates to 0.1% of the 6th UK Carbon Budget (2033-2037).

#### 25.7.1.1.3 Significance of effect – Offshore and Onshore Aspects of Project

158. As noted in **Section 25.3.2.4.2**, the significance of a project in relation to GHG emissions is dependent on the net GHG impacts and comparisons to the without project or 'do nothing' baseline and net zero aspirations.

159. As noted in the Sections above, the Offshore Project and Onshore Project would result in a reduction in the release of GHG's to the atmosphere by approximately 4.2 million tonnes $CO_2e$, compared to the without-project baseline (i.e. electricity produced by gas), and will provide a renewable source of electricity which beneficially contributes to the UK's goal of achieving net zero emissions by 2050. It was therefore considered that the effects of the Offshore Project and Onshore Project would be of **beneficial significance** in relation to reducing GHG emissions, when compared to the relevant baseline scenario, in accordance with IEMA guidance. This is considered significant in EIA terms.

160. Due to the extent of GHG emissions saved, the Offshore and Onshore Projects and the wider offshore wind sector, is anticipated to contribute towards the UK meeting its emission reduction targets set out in the Carbon Budgets and Climate Change Act 2008.

#### 25.7.1.2 Further Mitigation

161. No further mitigation is recommended for the Offshore and Onshore Projects.

### 25.7.2 CEA with Other Projects

162. As noted in **Cumulative Effects Assessment (CEA) Methodology Section**, the global atmosphere is the receptor for the GHG assessment (which is of high sensitivity) and IEMA guidance (2022) states that effects of GHG emissions from specific cumulative projects should therefore not be individually assessed, as there is no basis for selecting which projects to assess cumulatively over any other. The impact of GHG assessment is therefore inherently cumulative, and no specific cumulative assessment of other projects is required to be undertaken.

163. In addition, due to its setting, the Offshore Project is not considered to change the vulnerability or resilience of other developments, therefore a CEA for the CCRA was not undertaken.

## 25.8 Potential transboundary effects

164. As noted for cumulative effects, the receptor for the GHG assessment is the global atmosphere, and therefore emissions of GHGs have an indirect transboundary effect. As the GHG emissions are assessed in context of the UK Carbon Budgets and the aspirations to reduce GHG emissions in line with Climate Agreements, the cumulative transboundary effects of GHGs emitted by the Offshore Project and Onshore Project are not considered to require specific consideration.

## 25.9 Inter-relationships

165. Inter-relationship effects are covered as part of the assessment and consider effects from the construction, operation or decommissioning of the Offshore Project on the same receptor (or group). A description of the process to identify and assess these effects is presented in **Chapter 6: EIA Methodology**.

166. The receptor for the GHG assessment is the global atmosphere, therefore there are no inter-relationships with other environmental effects.

167. There are also not considered to be any inter-relationships for the aspects covered in the CCRA with other environmental effects related to the Offshore Project.

## 25.10 Interactions

168. The effects identified and assessed in this chapter are not considered to have the potential to interact with each other.  Therefore, an assessment of interactions between effects identified in this chapter was not carried out.

## 25.11 Summary

169. This chapter has investigated the potential effects on GHG emissions arising from the Offshore Project and Onshore Project as well as climate change effects on the Offshore Project and Onshore Project themselves. The range of potential impacts and associated effects considered has been informed by the Scoping Opinion, consultation, as well as reference to existing policy and guidance. The impacts considered include those brought about directly as well as indirectly.

170. **Table 25.25** presents a summary of the impacts assessed within this ES chapter, any commitments made, and mitigation required and the residual effects. The Offshore Project and Onshore Project were predicted to have a beneficial effect in the GHG assessment, and would contribute towards the UK meeting its emission reduction targets set out in the Carbon Budgets and Climate Change Act 2008. This was considered to be significant in EIA terms, in accordance with IEMA (2022) guidance. In addition, the effects of climate change to the Offshore Project were determined to the not significant in the CCRA.

171. The assessment of cumulative impacts from the Offshore Project and other developments and activities concluded that there would be no effects to other developments.

*Table 25.25: Summary of potential impacts for Climate Change during construction, operation, maintenance and decommission of the Offshore Project*

| Potential impact | Receptor | Sensitivity | Magnitude | Significance | Potential mitigation measure | Residual impact |
|---|---|---|---|---|---|---|
| **Construction, O&M and decommissioning (GHG Assessment)** | | | | | | |
| **GHG emissions during construction, O&M and decommissioning** | Global atmosphere | High | N/A* | Beneficial (significant) | Not required as effect is beneficial | Beneficial (significant) |
| **Operation and Maintenance (CCRA Assessment)** | | | | | | |
| **Climate change resilience** | Project infrastructure | Low+ | N/A** | Not significant | N/A | Not significant |
| *not defined as part of the assessment methodology<br>** **in terms of vulnerability to climate change** | | | | | | |

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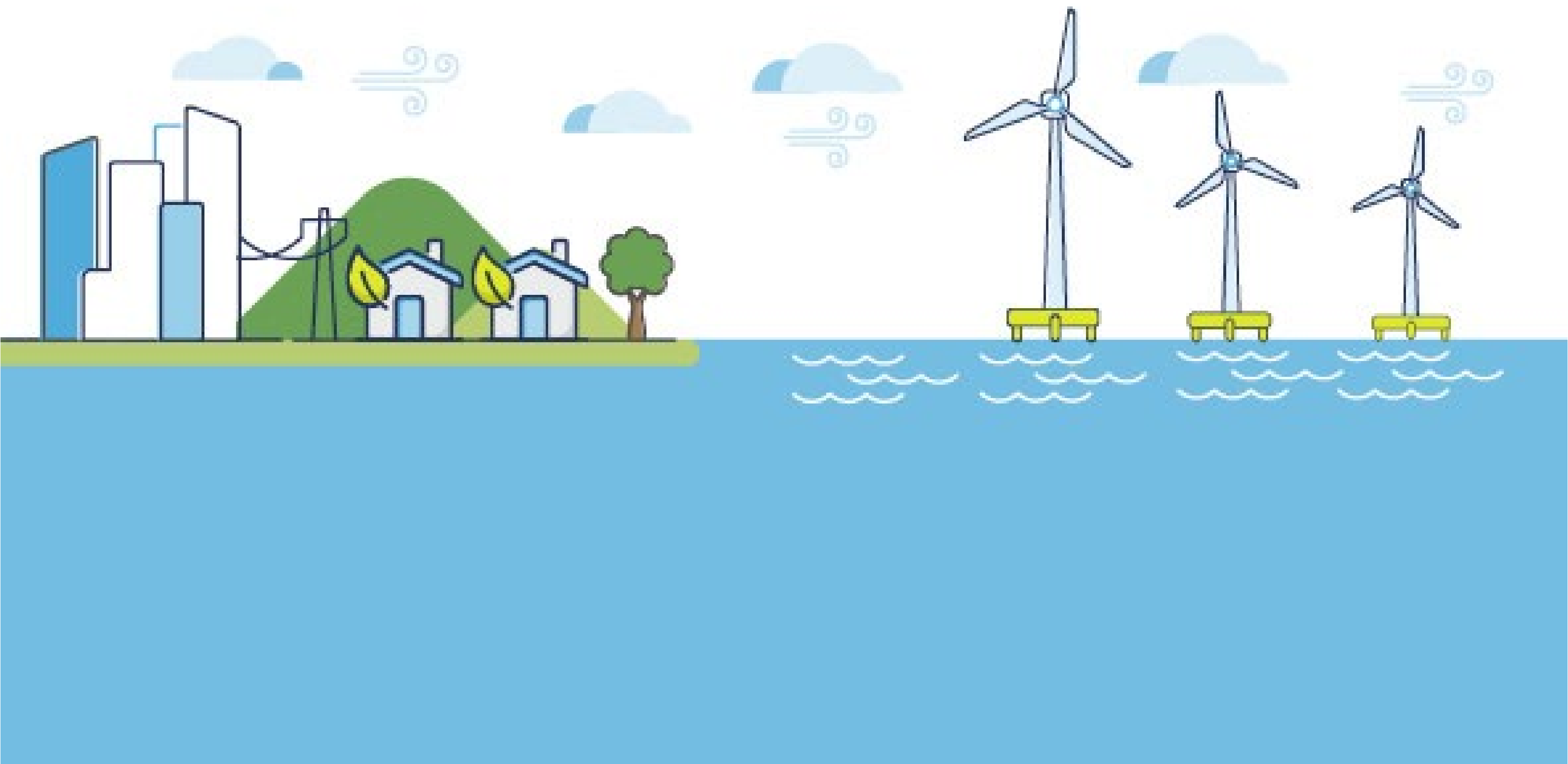
WHITE CROSS

# White Cross Offshore Windfarm Environmental Statement

## Appendix 25.A: Greenhouse Gas Assessment Methodology



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# Table of Contents



# Table of Tables

# Glossary of Acronyms

| Acronym | Definition |
| --- | --- |
| **AHT** | Anchor Handling Tug |
| **BEIS** | Department for Business, Energy and Industrial Strategy |
| **CEA** | Cumulative Effect Assessment |
| **GHG** | Greenhouse Gas |
| **GRP** | Glass Reinforced Plastic |
| **HDD** | Horizontal Directional Drilling |
| **HGV** | Heavy Goods Vehicle |
| **IAC** | Inter Array Cable |
| **ICE** | Inventory of Carbon and Energy |
| **MGO** | Marine Gas Oil |
| **MHWS** | Mean High-Water Springs |
| **NRMM** | Non-road Mobile Machinery |
| **OSP** | Offshore Substation Platform |
| **SOV** | Service Operations Vessel |
| **WTG** | Wind Turbine Generator |
| **XLPE** | Crosslinked Polyethylene |

# 1. Greenhouse Gas Assessment Methodology

## 1.1 Introduction

1. This Appendix sets out further technical details for greenhouse gas (GHG) assessment methodology presented in **Chapter 25: Climate Change**. As detailed in **Chapter 25: Climate Change** , the chapter presents the impacts of the Offshore Project on climate change. Specifically, the chapter considers the potential impact of the Project seaward of Mean High-Water Springs (MHWS) during its construction, operation and maintenance, and decommissioning phases.

2. As detailed in **Section 25.3.2** (the **Cumulative Effect Assessment (CEA) Methodology Section** in particular), the Onshore Project (i.e. landward of Mean Low Water Springs (MLWS) are being applied for under a separate Town and Country Planning Application to North Devon District Council. It is expected that the Offshore Project would be the most intensive in GHG terms; however, to provide a complete GHG assessment for the Offshore Project, emissions associated with the Onshore Project (where Onshore Project information is available at this stage) have also been considered. These are presented in **Section 25.7.1** of **Chapter 25: Climate Change** and details on this methodology are provided in **Section 1.3**.

3. This Appendix includes the methodology for quantifying GHG emissions from:

- The Offshore Project (i.e. embodied emissions in materials and marine vessel movements) (see **Section 1.2**)
- The Offshore Project in-combination with the Onshore Project (i.e. onshore embodied emissions in materials, road traffic movements and plant and equipment) (see **Section 1.3**).

## 1.2 The Offshore Project

### 1.2.1 Embodied emissions in offshore materials

4. Emissions of ‘cradle to (factory) gate’, a term which includes the extraction, manufacture and production of materials to the point at which they leave the factory gate of the final processing location, were calculated for the Project. GHG emissions were derived from quantities or volumes of known materials that will be used in construction of the Offshore Project, including the following infrastructure:

- WTGs (i.e. tower, nacelle, blades) and mooring system
- Offshore substation platform (OSP) and (sub-)structure
- Scour protection (i.e. rock)

- Offshore export and inter-array cables.

5. To provide a precautionary assessment, it was assumed that there will be no reduction in the emissions intensity during abstraction and manufacturing of materials up until and during the construction phase of the Project. This is likely to be a conservative approach, as the earliest that construction of the Project would commence is anticipated to be 2025, where the emissions intensity of some sectors such as transport and industry is likely to have decreased.

6. The quantities of each type of construction material to be used on site were obtained from the Project's design team, and the relevant emission factors sources from the Inventory of Carbon and Energy (ICE) database (Jones & Hammond, 2019) where possible. Alternative sources for emission factors were used for more specific components to wind farms, and are detailed in this Appendix.

7. Precautionary assumptions were adopted with respect to material quantities to be used for each component of the Project, which include contingency allowing for the worst-case scenario (e.g. maximum number of WTGs) of the maximum design envelope to be accounted for. It has also been assumed that virgin materials will be used, whereas the project will seek to use recycled sources for some of the components.

8. The emission factors used in the GHG assessment for embodied emissions in offshore construction materials are presented in **Table 1.1**.

*Table 1.1 Emission factors for embodied GHGs in offshore materials*

| Material | Emission Factor (kg $CO_2e$/kg, unless otherwise stated) | Source | Comment |
|---|---|---|---|
| Aluminium | 6.67 | ICE Database, v3.0 November 2019 (Jones & Hammond, 2019) | Europe |
| Concrete | 0.10 | | N/A |
| Copper | 2.71 | | Average of embodied carbon dioxide equivalent ($CO_2e$) virgin and recycled values provided in ICE database |
| Glass reinforced plastic (GRP) – Fibreglass (proxy) | 8.1 | | Carbon dioxide ($CO_2$) only. |
| Iron (cast iron proxy) | 2.03 | | N/A |
| Nylon | 9.14 | | Used nylon (polyamide) 6 polymer as worst case. |

| Material | Emission Factor (kg $CO_2e$/kg, unless otherwise stated) | Source | Comment |
|---|---|---|---|
| Steel (average) | 2.47 | | Average of embodied $CO_2e$ steel values provided in ICE database |
| Armouring (cable) | 1.46 | Cableizer (n/a) | |
| Lead (cable) | 1.67 | | General type. |
| Polyethylene sheath or filler cable | 2.54 | | General type. |
| Polypropylene yarn (cable) | 3.69 | | $CO_2$ only, |
| Semi-conductor (proxy) (cable) | 1.49 | | |
| Crosslinked polyethylene (XLPE) (cable) | 1.93 | | |

### 1.2.2 Marine vessels

9. Marine vessels will be used to bring materials and components to the wind farm site, install infrastructure (WTGs, offshore substation platforms, substructure and cables), provide crew accommodation and support during construction, commissioning and for operation and maintenance activities.

#### Indicative vessel logistics during construction, operation and maintenance

10. The current working assumptions for offshore vessel logistics during construction and operation and maintenance phases have been supplied by the Projects design team. These are outlined for construction transit and activities on site in **Table 1.2** and **Table 1.3** respectively. Operation and maintenance vessel activity is provided in **Table 1.3**. The Applicant will strive to choose vessels with clean and efficient propulsion systems where possible.

*Table 1.2 Anticipated vessel transit activity during construction of the Project*

| Component | Total vessel movements | Vessel type | Assumed total movements per vessel type | Notes/ comments/ assumptions |
|---|---|---|---|---|
| **Floating wind turbine** | 37 | Barge | 12 | Four barge deliveries, with up to three barges on site |

| Component | Total vessel movements | Vessel type | Assumed total movements per vessel type | Notes/ comments/ assumptions |
|---|---|---|---|---|
| **generators (WTG) scope** | | Small tug | 16 | Two per WTG |
| | | Anchor handling tug (AHT) | 8 | One per WTG |
| | | Service operations vessel (SOV) | 1 | During commissioning of WTGs |
| **Mooring scope** | 44 | AHT (pre-lay) | 4 | N/A |
| | | Barge for mooring chains (chain supply) | 8 | One per WTG |
| | | AHT (hook up) | 16 | Two per WTG |
| | | Small tug (hook up) | 8 | One per WTG |
| | | Offshore support vessel (hook up) | 8 | One per WTG |
| **Inter-array cable (IAC) scope** | 20 | Offshore support vessel | 2 | N/A |
| | | Cable lay vessel | 2 | N/A |
| | | Cable lay vessel | 8 | N/A |
| | | SOV | 8 | N/A |

*Table 1.3 Anticipated vessel activity on site during construction of the Project*

| Component | Activity | Vessel type | No. of days active | Total no. vessels (each with one day activity) |
|---|---|---|---|---|
| **WTG** | Barge in UK waters and unloading at H&W | Barge | 18 days | 32 |
| | Tow to integrated site | Small tug | 7 days | 14 |
| | Tow to site | AHT | 21 days | 24 |
| | | Small tug | 21 days | 42 |
| **Mooring** | Mooring pre-lay | AHT | 21 days | 21 |
| | Mooring chain supply | Barge for mooring chains | 21 days | 21 |
| | Mooring hook up | AHT | 14 days | 14 |
| | | Small tug | 14 days | 28 |
| | | Offshore support vessel | 14 days | 14 |
| **Cables** | Pre- and post-lay surveys | Offshore support vessel | 7 days | 7 |
| | IAC pre-lay | Cable lay vessel | 14 days | 14 |

| Component | Activity | Vessel type | No. of days active | Total no. vessels (each with one day activity) |
|---|---|---|---|---|
| | IAC hook up | Cable lay vessel | 14 days | 14 |
| | | SOV | 14 days | 14 |
| **WTG** | WTG commissioning | SOV | 14 days | 14 |

*Table 1.4 Anticipated vessel activities during operation and maintenance of the Offshore Project*

| Component | Assumed vessel type | Additional information | Duration on site | No. of vessel movements |
|---|---|---|---|---|
| **WTG maintenance** | SOV | Years 1 to 5 | 2 days per year per WTG | One return journey per year per WTG |
| | | Years 5 to 10 | 3 days per year per WTG | |
| | | Years 10 to 15 | 4 days per year per WTG | |
| | | Years 16 or more | 5 days per year per WTG | |
| **OSP jacket and other infrastructure inspection** | Offshore support vessel | N/A | 1 week every 3 to 4 years | One return journey per visit |
| **Inter-array cable (buried)** | Offshore support vessel | N/A | 3 weeks every 3 to 4 years | One return journey per visit |
| **Subsea Offshore export cable survey** | Offshore support vessel | N/A | 5 days every 2 years | One return journey per visit |
| **Substructure Underwater Inspection in Lieu of Dry-Docking/ external hull General Visual Inspection and mooring General Visual Inspection** | Offshore support vessel | N/A | 7 days every 5 years | One return journey per visit per WTG |
| **Substructure internal close visual inspections and Non-Destructive Testing for Design Fatigue Factor <3** | Offshore support vessel | N/A | 5 days per structure every 5 years | One return journey per visit per substructure |
| **Offshore export cable non-intrusive** | N/A | N/A | N/A | N/A |

| Component | Assumed vessel type | Additional information | Duration on site | No. of vessel movements |
|---|---|---|---|---|
| **Offshore export cable intrusive** | Offshore support vessel | N/A | 2 days every 3 years | One return journey per visit per WTG |
| **Lifting Operations and Lifting Equipment Regulations cranes and lifting (pad eyes, etc.)** | SOV | N/A | 1 day every 6 months per WTG | One return journey per visit per WTG |

11. As detailed in **Section 25.3.6** of **Chapter 25: Climate Change** , the origin port of some of the marine vessels was not known at the time of the assessment, which affects how far the vessels have to travel to the site, and subsequently the quantity of emissions released. The majority of emissions will be released from vessels whilst at the site during installation, therefore changes to the transit time for marine vessels will have a limited effect in terms of the overall GHG footprint. The current construction/assembly ports under consideration are H&W Belfast, Port Talbot, Hunterston, Falmouth and Bristol Port. Therefore, as a worst case, Hunterston port (a return journey of approximately 550nm) was used to calculate GHG emissions during vessel transit. For transit related GHG emissions during operation and maintenance, it is likely that a closer port (i.e. Port Talbot, Falmouth or Bristol Port) will be used; therefore, to provide a worst case, Falmouth Port was used (a return journey of approximately 230nm).

12. Marine vessels will also be used to transport scour protection material (i.e. quarried rock); however, GHG emissions associated with these deliveries were not quantified as the level of information regarding rock deliveries is not known at this stage of the Application.

13. Emissions from dredging activities during the construction of the Project have not been included in the assessment, as a breakdown of information regarding dredging activities is not known at this stage of the Application.

### Emission calculations

14. Indicative vessel types that will be used during construction, and operation and maintenance activities were provided by the project team. Representative vessel specifications for these vessels were obtained from other offshore wind farms of a similar nature to the Project. Fuel consumption figures were calculated by multiplying the engine size of the vessels by activity hours in transit or active on site

(accounting for average engine load factors). Emission factors for marine gas oil (MGO), in kg $CO_2e.kWh^{-1}$ were obtained from BEIS (BEIS, 2022).

15. The shipping sector is expected to decarbonise over the lifespan of the Project, and projections for the speed and the extent that this will take place are difficult to predict. It was therefore assumed that marine vessels continued to use MGO during the construction, and operation and maintenance phases of the Project. This approach is considered to be conservative and may result in an overestimation of emissions, particularly with respect to the operation and maintenance phase.

16. Some elements of the data used to calculate GHG emissions from marine vessels are confidential at this stage due to commercial sensitivities, therefore a detailed breakdown of information used to derive GHG emissions from this source is unavailable.

## 1.3 The Onshore Project (In-combination)

17. As stated in **Chapter 25: Climate Change**, the Offshore Project application is further progressed than the Onshore Project application and, at the time of writing, some elements of the Onshore Project have yet to be finalised. Therefore, there could be differences between GHG emissions presented in the Offshore Project and Onshore Project applications, as aspects of the Onshore Project are further refined. The current working assumptions that have been used in this chapter are detailed in the following sections. Where possible, these will be updated and refined for the separate Town and Country Planning Application for the Onshore Project. An overview of the Onshore Project and the onshore infrastructure is set out within **Chapter 5: Project Description**.

18. It is not anticipated that these differences will change the significance of effect concluded in this chapter.

### 1.3.1 Embodied emission in the Onshore Project

19. The same methodology and assumptions outlined in **Section 1.2.1** of this Appendix were used to calculate embodied emissions within onshore construction materials.

20. GHG emissions were derived from quantities or volumes of known materials (at this stage of the application) that will be used in construction. The key components of the Onshore Project considered in the embodied emission comprise:

- Onshore export cables installed underground from the landfall to the onshore substation
- Joint bays (concrete)

- Onshore substation (concrete and steel).

21. The emission factors used in the GHG assessment for embodied emissions in onshore construction materials have been presented in **Table 1.1**.

### 1.3.2 Road vehicles

22. Road vehicle movements associated with the construction, and operational and maintenance phases of the Project will result in the release of GHG emissions. GHG emissions were calculated from an estimation of the total kilometres travelled by heavy goods vehicles (HGVs) and staff transport to and from the onshore construction sites, and also during the operation and maintenance phase.

23. The total distance of vehicles travelled during the whole construction phase was provided by the Transport Consultants for the Project. To provide a conservative assessment, the fleet make up (in terms of fuel and Euro standards) for the earliest year of construction (2025) was used in the assessment for employee travel.

24. Emission factors for each vehicle type considered in the assessment were obtained from BEIS (2022), in kg $CO_2e$ per km travelled. To provide a conservative assessment, it was assumed that there were no fuel efficiency improvements or reduction in emissions over the Project period for each mode of transport in the assessment.

25. Distances travelled during the construction phase of the Project were calculated for HGVs and employee movements according to the following assumptions:

    - A journey distance of 14km per movement has been adopted as this represents the maximum distance from the proposed access (off Sandy Lane) to the extents of the traffic and transport study area at the A39. Journeys beyond the extent of the A39 are assumed to already be on the highway network and therefore would reassign to service the Project.
    - Working days assumes the worst case programme duration of 15 months and 5.5 working days per week.
    - Assumes a worst case of peak employees working each day.

26. The construction phase movements used to calculate GHG emissions are provided in **Table 1.5**.

*Table 1.5 Construction phase traffic movements*

| Variable | Units | HGV | Light vehicles |
|---|---|---|---|
| **Total HGV numbers** | HGVs | 3,014 | - |
| **Total HGV numbers (plus 30% contingency)** | HGVs | 3,918 | - |
| **Maximum daily number of employees** | Employees | - | 60 |
| **Total working days** | Days | - | 358 |
| **Total two-way movements** | Movements | 7,863 | 43,018 |
| **Maximum distance** | km | 14.5 | 14.5 |
| **Total distance travelled** | km | 113,619 | 623,759 |

27. The forecasted 2025 fleet composition (i.e. proportion of diesel, petrol and electric cars) was obtained from the Department for Transport (DfT) WebTAG data v1.17 (DfT, 2022). The proportion of diesel, petrol and electric cars in the UK fleet for 2025 was obtained from the DfT (2022) to determine a representative emission factor associated with employee travel. The fleet composition used in the assessment, and emission factors associated with each vehicle type are provided in **Table 1.6**. Emission factors for each vehicle type were obtained from BEIS (2022).

*Table 1.6 Calculation of emission factor used for light vehicles in assessment*

| Earliest year of construction | Fleet composition (DfT, 2022) | | | Vehicle emission factor (kg $CO_2e.km^{-1}$) (BEIS, 2022) | | | Emission factor used in assessment (kg $CO_2e.km^{-1}$) |
|---|---|---|---|---|---|---|---|
| | Diesel | Petrol | Electric | Diesel | Petrol | Electric* | |
| **2025** | 41.0% | 53.0% | 5.0% | 0.17 | 0.171 | 0.068 | 0.164 |
| *Assumed to be plug-in hybrid electric vehicles, as battery electric vehicle has 0 $CO_2e$ emissions in the 2022 DfT dataset | | | | | | | |

28. It was assumed that all HGVs used on the Project would be diesel powered. The emission factor for HGV movements (50% laden) was obtained from BEIS (2022) and was 0.850 kg $CO_2e.km^{-1}$. In the absence of suitable empirical data, it was assumed that the fleet composition of HGVs did not change over the temporal scope of the assessment to provide a precautionary approach.

29. During the O&M phase of the Project, traffic movements would be limited to those generated by the daily operation and periodic maintenance at the White Cross Onshore Substation and at link boxes along the onshore export cable corridor. It was therefore assumed that there would be two traffic movements (i.e. one visit) per week during the 25-year lifespan of the operational phase of the Project. This visit was assumed to a 20 km round-trip, i.e. 10 km each way, and amounted to approximately 1,040 km per annum.

### 1.3.3 Plant and equipment

30. Fuel consumption associated with the operation of non-road mobile machinery (NRMM) for the Onshore Project were calculated based on the estimated use of each item of plant and equipment. Indicative construction plant and equipment types for construction activities at landfall, along the onshore export cable corridor and at the White Cross Onshore Substation were provided by the OWL design team, and some assumptions were made regarding the number and specification of each type of plant based on other projects of a similar nature.

31. The anticipated fuel demand over the duration of construction was calculated and the emission factor for gas oil consumption was obtained from BEIS (2022) to derive GHG emissions.

32. The following assumptions were adopted in the assessment:

- Plant and equipment are assumed to operate throughout the consented working hours for the Project (66 hours per weeks). On-time factors were applied for each plant and equipment.
- Construction plant and equipment were all assumed to use diesel to provide a conservative assessment.
- Engine sizes for plant and equipment were either provided by the project team or obtained for NRMM typically required during construction activities, and from manufacturer specifications. It was assumed that engines operated at a load factor of 75%.

33. An indicative Onshore Project construction programme was provided by OWL design team, based on different programme scenario determined in the traffic and transport assessment. The longest (i.e. 15-month) indicative programme was used in this assessment of onshore plant and equipment GHG emissions, as it provides the worst case scenario. The onshore activities and duration of each activity used in the calculation of plant and equipment GHG emissions is detailed in **Table 1.7**.

*Table 1.7 Indicative Onshore Project construction programme (15 months)*

| Construction activity | Duration (months) |
|---|---|
| **Activity 1. Construction Consolidation Sites (CCSs)** | 2 |
| **Activity 2. Landfall HDD Compound*** | 2 |
| **Activity 3. Haul Road**** | 4 |
| **Activity 4. Backfill Material – CBS**** | 8 |
| **Activity 5. Tape / Tile**** | 8 |
| **Activity 6. Ducts (trench)**** | 8 |
| **Activity 7. Cables**** | 8 |

| Construction activity | Duration (months) |
|---|---|
| **Activity 8. HDD Compounds*** | 2 |
| **Activity 9. HDD installation*** | 5 |
| **Activity 10. Landfall Transition Bays** | 2 |
| **Activity 11. Joint Bays** | 6 |
| **Activity 12. Link Boxes** | 6 |
| **Activity 13. Demobilisation of Haul Road** | 2 |
| **Activity 14. Demobilisation of Temporary Construction Compounds (CCSs)** | 2 |
| **Activity 15. Demobilisation of Landfall HDD Compound** | 2 |
| **Activity 16. Demobilisation of HDD Compounds** | 2 |
| **Activity 17. Substation** | 6 |
| * Assumed that HDD activities would occur for 32 days (12 hours per day, 7 days a week). **Overlap occurred for these activities in the indicative programme, so it was assumed that the construction duration of these elements of the onshore export cable corridor was 11 months in total | |

34. Plant and equipment used during the construction of the Project are provided below in **Table 1.8**.

*Table 1.8 Indicative Onshore Project plant and equipment requirements*

| Construction activity | Indicative number required | | | | |
|---|---|---|---|---|---|
| | Landfall | | Cable corridor | | White Cross Onshore Substation |
| | HDD | Transition joint bay | Onshore export cable corridor | Link boxes | |
| **Excavator** | 1 | - | - | - | - |
| **Dumper** | 1 | - | - | - | - |
| **Mobile crane** | 1 | - | - | - | - |
| **HDD drill rig** | 1 | - | - | - | - |
| **Water pump** | 1 | - | - | - | - |
| **Power unit** | * | - | - | - | - |
| **Drill rack** | ** | - | - | - | - |
| **Mud tank** | ** | - | - | - | - |
| **Recycling unit** | ** | - | - | - | - |
| **Generator – large** | 1 | - | - | - | 1 |
| **Generator – small** | 1 | - | - | - | 1 |
| **Fast track forklifts** | - | 1 | 2 | 2 | - |
| **20T tracked excavators** | - | 1 | 2 | 2 | - |
| **30T tracked excavators** | - | 2 | 3 | 3 | - |
| **3T tracked excavators** | - | 1 | 1 | 1 | - |
| **Sand carts** | - | 2** | 2** | 2** | - |
| **Moxy dumpers** | - | 2 | 2 | 2 | - |
| **Crawler crane** | - | - | 1 | 1 | - |

| Construction activity | Indicative number required | | | | |
|---|---|---|---|---|---|
| | Landfall | | Cable corridor | | White Cross Onshore Substation |
| | HDD | Transition joint bay | Onshore export cable corridor | Link boxes | |
| **D4/6 dozer** | - | - | 2 | 2 | - |
| **360-degree excavators** | - | - | - | - | 2 |
| **Backhoe loaders** | - | - | - | - | 2 |
| **Dozers** | - | - | - | - | 2 |
| **Swivel skip dumpers** | - | - | - | - | 2 |
| **Mobile cranes** | - | - | - | - | 2 |
| **Cement mixer trucks** | - | - | - | - | 2 |
| **Truck mounted concrete pump** | - | - | - | - | 1 |
| **Piling rig** | - | - | - | - | 1 |
| ***assumed emissions from generators**<br>****assumed no emissions** | | | | | |

35. The duration that these plant and equipment were used was dependent on the construction programme. The total number of hours plant was operational during construction was calculated by multiplying the total number of plant/equipment required per month by the construction hours per month (66 hours per week).

**36.** For the purposes of the assessment, it was assumed that plant and equipment operated using gas oil as fuel, which has an emission factor of 0.257 kg $CO_2e.kWh^{-1}$ (BEIS, 2022). All plant were assumed to operate at an average load factor of 0.75.

## 1.4 References


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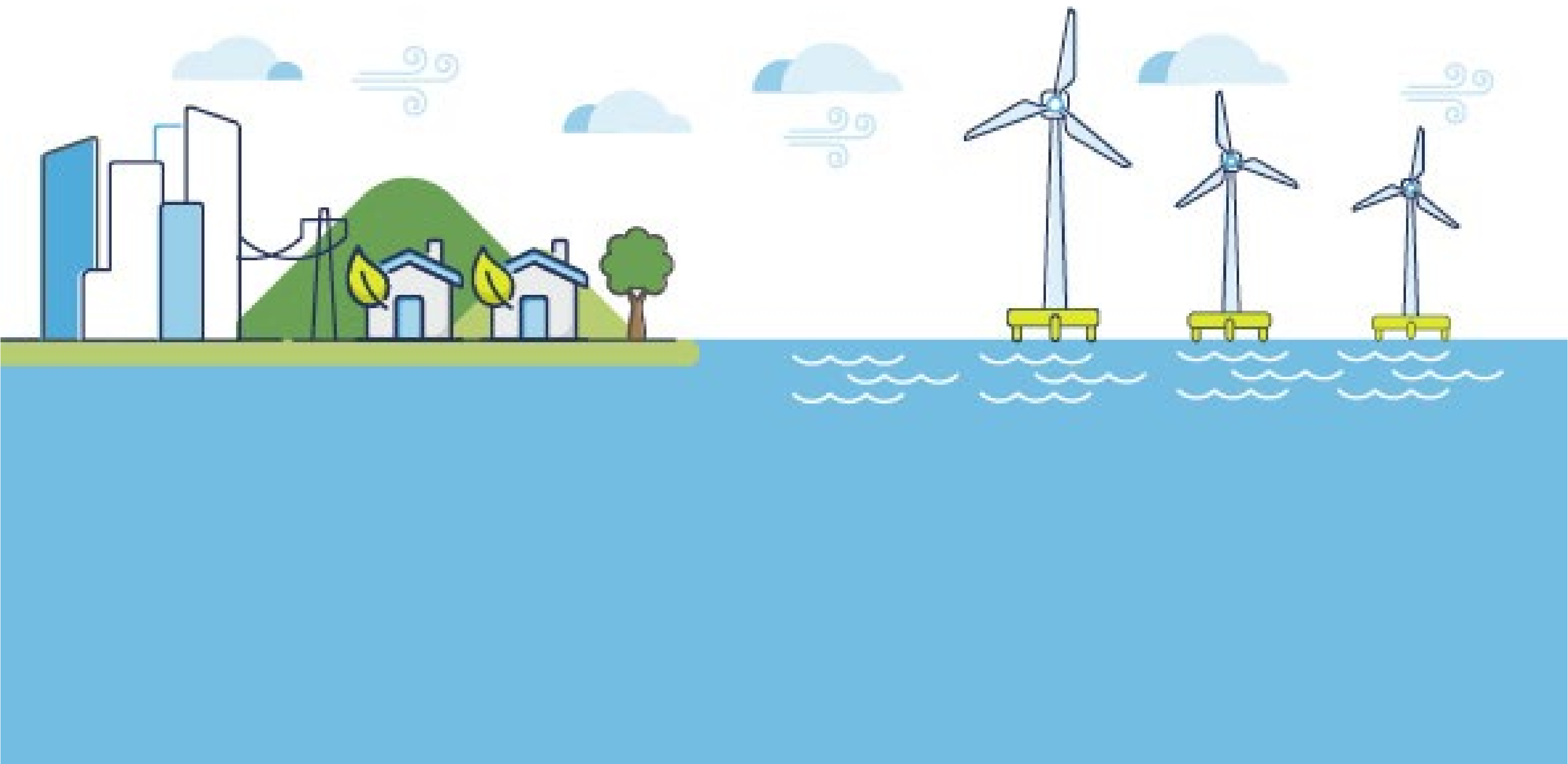
# White Cross Offshore Windfarm Environmental Statement

## Appendix 25.B: Climate Change Resilience Assessment Methodology



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## Table of Contents



## Table of Tables

## Glossary of Acronyms

| Acronym | Definition |
|---|---|
| **CCRA** | Climate Change Risk Assessment |
| **UKCP** | UK Climate Projections |

# 1. Climate Change Resilience Assessment Methodology

## 1.1 Introduction

## 1.2 Approach

1. A four-step methodology was adopted for the CCRA. The initial stages of the assessment aim to identify the climate variables to which the Project could be vulnerable to during its lifetime. If deemed necessary, a more detailed risk assessment was then undertaken following the identified of influencing climate variables, to assess the level of risk associated with the hazards posed by the predicted changes in climate variables.

2. The approach carried out for each step of the CCRA is provided below.

## 1.3 Step 1: Identifying Climate Variables

3. The first step of the CCRA was to identify the receptors which may potentially be impacted by climate change hazards. Those receptors identified should include both known receptors (such as receptors reported / known to have already experienced a climate-related event (i.e. flooding)) and unknown receptors which are yet to be impacted according to available data and literature.

## 1.4 Step 2: Climate Vulnerability Assessment

4. The second step consisted of a qualitative assessment (informed by professional judgement and supporting literature) of the Project to changes in the climate variables. Vulnerability is considered to be a function of:

   - The sensitivity of the Project and any associated offshore infrastructure to climate change
   - The exposure (both spatially and temporally) of the Project and its associated offshore infrastructure to climate variables.

5. Both the sensitivity and the exposure of the Project and its associated offshore infrastructure to climate variables were considered in the vulnerability assessment. This approach attributes either a high, moderate or low sensitivity/exposure categorisation to each vulnerability.

6. Overall vulnerability is determined by considering the interrelationship between the exposure and the receptor sensitivity, as set out in **Table 25.1.**

*Table 25.1 CCRA: Sensitivity/Exposure Matrix for Determining Vulnerability Rating*

| Sensitivity | Exposure | | |
|---|---|---|---|
| | Low | Moderate | High |
| **Low** | Low vulnerability | Low vulnerability | Low vulnerability |
| **Moderate** | Low vulnerability | Medium vulnerability | Medium vulnerability |
| **High** | Low vulnerability | Medium vulnerability | High vulnerability |

7. Climate change projection data from the UKCP database is summarised in **Section 25.4.2** of the Climate Change Chapter.

8. Further information related to the vulnerability of the Project to the projected effects of climate change were obtained from the other topic chapters such as **Chapter 27: Accidents and Disasters**.

9. For those vulnerabilities categorised as medium or high, the risk of climate change to the design and infrastructure of the Project, and consequently to its operation was then determined through Steps 3 to 4 of the assessment process.

## 1.5 Step 3: Risk Assessment

10. For those vulnerabilities categorised as medium or high, climate-related hazards were identified through professional judgement. The risks of the Project and its associated offshore infrastructure to the occurrence of a hazard event were qualitatively identified through a hazard likelihood and consequence matrix, as detailed in **Table 25.2**.

*Table 25.2 Likelihood/Consequence Matrix for Determining Risk Rating*

| Likelihood | Exposure | | | | |
|---|---|---|---|---|---|
| | Insignificant | Minor | Moderate | Major | Catastrophic |
| **Almost certain** | Low | Medium | High | Extreme | Extreme |
| **Likely** | Low | Medium | Medium | High | Extreme |
| **Moderate** | Low | Low | Medium | High | Extreme |
| **Unlikely** | Low | Low | Medium | Medium | High |
| **Very unlikely** | Low | Low | Low | Medium | Medium |

## 1.6 Step 4: Mitigation

11. For climate risks to the Project or its associated offshore infrastructure identified as 'medium' or higher, further mitigation measures were identified by professional judgement. With the proposed mitigation measures taken into consideration, a residual risk rating was assessed.

12. For each hazard, a resilience rating is identified as one of the following:

- High – strong degree of climate resilience. Remedial action or adaptation may be required but is not a priority.
- Moderate – a moderate degree of climate resilience. Remedial action or adaptation is recommended.
- Low – a low level of climate resilience. Remedial action or adaptation is required as a priority.

## 1.7 CCRA: Significance Criteria

13. The significance of the CCRA was determined through consideration of the residual risk and resilience rating applied to each hazard identified. **Table 25.3** presents the matrix used to identify the overall significance of climate change resilience.

*Table 25.3 CCRA Significance Criteria*

| **Risk Rating** | **Resilience Rating** | | |
|---|---|---|---|
| | High | Moderate | Low |
| **Extreme** | Significant | Significant | Significant |
| **High** | Not significant | Significant | Significant |
| **Medium** | Not significant | Not significant | Significant |
| **Low** | Not significant | Not significant | Not significant |